

Chapter 6

Research Praxis of Generative Relational Theory

6.1 Praxis as a Unified Category

This section establishes the broad practical category within which Chapter 6 will locate research. Its role is foundational: before distinguishing research-dominant and application-dominant praxis, the chapter requires an account of what both modes share. The objective is to treat knowing, judgment, action, relation, feedback, revision, historical situatedness, and generativity as interdependent moments of praxis whose relative prominence changes across concrete situations. The discussion proceeds analytically through these moments and then returns to their historical and generative organization. The method is reconstructive rather than genealogically exhaustive. Several traditions have developed concepts of praxis, practice, experience, conduct, and situated action in different philosophical and social-theoretical vocabularies. Marx's early writings emphasize sensuous practical activity and historically constituted social relations; Dewey develops accounts of conduct and experience through organism–environment interaction, habit, inquiry, and consequence; Gramsci's philosophy of praxis situates thought and action within historically mediated social struggle; and Bourdieu develops a theory of practice through historically formed dispositions and structured fields (Marx 1994; Dewey 1922; Dewey 1925; Gramsci 2007; Bourdieu 1977). GRE draws a limited architectural lesson from these heterogeneous lineages: inquiry can be understood as activity conducted within a changing relational world, through which actors also participate in the production of later conditions of knowing and acting.

Definition 6.1 (Praxis). *Praxis* is historically situated relational activity in which knowing, judgment, action, feedback, and revision participate in the formation of subsequent capacities, relations, representations, conditions, or possibilities.

Definition 6.1 is intentionally broad. It does not identify praxis with purposeful intervention alone, nor does it require every practical episode to contain each listed moment with equal intensity. A concrete praxis can be predominantly investigative, administrative, political, productive, educational, technical, artistic, or otherwise organized. What makes these cases comparable for the present chapter is that activity occurs within relations, depends on inherited conditions, produces consequences,

and can alter the conditions under which later activity proceeds. This broad category allows research to be analyzed as praxis without reducing research to application or application to research.

6.1.1 Praxis beyond the Opposition between Knowing and Acting

The initial analytical problem concerns the common tendency to separate knowing from acting into successive or independent domains. Research is then imagined as the production of knowledge, while application begins only after knowledge has been completed. Such a sequence can describe some institutional arrangements, yet it gives an incomplete account of concrete inquiry. Observation requires practical access; classification organizes what can be recorded; measurement changes the conditions under which phenomena become comparable; interpretation selects among possible descriptions; publication can alter expectations and behavior; and interventions frequently generate evidence that did not previously exist. Knowing therefore occurs through practical relations with objects, participants, instruments, archives, institutions, and representations.

The converse relation also matters. Action rarely proceeds in the absence of knowing, however incomplete. Practical orientation depends on descriptions of the situation, expectations about consequences, distinctions among alternatives, judgments of significance, tacit knowledge, institutional memory, or inherited categories. Even urgent action under uncertainty involves an epistemic configuration, because uncertainty itself is apprehended through some representation of what is known, unknown, or contested. The relevant distinction is consequently one of organization and emphasis: some praxis is oriented primarily toward transforming an epistemic-theoretical system, while other praxis is oriented primarily toward transforming a practical-relational situation.

Dewey's accounts of conduct and experience offer one precedent for treating doing, undergoing, habit, consequence, and inquiry as connected within situated activity (Dewey 1922; Dewey 1925). Marx's emphasis on practical activity similarly provides a historical precedent for refusing an image of knowledge detached from material and social life (Marx 1994). GRE does not require identity with either philosophical system. Their relevance here lies in opening a space in which cognition and action can be analyzed as mutually implicated within praxis.

Definition 6.2 (Praxis configuration). A *praxis configuration* is a historically and relationally situated organization of epistemic, judgmental, practical, feedback, and revision processes whose relative prominence is determined by the activity, its conditions, and its current orientation.

The configuration concept allows the chapter to distinguish modes without converting them into separate substances. A research project can contain decisions with material consequences; an institutional intervention can contain substantial inquiry; a field experiment can simultaneously produce knowledge and alter the field; an archival project can reorganize public memory; and a computational classification can become operational in later decisions. The distinction between research and application will therefore be developed in the next section through dominant contradiction and practical orientation rather than through a strict border between thought

and action.

Proposition 6.3 (Integrated moments of praxis). *Knowing and acting within praxis can be analytically distinguished while remaining practically interdependent, because the production of knowledge requires situated activity and practical action is ordinarily organized through some epistemic representation of its conditions and possibilities.*

Proposition 6.3 supplies the chapter's starting point. Later distinctions between research-dominant and application-dominant praxis concern which tensions organize the activity and where provisional closure is sought, while both modes remain configurations within the broader field defined here.

6.1.2 Knowing within Praxis

Knowing within praxis concerns the production, preservation, interpretation, testing, and revision of representations that orient activity. Chapter 5 developed the epistemic conditions under which relational and generative claims can receive bounded warrant. The present chapter adds a practical implication: knowledge is produced through arrangements of access, attention, instruments, categories, institutions, archives, communities, and material resources. These arrangements are themselves parts of praxis and can change while inquiry proceeds.

This formulation gives knowledge an operational role without reducing it to instrumental usefulness. A claim may be epistemically valuable because it explains a historical trajectory, clarifies a relation, preserves an overlooked experience, or discriminates among competing descriptions even when no immediate intervention follows. At the same time, knowledge can alter later praxis by changing what actors can notice, formulate, compare, imagine, coordinate, or contest. A new concept can make a previously diffuse relation discussable; a measurement practice can make a pattern administratively legible; a historical reconstruction can reopen an apparently settled institutional narrative; a negative result can redirect a research programme. Knowing can therefore have generative consequences even where direct application is absent.

The epistemic commitments consolidated near the end of the preceding chapter remain relevant here. Partiality, explicit representation, boundary and scale, uncertainty, evidential pluralism, historical sensitivity, revisability, and epistemic humility are not only standards applied after research is complete. They shape the conduct of inquiry. A researcher who expects partial observation organizes documentation differently from one who assumes complete access. A project committed to revisability preserves provenance and alternative interpretations. A project attentive to boundary uncertainty records cross-boundary relations rather than treating them as accidental noise. Epistemology thus enters praxis through the organization of concrete research conduct.

Knowing also has a distributed dimension. Much research knowledge is generated across participants, technicians, archivists, informants, communities, software infrastructures, instruments, disciplinary traditions, datasets, reviewers, and institutions. The epistemic product attributed to an individual author can therefore depend on a wider relational configuration. Chapter 6 will later examine collective and distributed knowledge production in detail. At the present stage, the important point

is that knowing within praxis is situated within relational conditions of possibility, access, maintenance, and correction.

Claim 6.4 (Practical conditions of knowing). *The warrant of knowledge can depend partly on practical conditions of inquiry because access, recording, classification, preservation, comparison, and revision affect which traces become available and how inferential alternatives can be evaluated.*

Claim 6.4 does not make truth equivalent to practice. It identifies a dependence of epistemic warrant on the practical organization through which evidence becomes accessible and contestable. This dependence becomes especially important when evidence is fragile, historically distributed, institutionally controlled, or mediated by computational systems.

6.1.3 Judgment within Praxis

Praxis requires judgment because actors encounter more possible observations, questions, interpretations, actions, and responses than can be pursued simultaneously. Judgment selects salience, significance, adequacy, priority, proportionality, and provisional closure under conditions of limited attention and incomplete knowledge. Research judgment appears in the selection of problems, evidence, concepts, models, comparisons, stopping rules, and standards of sufficiency. Application-oriented judgment appears in the selection of actions, timing, acceptable risk, reversibility, and distributions of benefit or burden. These forms overlap while remaining analytically distinguishable.

The chapter will later separate aesthetic, epistemic, and normative judgment more carefully. For the present section, judgment is the mediating activity through which a praxis configuration assigns practical significance to possible interpretations and courses of action. This includes judgments whose criteria are explicit and formalized as well as judgments that rely on tacit expertise, disciplinary taste, historical sensibility, or experiential recognition. The existence of tacit elements does not place judgment beyond analysis. It creates a reason to examine how such criteria are formed, transmitted, contested, and revised.

Judgment links knowing to action without functioning as a mechanical rule that converts evidence into behavior. The same evidential state can support different practical responses when objectives, values, risks, temporal constraints, or acceptable error differ. Likewise, the same practical objective can lead to different judgments when the epistemic state changes. This is one reason the book distinguishes epistemic justification from normative evaluation. A well-supported description does not alone determine what should be done, while a normative commitment does not alone determine which empirical description is warranted.

Judgment is also historically situated. What counts as an elegant explanation, a serious anomaly, a meaningful effect size, an admissible source, a responsible intervention, or a research-worthy question can change with disciplines, technologies, institutions, political conditions, and accumulated experience. Such historical formation need not imply arbitrariness. Criteria can be criticized through evidence, consistency, consequences, comparative performance, justice considerations, and their capacity to generate productive inquiry. Judgment therefore belongs inside revisable praxis

rather than outside it as an unexplained faculty.

Definition 6.5 (Praxis judgment). *Praxis judgment* is the situated evaluation through which an actor or collectivity assigns relevance, adequacy, priority, significance, or practical orientation to possible interpretations, questions, representations, or actions under specified epistemic and normative conditions.

Definition 6.5 prepares the later analysis of research judgment. It also clarifies why research praxis cannot be reduced to method execution. Methods generate and organize evidence; judgment remains necessary in deciding what object to construct, what evidence is sufficient, which anomaly deserves attention, what uncertainty matters, and when a claim should remain open.

6.1.4 Action within Praxis

Action within praxis includes deliberate intervention, but its scope is broader. Selecting a classification, opening an archive, designing a survey, training a model, conducting an interview, publishing a result, refusing an intervention, maintaining an infrastructure, or preserving a record can all alter the relational conditions under which later events occur. The practical effects vary greatly in magnitude and reversibility, yet each can participate in the production of subsequent evidence, capacities, expectations, or institutional responses.

This broader account is especially important for research. Scientific and scholarly activity sometimes presents itself as observation of a world whose relevant relations remain external to the act of inquiry. Chapter 5 showed why that image requires qualification. Representation can become performative; observation can alter behavior; machine classifications can enter administrative processes; public indicators can reorganize incentives; and categories can shape future records. Research action therefore includes the material and symbolic operations through which inquiry enters the relational field.

The presence of practical effects does not imply that every act of observation produces a substantively important transformation. The appropriate question is empirical and target-relative: which actions enter the relations under study, through what pathway, at what scale, and with what persistence? A laboratory measurement can have negligible effects on a distant institutional process, while publication of a ranking can materially alter organizational behavior. The category of praxis keeps this possibility visible without presuming its magnitude.

Action also introduces temporal consequences. Some effects are immediate; others accumulate through repeated routines, institutionalization, memory, learning, or delayed uptake. A methodological standard adopted today can shape what evidence is preserved for decades. An administrative category introduced for temporary coordination can become embedded in infrastructures and survive the problem that initially motivated it. Practical action therefore connects present judgment to future possibility structures, a connection that becomes central to the book's later treatment of generative relations.

Claim 6.6 (Action and epistemic consequence). *Actions undertaken within inquiry can become epistemically consequential when they alter access, trace production, partic-*

ipant behavior, classification, institutional memory, or the conditions through which subsequent evidence is generated.

Claim 6.6 provides one reason for reflexivity in research praxis. The researcher may participate in the conditions that later appear as evidence. Recognizing this participation supports better attribution and documentation without requiring the researcher to treat every observed change as an artifact of inquiry.

6.1.5 Relations within Praxis

Praxis is relationally constituted because activity depends on relations among actors, objects, institutions, infrastructures, environments, concepts, representations, and historically inherited conditions. A researcher gains access through institutional permissions and participant relations; a practitioner acts through organizations, laws, material resources, and public expectations; a community sustains knowledge through memory, language, trust, and shared practices; a technical system depends on maintenance, standards, energy, data, and coordination. Activity therefore takes place within relational configurations that shape available capacities and constraints.

Bourdieu's theory of practice provides one influential precedent for relating durable dispositions to structured social conditions rather than locating practice exclusively in explicit calculation (Bourdieu 1977). Gramsci's philosophy of praxis likewise emphasizes historically mediated consciousness and action within social relations and institutions (Gramsci 2007). GRE draws from these traditions without adopting their concepts as interchangeable with its own. The narrower claim is that practical activity is enabled and constrained through relations whose organization affects what participants can perceive, judge, and do.

Relations within praxis can be cooperative, competitive, hierarchical, fiduciary, contractual, affective, epistemic, administrative, ecological, technical, or otherwise heterogeneous. Their practical significance cannot be inferred from one general relational form. A relation of trust may enable evidence sharing in one context and suppress criticism in another. Institutional authority may make coordination possible while concentrating control over classifications. Technical infrastructure can expand observation while making inquiry dependent on opaque systems. Relational analysis therefore concerns the concrete organization and consequences of relations rather than a presumption that relationality is intrinsically desirable.

The relational constitution of praxis also distributes agency. Outcomes attributed to a named researcher, organization, or decision-maker can depend on many supporting relations whose contributions are weakly visible in conventional accounts. Maintenance work, translation, data stewardship, community access, technical support, legal authorization, caregiving, environmental stability, and accumulated public knowledge can all contribute to what an actor is able to accomplish. This point anticipates later discussions of distributed knowledge production and generative attribution.

Proposition 6.7 (Relational constitution of praxis). *A praxis configuration should be analyzed through the relations that enable, constrain, mediate, authorize, sustain, or transform its activity when those relations materially affect the capacities or consequences relevant to the inquiry.*

The proposition is deliberately selective. Relational analysis does not require exhaustive mapping of every conceivable connection. It requires attention to relations whose omission would materially weaken explanation of the praxis configuration under study.

6.1.6 Feedback within Praxis

Feedback occurs when consequences of activity re-enter the conditions of subsequent knowing, judgment, action, or relation. A research finding can redirect attention; participant responses can change an interview protocol; an intervention can expose an unanticipated mechanism; a failed model can reshape theory; a policy can generate new administrative categories; an institutional reform can alter the data through which its own effects are later evaluated. Feedback therefore links successive phases of praxis and makes practical activity recursively organized through time.

Feedback can carry heterogeneous information. Some feedback is intentionally designed, as in monitoring systems, replication, peer criticism, participant validation, or adaptive experiments. Other feedback appears through anomaly, resistance, breakdown, side effects, changed behavior, or the disappearance of expected traces. Its epistemic value depends on interpretation. A negative outcome can reflect a false theory, inadequate implementation, changed conditions, measurement failure, or interaction among several causes. Feedback becomes informative through analysis of the pathway that produced it.

Dewey's emphasis on consequences and the reconstruction of conduct through experience offers a useful precedent for this recursive view (Dewey 1922; Dewey 1925). GRE extends the architectural idea into relational inquiry: feedback may travel through social, institutional, material, symbolic, ecological, or computational relations, and the pathway itself can change during the process. The same signal can therefore acquire different practical meanings across fields or historical moments.

Definition 6.8 (Praxis feedback). *Praxis feedback* is a pathway through which consequences, traces, responses, or transformations generated in one phase of activity become conditions or evidence for subsequent knowing, judgment, action, relation, or revision.

Feedback can reinforce an existing configuration, destabilize it, or redirect it. Repeated success can stabilize a method and make alternatives less visible; repeated failure can motivate conceptual revision; institutional rewards can amplify one research orientation; participant resistance can expose categories that fail to represent lived relations. Because feedback can reproduce error as well as correct it, recursive organization does not guarantee learning. Learning requires procedures capable of distinguishing informative feedback from self-reinforcing closure.

Proposition 6.9 (Recursive organization of praxis). *Praxis becomes recursively organized when consequences from earlier activity materially alter the epistemic, relational, or practical conditions under which later activity is conducted.*

Proposition 6.9 prepares the chapter's later analysis of iterative research, reflexivity, failure, and cumulative practice. It also makes revision a structural possibility of praxis rather than an external correction added after activity has concluded.

6.1.7 Revision within Praxis

Revision concerns changes to the organization of praxis in response to evidence, consequences, contradiction, reflection, historical transformation, or altered objectives. What is revised can include a factual claim, concept, model, category, research question, method, practical objective, institutional rule, allocation of authority, or relation among participants. Revision therefore extends beyond correcting propositions. It can transform the architecture through which later propositions and actions are produced.

Chapter 5 treated revisability as a condition of relational knowledge. Within praxis, revisability acquires an additional dimension: the procedures that generated the knowledge may themselves need revision. A category can become inadequate because the object changes; an observational instrument can produce effects that distort later evidence; a methodological convention can systematically exclude weakly institutionalized relations; a research question can become obsolete after an intervention changes the field. In each case, retaining the original procedure for the sake of consistency may weaken rather than strengthen continuity of inquiry.

Revision nevertheless requires provenance. If a project changes categories, methods, boundaries, or evaluative standards, later readers should be able to reconstruct what changed and why. Otherwise the appearance of cumulative knowledge can conceal shifts in the object or criteria of comparison. Versioned documentation, preserved alternative interpretations, explicit change rationales, and historical records therefore support revision as a disciplined form of praxis.

Revision can also concern goals. An application initially oriented toward efficiency can encounter evidence that distributional consequences are more significant than anticipated. A research programme organized around prediction can discover that explanation, preservation, or participatory understanding is the more appropriate objective. Such changes should be made explicit because they alter the criteria by which success and failure are judged.

Definition 6.10 (Praxis revision). *Praxis revision* is a traceable modification of the epistemic, judgmental, relational, methodological, normative, or practical organization of activity in response to materially relevant evidence, consequences, contradictions, or historical change.

Definition 6.10 makes revision broader than error correction and narrower than arbitrary change. A revision is disciplined when the reason for change can be reconstructed and when the altered component is matched to the problem that motivates the change. This principle will later support the chapter's treatment of methods and evaluative criteria as historically revisable objects.

6.1.8 Historical Situatedness of Praxis

Praxis occurs within historical conditions that shape available concepts, institutions, technologies, resources, problems, and possibilities. The same nominal action can therefore occupy different relational positions across periods. Collecting population data with paper registers, centralized databases, or pervasive machine sensing involves different capacities, costs, access structures, privacy conditions, and possi-

bilities of feedback. Conducting economic inquiry before national accounting, before large-scale digital transaction records, and under contemporary high-frequency data infrastructures similarly presents different objects of observation and different forms of blindness.

Historical situatedness also concerns categories and standards. Concepts such as household, employment, productivity, risk, intelligence, disability, development, or creditworthiness acquire operational meanings through institutions and measurement practices that change over time. Research conducted through these categories participates in their historical life. A category can stabilize coordination and comparison while also becoming inadequate as relations change. Historical analysis therefore concerns both the object studied and the practical apparatus through which the object becomes knowable.

Marx's historical materialist writings provide a major precedent for relating forms of consciousness and social organization to historically changing material and relational conditions (Marx 1859; Marx and Engels 1970). Gramsci further develops the historically mediated relation among ideas, institutions, social forces, and practical struggle (Gramsci 2007). GRE uses these lineages as critical resources while maintaining its broader ontological suspension and methodological pluralism. The practical implication is that research methods and evaluative standards should themselves be open to historical inquiry.

Historical situatedness does not confine inquiry to description of the present. It strengthens comparison by requiring explicit bridges across periods. A method transported historically should examine whether its categories, recording systems, participant positions, and institutional meanings remain sufficiently comparable. A normative or epistemic standard projected backward should state the basis on which the historical actors, relations, or records can be interpreted through it. The same discipline applies prospectively: future praxis will inherit present infrastructures and classifications in ways that present researchers cannot fully predict.

Claim 6.11 (Historical index of praxis). *A praxis configuration is historically indexed when its available capacities, relations, representations, evaluative criteria, and practical alternatives depend materially on conditions specific to its historical situation.*

Claim 6.11 prevents the chapter's general vocabulary from becoming a timeless template imposed identically on every case. Knowing, judgment, action, feedback, and revision are broad analytical moments; their concrete organization must be reconstructed historically.

6.1.9 Generativity of Praxis

Praxis is generative when activity contributes to the formation or transformation of conditions that affect later activity. These effects can include new knowledge, concepts, questions, skills, infrastructures, institutions, relations, habits, capacities, constraints, classifications, memories, or future possibilities. The generativity of praxis therefore extends beyond successful achievement of an immediate objective. An activity can fail at its stated aim while still generating evidence, coordination, institutional learning, distrust, dependence, or new possibilities that shape later trajectories.

This generative perspective is especially important for research. Inquiry can produce more than propositions. It can generate datasets, archives, measurement infrastructures, disciplinary vocabularies, participant expectations, research communities, computational tools, evaluative standards, institutional legitimacy, or public classifications. These products can support later inquiry, constrain alternative questions, redistribute representational authority, or become inputs into application-dominant praxis. Research praxis thus participates in the generative relational world it seeks to understand.

Generativity remains normatively open. A praxis can generate capability while simultaneously producing dependency; it can expand knowledge while narrowing privacy; it can stabilize cooperation while suppressing dissent; it can create a powerful research infrastructure while making future inquiry dependent on categories that later become inadequate. The descriptive claim that praxis is generative therefore remains separate from the normative judgment that its generated conditions are desirable. This distinction preserves the book's broader separation among generativity, value, justice, and governance.

Definition 6.12 (Generative praxis). *Generative praxis* is praxis whose activity contributes to the formation, reproduction, suppression, or transformation of capacities, relations, representations, institutions, constraints, or possibility structures that materially condition subsequent praxis.

The definition includes reproduction because maintaining a condition can require active work and can shape future possibilities as strongly as visible transformation. It includes suppression because practical activity can reduce the feasibility of later relations or actions. It also preserves target relativity: a praxis may be generative with respect to one capacity while merely reproductive, or even foreclosing, with respect to another.

Proposition 6.13 (Generative openness of praxis). *The generative effects of praxis should be evaluated separately from the immediate objectives of the acting participants, because practical activity can produce persistent relational and institutional consequences that exceed, redirect, or outlast those objectives.*

Proposition 6.13 closes the foundational argument of this section. Praxis is a useful unified category because knowing, judgment, action, relation, feedback, revision, historical conditions, and generative consequences can be analyzed within one practical architecture while retaining their differences. The next section narrows this broad category to research praxis and distinguishes research-dominant from application-dominant configurations according to their orientation, principal contradiction, and phase-dependent point of provisional closure.

6.2 Research Praxis within the Field of Praxis

Section 6.1 established praxis as a historically situated relational configuration in which knowing, judgment, action, feedback, and revision participate in the formation of subsequent conditions and possibilities. The present section narrows that broad category to research praxis. Its role is classificatory and architectural: the objective is to distinguish research-dominant and application-dominant praxis without treating

research and application as separate domains of human activity. The discussion proceeds from research as a mode of praxis to dominant practical orientations, overlap, mutual transformation, hybrid configurations, and phase dependence. The method is analytical. It identifies differences in orientation, contradiction, and provisional closure while preserving the shared practical structure developed in the preceding section. This formulation also draws on traditions in which inquiry is embedded in experience and consequence, practical activity is historically situated, and practice is structured through relations and inherited conditions (Dewey 1922; Dewey 1925; Marx 1994; Gramsci 2007; Bourdieu 1977). The purpose is narrower than reconstructing those traditions: Chapter 6 requires a vocabulary capable of following inquiry as it moves between knowledge production and practical transformation.

Definition 6.14 (Research praxis). *Research praxis* is praxis whose organized activity includes the production, reconstruction, testing, preservation, comparison, or revision of epistemic representations concerning a specified object, relation, process, field, or generative trajectory.

Definition 6.14 describes research through an epistemic orientation while keeping its practical conditions visible. Research praxis can involve observation, conceptualization, archival work, measurement, formalization, interviewing, field engagement, experimentation, computation, interpretation, intervention, publication, preservation, or collective deliberation. The particular combination depends on the object and research design. Research praxis therefore belongs within the broader field of praxis because its epistemic activity is carried by practical relations, institutions, instruments, judgments, and consequences.

A second distinction organizes the section. Research-dominant and application-dominant praxis are treated as modes of practical organization rather than as fixed identities attached permanently to persons, institutions, or projects. A university laboratory can enter an application-dominant phase when urgent intervention becomes the immediate organizing problem. A public agency can enter a research-dominant phase when it suspends routine action to reconstruct why an intervention produced unexpected effects. The same collective activity can therefore move between orientations while preserving historical continuity.

6.2.1 Research as a Mode of Praxis

Research becomes intelligible as a mode of praxis when epistemic production is examined together with the relations and activities that make it possible. A researcher must gain access to sites, archives, instruments, participants, datasets, conceptual traditions, or computational infrastructures. Questions are formulated through inherited vocabularies. Evidence is produced or preserved through material and institutional arrangements. Results are judged, represented, circulated, criticized, and revised through scholarly and public relations. These activities can alter the conditions of later inquiry even where direct intervention in the substantive object is limited.

This account is compatible with the epistemic distinctions developed in Chapter 5. The fact that research is praxis does not make truth or warrant reducible to practical success. A claim can be well warranted and practically inconvenient; an intervention can succeed for reasons that remain poorly understood; a socially influential repre-

sensation can possess considerable performative efficacy while remaining epistemically inadequate. The practical organization of research and the epistemic warrant of its claims therefore require connected but distinguishable analysis.

Dewey's treatment of inquiry within experience and conduct provides one historical resource for understanding knowledge production as activity within problematic situations rather than as detached contemplation (Dewey 1922; Dewey 1925). Marxian and Gramscian traditions likewise situate thought and knowledge within historically formed practical relations (Marx 1994; Gramsci 2007). GRE adopts a limited consequence from these lineages: research can be analyzed in terms of what relations organize inquiry, what contradictions motivate reconstruction, what actions generate evidence, what consequences feed back into representation, and how the resulting epistemic-practical configuration changes through time.

Research praxis can have objects that are themselves minimally affected by the research activity, as in some forms of historical reconstruction or remote observation. It can also have objects strongly affected by inquiry, as in participatory research, organizational study, experimentation, policy evaluation, or machine-mediated classification. The category therefore accommodates different degrees of reflexive coupling between observer and observed. The practical character of research lies in the situated organization of inquiry; the strength and direction of observer effects remain empirical questions.

Claim 6.15 (Research within praxis). *Research can be treated as a mode of praxis when epistemic production is analyzed together with the practical relations, judgments, infrastructures, consequences, and revision processes through which inquiry is conducted.*

Claim 6.15 does not erase disciplinary distinctions among laboratory science, historical inquiry, ethnography, formal analysis, economics, engineering, or political research. It establishes a common practical vocabulary through which their different research arrangements can later be compared.

6.2.2 Research-Dominant Praxis

A praxis configuration is research-dominant when its principal orientation concerns an epistemic-theoretical transformation. The immediate problem may involve inadequate observation, uncertain classification, conceptual inconsistency, unexplained variation, conflicting evidence, insufficient formal representation, historical ambiguity, or a phenomenon that available theory cannot adequately reconstruct. Practical activity is organized primarily to transform the epistemic situation: to make a relation observable, distinguish alternatives, reconstruct a history, develop a concept, revise a model, formulate an explanation, preserve evidence, or establish the limits of what can presently be known.

The term *dominant* is important because research-dominant praxis still contains action. Researchers choose cases, allocate resources, design instruments, request access, intervene in measurement environments, create classifications, conduct experiments, maintain archives, write software, and publish representations. These actions can have material and institutional consequences. Research-dominant praxis is distinguished by the provisional point toward which these activities are organized. A

phase can reach provisional closure when the epistemic contradiction that organized it has been sufficiently reconstructed for the current purpose, even though practical consequences and later revisions remain open.

Definition 6.16 (Research-dominant praxis). *Research-dominant praxis* is a praxis configuration in which the principal practical orientation is the transformation of an epistemic-theoretical situation through inquiry, representation, explanation, evaluation of evidence, or revision of knowledge.

This definition makes research dominance phase-relative. A long project may contain several research-dominant phases directed at different epistemic problems. Initial inquiry may clarify categories; later inquiry may reconstruct mechanisms; a subsequent phase may test whether the resulting explanation travels across scale or history. The practical orientation can change even while the project remains institutionally classified as research.

Research dominance also varies by the form of object under investigation. In highly mediated domains, the central epistemic transformation may concern the adequacy of representation. In historical inquiry, it may concern reconstruction from partial records. In formal work, it may concern whether a representation clarifies a structure and what assumptions support the mapping between model and target. In participatory inquiry, it may concern whether the research configuration makes previously excluded relations intelligible. The shared feature is organizational priority given to an epistemic-theoretical contradiction whose transformation structures the phase.

The detailed principal contradiction of research-dominant praxis is reserved for Section 137. At this stage, the important point is architectural: research dominance names the orientation of praxis, not a purified sphere in which action disappears.

6.2.3 Application-Dominant Praxis

Application-dominant praxis is organized primarily around transformation of a practical-relational situation. A decision must be made, a service delivered, a danger reduced, an institution reorganized, a technology deployed, a conflict managed, a resource allocated, or a collective capacity maintained. Knowledge remains important, often decisively so, yet the practical configuration cannot defer action until epistemic uncertainty disappears. Its provisional closure concerns a practical decision, intervention, maintenance activity, institutional arrangement, or other transformation in the relational world.

Definition 6.17 (Application-dominant praxis). *Application-dominant praxis* is a praxis configuration in which the principal practical orientation is decision, intervention, maintenance, or transformation of a practical-relational situation under conditions that include incomplete and revisable knowledge.

Application dominance therefore does not imply the mechanical execution of prior knowledge. Action frequently requires situated judgment concerning whether available evidence is sufficiently relevant, whether circumstances match those under which knowledge was produced, which values and constraints should guide choice, what risks are reversible, and what information can be generated through action

itself. The epistemic component remains internal to praxis even where action has temporal priority.

The category includes maintenance as well as visible intervention. Preserving an institution, infrastructure, ecological condition, archive, care relation, or technical system can require continuous practical activity. Maintenance may be application-dominant when its central problem concerns sustaining conditions in the face of deterioration, changing demands, or uncertainty. This matters for GRE because reproduction of a relational configuration can be generative: maintenance can preserve capacities and future possibilities, while neglect can alter them.

Application-dominant praxis can also generate knowledge. Implementation reveals friction that was absent from a model; users adapt a technology in unanticipated ways; an intervention exposes hidden dependencies; failure reveals a constraint; institutional resistance makes power relations visible; maintenance records create longitudinal evidence. Practical transformation can therefore become an epistemic event. The subsequent coupling of research and application will be developed in Section 139. Here, the key distinction is that generated knowledge remains embedded in a phase whose principal orientation concerns practical transformation.

The detailed principal contradiction of application-dominant praxis is reserved for Section 138. The present section establishes only the mode: action under incomplete knowledge belongs within praxis and remains capable of generating further inquiry.

6.2.4 Overlap between Research and Application

Research and application overlap whenever a praxis configuration simultaneously transforms an epistemic representation and the practical-relational situation to which that representation refers. This condition is common. Experiments alter conditions in order to learn from resulting differences. Participatory research can reorganize relations of voice and representation while producing knowledge about them. Policy pilots can test an intervention while delivering it. Clinical, educational, organizational, and engineering practice often requires observation and adaptation during implementation. Computational systems can generate predictions while simultaneously changing the decisions, incentives, or classifications that shape subsequent data.

Overlap should therefore be described by the functions performed within praxis rather than by institutional labels alone. A university project may contain application-dominant episodes; a public administration may conduct research-dominant reconstruction; an NGO may develop theory while delivering services; a firm may generate generalizable knowledge during product development; a community archive may simultaneously preserve history and transform representational authority. The location of an activity does not settle its mode.

Proposition 6.18 (Overlap of praxis modes). *Research-dominant and application-dominant praxis can overlap within the same activity when epistemic reconstruction and practical transformation are jointly produced, provided their respective orientations and points of provisional closure remain analytically distinguishable.*

Proposition 6.18 protects two useful insights. First, overlap is ordinary rather than

exceptional. Second, overlap does not require abandoning distinctions. A project can ask whether a relation exists and simultaneously decide how to act upon it. The evidential standards governing the first question and the practical criteria governing the second can remain different even when both are pursued by the same participants.

Overlap also has ethical and epistemic implications. Research designed around practical goals may privilege evidence that is actionable while neglecting historically important or normatively significant relations that do not fit the immediate intervention. Conversely, inquiry designed around epistemic novelty may produce operational consequences for participants without treating those consequences as part of the research object. Recognizing overlap therefore expands the scope of reflexive analysis. Researchers and practitioners can ask which transformations are occurring simultaneously and whose capacities, risks, or representational positions are being altered in the process.

6.2.5 Mutual Transformation between Praxis Modes

Praxis modes can transform into one another when the contradiction organizing activity changes. An application-dominant intervention may encounter an unexpected failure, converting the immediate problem into one of explanation. A research-dominant inquiry may identify an urgent and sufficiently understood risk, shifting practical priority toward intervention. A new representation may make an actionable relation visible; an intervention may generate traces that make a previously inaccessible relation researchable. These transitions are transformations of orientation within continuing praxis rather than simple handoffs between isolated domains.

The transformation can be reversible or recursive. Inquiry generates an intervention; intervention produces evidence; evidence revises the theory; the revised theory changes the intervention. Dewey's account of inquiry within changing situations offers one historical resource for understanding such recursive movement between problematic conditions, inquiry, and consequence (Dewey 1922; Dewey 1925). In GRE, the emphasis falls on how each phase transforms the relational conditions inherited by the next. A research phase can change the available categories, datasets, expectations, or institutional legitimacy. An application phase can change the population, infrastructure, incentive structure, or institutional relations that later research observes.

Definition 6.19 (Praxis-mode transformation). A *praxis-mode transformation* occurs when the principal orientation and provisional point of closure of an ongoing praxis configuration shift sufficiently for research-dominant or application-dominant organization to become the more appropriate description of the active phase.

The definition avoids treating transition as a change in institutional identity. A hospital remains a hospital when clinical practice enters a research-dominant phase; a university remains a university when a research programme enters an application-dominant phase. What changes is the organization of the active contradiction and the practical criteria by which the phase is provisionally advanced or closed.

Mode transformation can also generate path dependence. Decisions taken during an application-dominant phase can constrain what later inquiry can observe. Cat-

egories created for research can become embedded in administrative systems and shape later interventions. Infrastructure built for one epistemic purpose can become the default channel through which practical action occurs. The transition between modes therefore deserves historical reconstruction rather than being represented as a neutral switch.

6.2.6 Hybrid Praxis

Some activities sustain research and application orientations so closely that assigning a single dominant mode for the whole configuration would discard relevant structure. These cases can be described as hybrid praxis. Hybrid does not mean conceptually indeterminate. It indicates that multiple orientations remain materially consequential over the analytical interval and that the activity is deliberately organized to preserve their interaction.

Definition 6.20 (Hybrid praxis). *Hybrid praxis* is a praxis configuration in which research-dominant and application-dominant orientations remain jointly operative over the relevant analytical interval, with neither orientation adequately representing the configuration by itself.

Examples can include long-term participatory research, adaptive management, iterative engineering, action-oriented field laboratories, implementation research, community-based inquiry, or institutional experiments in which knowledge production and practical transformation are co-designed. The examples are illustrative categories rather than claims that every activity carrying those labels is necessarily hybrid. The analytical determination depends on how the actual praxis is organized.

Hybrid praxis creates special demands for evaluation. An epistemically productive intervention may be practically harmful; a practically successful intervention may generate little transferable knowledge; a method that increases comparability may undermine local participation; a participatory process may generate valuable situated knowledge while limiting standardization. A single success metric can therefore obscure the plurality of outputs and burdens. Evaluation should identify which orientation a criterion addresses and how tensions among criteria are managed.

Hybrid configurations also complicate authorship and responsibility. Knowledge may be produced through distributed contributions from researchers, participants, practitioners, technicians, institutions, and affected communities. Practical consequences may be generated by the same relational configuration that generates evidence. Later sections on researcher power, epistemic justice, AI-assisted research, and collective knowledge production will develop these problems in greater detail. The present concept provides a place within the architecture for praxis whose epistemic and practical orientations remain deliberately intertwined.

6.2.7 Phase-Dependent Practical Orientation

Praxis orientation often changes at a finer temporal resolution than project labels suggest. A multi-year research programme can move through exploratory observation, conceptual reconstruction, formalization, experimental intervention, implementation, monitoring, and revision. Some phases are research-dominant, some

application-dominant, and some hybrid. Treating the whole project as belonging permanently to one mode can hide the moments at which standards of warrant, urgency, responsibility, and acceptable uncertainty change.

Definition 6.21 (Phase-dependent practical orientation). *Phase-dependent practical orientation* is the dominant research, application, or hybrid organization of praxis relative to a specified temporal segment, practical problem, and point of provisional closure.

This definition makes the analytical interval explicit. A short interval may reveal a clear application-dominant decision episode inside a broadly research-oriented programme. A longer interval may reveal recursive alternation between inquiry and intervention. The appropriate scale therefore depends on the question. Analysis of responsibility for an urgent decision may require a fine-grained phase boundary; analysis of institutional learning may require a longer trajectory.

Phase dependence also alters acceptable epistemic posture. During exploratory research, broad uncertainty and competing explanations may be retained because the objective is to map a problem-space. During an urgent application phase, a decision may be necessary despite unresolved uncertainty, making reversibility, monitoring, and contingency planning more important. During post-intervention research, the system may already have changed, so evidence should be interpreted relative to the transformed configuration. The same claim can consequently play different practical roles across phases.

Claim 6.22 (Orientation is indexed to phase). *A classification of praxis as research-dominant, application-dominant, or hybrid should be indexed to a specified phase and problem, because practical orientation can change while institutional identity and over-all project continuity remain stable.*

Claim 6.22 prevents the chapter's vocabulary from hardening into permanent classifications of people or organizations. It also prepares the analysis of contradictions in the next section, because a change in principal contradiction can mark a change in practical orientation.

6.2.8 Limits of Fixed Research–Application Boundaries

Fixed research–application boundaries remain useful for many institutional purposes. Ethics review, funding, professional responsibility, regulation, publication, and organizational accountability can require categorical distinctions. The analytical problem arises when these administrative distinctions are treated as complete descriptions of praxis. Institutional classifications can stabilize responsibilities while still failing to capture overlap, mode transformation, hybrid organization, or phase dependence.

A fixed boundary can obscure causal and generative relations across the divide. Research representations can alter later policy, investment, organizational design, public expectations, or technological development. Application can create new datasets, categories, infrastructures, and populations that later research treats as given. Research funding can shape what practical problems become visible; implementation requirements can shape what research questions are considered relevant.

The boundary is therefore often permeable in both directions even where institutions assign different roles to each side.

The boundary can also distribute responsibility selectively. Researchers may treat downstream use as external to research even when a project is designed around foreseeable deployment. Practitioners may treat the categories or models they inherit as epistemically settled even when those representations were produced under narrow conditions. A relational account asks how responsibility, knowledge, authority, and consequences are actually connected across phases. This does not mean that every researcher is responsible for every later use, or that every practitioner must reconstruct the entire genealogy of a tool. It means that the structure of connection should be examined before institutional separation is taken as evidence of practical independence.

Proposition 6.23 (Analytical permeability of the research–application boundary). *Institutional distinctions between research and application can remain administratively necessary while their analytical boundary remains permeable whenever knowledge production and practical transformation condition one another across phases.*

Proposition 6.23 supplies the section’s closing architecture. Research praxis belongs within the field of praxis because epistemic and practical transformations remain historically and relationally connected. Research-dominant, application-dominant, and hybrid configurations can be distinguished by orientation and provisional closure, yet these modes can overlap and transform as the contradiction organizing activity changes. The next section develops contradiction as an analytical relation within praxis and prepares the more specific accounts of the principal contradictions of research-dominant and application-dominant activity.

6.3 Contradictions within Praxis

This section develops contradiction as an analytical category for examining how praxis becomes organized, strained, redirected, and transformed. Its role is intermediate between the general account of praxis developed in Sections 6.1–6.2 and the more specific analyses of research-dominant and application-dominant praxis that follow. The objective is to distinguish several forms of contradiction, specify the difference between principal and secondary contradictions, and explain how their relative significance can change across phases and historical conditions. The method is relational and generative: contradiction is treated as a structured relation among demands, capacities, representations, institutions, or practical conditions whose interaction can alter subsequent possibilities. The section therefore uses contradiction as an explanatory instrument for the dynamics of praxis while preserving room for non-contradictory mechanisms, contingency, and plurality.

The vocabulary has an identifiable historical lineage. Marx’s writings repeatedly analyze tensions among productive forces, social relations, forms of consciousness, and historically specific institutions (Marx 1994). Mao’s 1937 essay “On Contradiction” gives explicit form to the distinction between principal and secondary contradictions and emphasizes that their relative positions can change across stages of a process (Mao 1967). Althusser later develops an account of contradiction and overde-

termination that resists reducing complex historical processes to a single expressive opposition (Althusser 2006). GRE draws selectively from these lineages. Its use of contradiction is narrower than a complete dialectical ontology: the concept functions here as a way to identify relational tensions that organize praxis and generate pressures for transformation.

6.3.1 Contradiction as a Generative Relation

A contradiction within praxis arises when two or more practically significant demands, tendencies, capacities, commitments, representations, or conditions are mutually implicated yet cannot be simultaneously realized in their current form without producing strain, displacement, revision, or transformation. Examples include the demand for stable concepts under historically changing conditions, the need to decide while evidence remains incomplete, the pursuit of comparability alongside sensitivity to local difference, or the requirement to act quickly while preserving reversibility. The relevant relation is therefore practical and generative: its significance lies in how the tension reorganizes subsequent knowing, judgment, action, or institutional arrangement.

This use of contradiction differs from formal logical contradiction. A theory containing mutually inconsistent propositions presents a logical problem. A praxis contradiction can exist even when every proposition used by participants is logically consistent. A hospital may possess coherent protocols and still confront a contradiction between rapid standardized triage and the individualized attention required by heterogeneous cases. A research programme may possess internally coherent models and still confront a contradiction between stable formal categories and a changing object of inquiry. Logical analysis can become relevant within such situations, while the praxis contradiction concerns the relational organization of activity.

Contradictions can also be latent. Two requirements may coexist for long periods because institutional slack, abundant resources, weak interaction, or temporal separation prevents their tension from becoming consequential. The contradiction becomes practically salient when conditions force the requirements into tighter interaction. A budget constraint, technological change, legal reform, crisis, new evidence, or changed population can therefore disclose a contradiction that had previously remained weakly manifest. This temporal feature makes contradiction compatible with the chapter's broader emphasis on emergence and historical situatedness.

Definition 6.24 (Praxis contradiction). A *praxis contradiction* is a historically situated relation among practically significant demands, tendencies, capacities, commitments, representations, or conditions whose joint operation generates pressure for reorganization, prioritization, revision, or transformation within a specified praxis configuration.

Definition 6.24 makes the target and scope explicit. The relevant pressure may be epistemic, institutional, normative, material, temporal, or distributed across several dimensions. The presence of tension alone does not establish that the contradiction is decisive. Its explanatory significance depends on evidence that the relation materially organizes the praxis under study.

Claim 6.25 (Generative potential of contradiction). A *contradiction has generative*

significance when responses to the tension alter subsequent capacities, relations, representations, institutions, orientations, or possibility structures within the praxis configuration.

Claim 6.25 also preserves normative openness. A contradiction can generate learning, institutional innovation, conceptual refinement, and new cooperation; it can also generate exclusion, coercive simplification, dependency, or foreclosure. Generativity describes transformation of subsequent conditions, while normative evaluation remains a separate task.

6.3.2 Principal and Secondary Contradictions

Complex praxis usually contains several contradictions at once. A research project may face uncertainty about its object, disagreement over categories, limited resources, institutional incentives, participant mistrust, technical failure, and pressure for practical relevance. Treating all tensions as equally organizing can make analysis diffuse. The distinction between principal and secondary contradictions provides a way to ask which tension most strongly structures the current phase and which tensions remain consequential through their relation to it.

The terminology has a direct historical precedent in Mao's analysis of complex processes, where one contradiction can become principal for a particular stage while others occupy secondary positions, and where those positions can change as the process develops (Mao 1967). GRE retains the stage-sensitive insight while giving the distinction a more explicitly analytical and revisable form. Principal status is attributed relative to a specified problem, temporal interval, boundary, and practical orientation. It is therefore a claim requiring evidence rather than a property assumed in advance.

Definition 6.26 (Principal contradiction of praxis). The *principal contradiction of praxis* is the contradiction that, relative to a specified phase, boundary, and practical problem, most strongly organizes the allocation of attention, judgment, resources, action, and revision within the praxis configuration.

Definition 6.27 (Secondary contradiction of praxis). A *secondary contradiction of praxis* is a materially relevant contradiction whose organizing significance is lower than that of the principal contradiction for the specified phase, while retaining the capacity to condition, amplify, redirect, or later displace it.

The distinction concerns organizing significance rather than moral importance. A contradiction can be ethically serious while remaining secondary to the process currently organizing action. Likewise, a principal contradiction can be analytically decisive while concerning a relatively narrow operational problem. This separation reduces the risk of turning analytical priority into normative ranking.

Several indicators can support identification of principal status. A contradiction may repeatedly redirect decisions, absorb disproportionate resources, constrain multiple other activities, structure institutional debate, trigger revision across methods or roles, or determine the point at which provisional closure becomes necessary. Evidence should also examine plausible alternatives. What appears principal from the viewpoint of a project leader may differ from what organizes participant expe-

rience, community response, or institutional behavior. Principal-contradiction analysis therefore inherits the observer-position and boundary problems developed in Chapter 5.

Althusser's account of overdetermination is useful as a caution against interpreting one contradiction as an isolated or self-sufficient cause (Althusser 2006). A principal contradiction can be constituted through many secondary relations, historical inheritances, institutional forms, and contingent conditions. GRE therefore treats principal status as relationally produced. Secondary contradictions can change the form through which the principal contradiction appears and can alter the pathways available for its transformation.

Proposition 6.28 (Relational identification of principal contradiction). *Attribution of principal status should be supported by evidence that a contradiction has greater organizing significance for the specified praxis phase than plausible competing contradictions, while the secondary relations that condition its operation remain analytically visible.*

6.3.3 Contradictions of Knowing

Knowing within praxis is organized by tensions between epistemic aspiration and limited access. Inquiry seeks sufficiently warranted understanding while observation remains partial, manifestations remain mediated, historical traces remain incomplete, and categories remain revisable. These conditions create contradictions whenever practical or theoretical demands exceed the knowledge presently available.

One recurring form concerns the relation between the openness of the object and the need for provisional epistemic closure. Research cannot retain every possible explanation indefinitely. Concepts, hypotheses, measurement rules, and evidential standards must eventually be selected sufficiently to permit inquiry to proceed. Yet closure can suppress alternatives too early and stabilize representations that later evidence challenges. The resulting contradiction concerns the need to make knowledge workable while preserving its revisability.

A second form concerns depth and tractability. Rich relational reconstruction can preserve historical, institutional, and qualitative complexity, while tractable inquiry often requires selective representation. Greater detail can improve local adequacy and simultaneously increase demands on evidence, computation, interpretation, and communication. Simplification can enable comparison while obscuring relations that matter for the target. The contradiction therefore lies in the organization of epistemic effort rather than in an abstract choice between complexity and simplicity.

A third form concerns breadth and situated access. Distributed inquiry can combine heterogeneous evidence across sites and scales, but each additional source introduces its own conditions of production, missingness, category structure, and observer position. Expanding the evidential field can therefore increase both epistemic reach and the work required to preserve provenance and comparability. The chapter's earlier account of profiled epistemic confidence provides one response: uncertainty can be localized instead of compressed into one global judgment.

Claim 6.29 (Contradiction of epistemic closure). *Research praxis often contains a contradiction between the provisional closure required for cumulative inquiry and the revisability required by partial, historically situated knowledge.*

Claim 6.29 prepares the more specific analysis of research-dominant praxis in the following section. The present point is broader: contradictions of knowing can appear in research, application, and hybrid praxis whenever action or interpretation requires commitments under incomplete epistemic conditions.

6.3.4 Contradictions of Representation

Praxis depends on representations because relations, institutions, populations, histories, and future possibilities cannot ordinarily be carried into deliberation in their full complexity. Maps, categories, variables, narratives, legal classifications, indicators, models, visualizations, and computational embeddings make aspects of a relational system portable. Representation thereby expands the capacity to coordinate, compare, communicate, and act. The same operation selects, compresses, and transforms what becomes legible.

Contradictions of representation arise when the properties that make a representation practically usable also generate losses that matter for the task. Standardization can support comparison while reducing sensitivity to historically specific meanings. Aggregation can make a population visible while hiding internal relational differentiation. A network representation can expose connectivity while underrepresenting legal, affective, material, or temporal qualities of edges. A legal category can stabilize rights and obligations while failing to capture relations that exceed its criteria.

Representations can also become performative. Once used in funding, evaluation, eligibility, policing, credit, diagnosis, publication, or institutional planning, a representation can alter the relations it purports to describe. This creates a recursive contradiction: better operational integration can increase the representation's practical efficacy while simultaneously changing the object against which its adequacy is assessed. The epistemic and causal roles of representation then become intertwined.

Definition 6.30 (Representational contradiction in praxis). *A representational contradiction in praxis is a tension in which features that increase the usability, portability, comparability, or operational force of a representation also generate losses, distortions, or performative effects that materially affect the object or purpose for which the representation is used.*

The definition does not imply that representation can become complete. It directs attention to target-relative tradeoffs and to the possibility that the representation itself enters the relational system. The practical response may involve layered representations, provenance records, local supplements, multiple models, contestability mechanisms, or explicit uncertainty rather than pursuit of a universally exhaustive representation.

6.3.5 Contradictions of Theory

Theory organizes inquiry by stabilizing concepts, relations, explanatory structures, and expectations across cases. This stabilizing function creates continuity and cumu-

lative development. Historical and generative reality, however, can alter the very relations that made an earlier theory adequate. Contradictions of theory emerge where theoretical stability encounters anomaly, counterevidence, new objects, transformed institutions, or relations that exceed the architecture through which the theory currently explains them.

The contradiction can concern scope. A theory developed in one historical setting may travel successfully across some contexts and fail in others. It can concern abstraction. A parsimonious mechanism may explain an important regularity while omitting relational conditions required for its reproduction. It can concern category formation. Terms that once differentiated relevant objects can lose discriminatory power as practices or institutions change. It can also concern theoretical productivity: a framework may continue to fit existing evidence while generating progressively fewer informative questions about newly emerging phenomena.

Theory revision therefore involves more than accumulating exceptions. The key question is whether the encountered tension can be addressed through parameter adjustment, boundary revision, supplementary mechanisms, category differentiation, or deeper reconstruction of the theoretical architecture. These responses have different epistemic costs. A framework that can absorb every anomaly through ad hoc additions may preserve formal continuity while losing explanatory discrimination. A framework revised too readily may lose the stability required for cumulative comparison.

Claim 6.31 (Theory–counterevidence contradiction). *A contradiction becomes theoretically generative when counterevidence or newly observed relations create pressure to revise the scope, categories, mechanisms, or architecture through which the research programme organizes explanation.*

This formulation connects contradiction to generativity without assuming that every disagreement produces theoretical progress. Counterevidence can be mistaken, theory can remain adequate within a narrower scope, and apparent novelty can reflect measurement failure. The contradiction becomes productive through disciplined diagnosis of where the mismatch originates and what forms of revision it warrants.

6.3.6 Contradictions of Decision

Decision compresses an open field of possibilities into a provisional practical commitment. This operation is central to praxis because resources, time, attention, and institutional authority are finite. Decisions therefore create contradictions whenever several legitimate demands cannot be simultaneously satisfied under existing conditions. The tension may concern speed and deliberation, local benefit and distributed consequences, standardization and discretion, present needs and future options, or commitment and reversibility.

Decision contradictions differ from contradictions of knowing because additional knowledge may leave the practical tension intact. Two values can remain in conflict after the relevant facts are well established. Two groups can hold legitimate but incompatible claims over the same scarce resource. A decision may need to distribute risk among actors whose interests cannot be reduced to one metric. Epistemic im-

provement can clarify the structure of the problem while leaving a practical contradiction to be judged.

At the same time, uncertainty shapes the decision relation. A choice can alter future evidence, close options, create constituencies, change incentives, or transform the system whose consequences were initially estimated. Decision therefore has a generative dimension. The contradiction is partly about the present allocation and partly about which future conditions the decision helps create.

Definition 6.32 (Decision contradiction). A *decision contradiction* is a relation among practically significant commitments, constraints, values, or consequences that cannot be jointly realized in their current form within the available decision space and therefore requires prioritization, redesign, sequencing, compensation, or transformation of that space.

The definition leaves room for creative transformation. A contradiction need not be handled exclusively by choosing one side. Institutional redesign, new resources, temporal sequencing, modularity, reversible experimentation, or changed relational arrangements can alter the decision space itself. Contradiction analysis is therefore useful when it reveals possibilities for transforming the conditions under which the choice is posed.

6.3.7 Contradictions of Action under Incomplete Knowledge

Action frequently becomes necessary before uncertainty can be substantially reduced. Emergencies, institutional deadlines, ecological thresholds, care obligations, infrastructure failure, financial constraints, or political decisions can impose temporal closure on deliberation. Application-dominant praxis therefore often contains a contradiction between the necessity of acting and the incompleteness of available knowledge.

The tension is intensified when action changes the evidential environment. An intervention can produce new data while also altering baseline conditions. It can reveal mechanisms that were previously hidden while creating path dependence that makes reversal costly. Early action can preserve options in one dimension and close them in another. Waiting for stronger evidence can reduce one form of uncertainty while allowing harms, lock-in, or lost opportunities to accumulate. The contradiction therefore concerns both epistemic quality and temporal structure.

Dewey's account of inquiry and conduct emphasizes learning through consequences and reconstruction of action in light of experience (Dewey 1922; Dewey 1925). Within GRE, this recursive structure motivates attention to reversible action, monitoring, feedback, adaptive revision, and preservation of alternatives where feasible. These practices do not eliminate the contradiction. They organize action so that the consequences of incomplete knowledge can remain partially observable and revisable.

Proposition 6.33 (Action under incomplete knowledge). *When action is required before epistemic uncertainty can be sufficiently reduced, praxis should treat monitoring, reversibility, feedback, and revision capacity as part of the action design whenever those capacities are materially available.*

Proposition 6.33 anticipates the dedicated analysis of application-dominant praxis later in this chapter. Its present function is to show why action contradictions can become principal even within projects that began with a research orientation.

6.3.8 Transformation of the Principal Contradiction

The principal contradiction of praxis can change as the configuration develops. A project may begin with uncertainty about whether a relation exists, later shift toward disagreement over how to represent it, and eventually confront a practical contradiction about intervention. A crisis can move the organizing problem from methodological adequacy to immediate decision. New evidence can resolve one tension while making a previously secondary contradiction visible. Institutional success can also create new contradictions by expanding scale, changing participants, or increasing dependence on infrastructures that were previously peripheral.

Transformation can occur through resolution, displacement, amplification, coupling, or reframing. Resolution reduces the organizing force of a contradiction sufficiently that another tension becomes more consequential. Displacement moves pressure elsewhere without removing the underlying relation. Amplification increases the practical significance of a secondary contradiction. Coupling links several contradictions so that they begin to reorganize one another. Reframing changes how participants understand the problem and can alter which relations count as central.

Definition 6.34 (Principal-contradiction transition). A *principal-contradiction transition* occurs when the contradiction with the greatest organizing significance for a specified praxis phase changes because the relational configuration, available knowledge, institutional conditions, practical orientation, or field of feasible action has materially changed.

A transition should be reconstructed rather than inferred solely from labels. The same institutional project can retain its name while its organizing contradiction changes substantially. Conversely, a change in vocabulary can occur without a change in the practical relation that organizes activity. Evidence may include shifts in resource allocation, meeting agendas, methodological revision, intervention timing, authority structures, failure modes, or the kinds of uncertainty that participants attempt to reduce.

Claim 6.35 (Praxis-mode transformation through contradiction). A *transformation between research-dominant, application-dominant, and hybrid praxis can occur when a change in principal contradiction reorganizes the project's orientation and point of provisional closure.*

This claim connects the present section directly to Section 6.2. The relation is analytical rather than deterministic: a shift in contradiction can support a mode transformation, while institutional rules or deliberate design can preserve the previous orientation despite changed pressures.

6.3.9 Historical Transformation of Praxis

Contradictions are historically situated because the demands and conditions entering praxis are themselves historically produced. New instruments can alter what is

observable; legal reforms can change which relations are recognized; institutional expansion can change scale; new infrastructures can redistribute access; changes in language can reorganize classification; crises can compress decision time; and new technologies can alter the relation between expertise and action. The contradiction organizing praxis therefore belongs to a historical configuration rather than to an invariant list of oppositions.

Historical transformation also affects the forms through which contradiction is managed. A tension once handled through professional discretion may later be handled through standardized protocols or computational systems. A contradiction between local knowledge and central coordination may be reorganized through new communication infrastructures. A conflict between research speed and evidential scrutiny can change when automated tools accelerate literature search, coding, simulation, or drafting. These transformations can reduce some burdens while generating new asymmetries, dependencies, and representational problems.

This historical sensitivity is consistent with the book's treatment of methods and evaluative practices as historically evolving. The criterion by which a contradiction appears salient can itself change. What counts as adequate evidence, acceptable delay, sufficient participation, or tolerable uncertainty is shaped by disciplinary, institutional, technological, and normative histories. Contradiction analysis therefore requires reconstruction of the practical standards operating in the period under study.

Proposition 6.36 (Historical index of praxis contradiction). *Claims about a principal or secondary contradiction should be indexed to the historical conditions that constitute the relevant demands, capacities, institutions, representations, and feasible responses.*

Proposition 6.36 prevents contradiction categories from becoming timeless templates. It also allows later inquiry to re-epistemize an earlier praxis configuration when new evidence or changed historical understanding reveals relations that contemporaneous actors could not easily observe.

6.3.10 Limits of Contradiction-Based Analysis

Contradiction-based analysis is useful when tensions materially organize praxis, yet it does not exhaust the causes of transformation. Change can arise through contingency, encounter, imitation, invention, demographic movement, ecological disturbance, institutional drift, random variation, aesthetic judgment, or the appearance of an opportunity whose significance is not well described as the resolution of an opposition. A generative relational analysis therefore treats contradiction as one family of transformative relations within a wider field of generative processes.

The vocabulary can also encourage premature binary reduction. Many praxis configurations involve several actors, values, temporalities, scales, and institutional logics whose relations cannot be adequately represented by two opposing sides. Higher-order and field relations developed in Chapter 5 remain relevant here. What appears to be one contradiction may be the manifest expression of a multilayer configuration, and different observers may identify different tensions because their positions expose different parts of the field.

A further limit concerns retrospective coherence. Once a transformation has oc-

curred, researchers can reconstruct the preceding period around the tension that appears to explain the outcome. This can understate unrealized alternatives and overstate the inevitability of the path taken. Contradiction analysis should therefore preserve historical counterfactuals, failed responses, secondary tensions, and evidence of contingency where these are relevant to the trajectory.

The language of principal contradiction can also over-centralize analysis. A single contradiction may organize one phase while several partly independent tensions remain causally important. The strongest explanation can therefore combine principal-contradiction analysis with distributed generative attribution rather than forcing every effect through one dominant pathway. Althusser's emphasis on overdetermination provides one historical resource for maintaining this caution (Althusser 2006).

Proposition 6.37 (Scope condition for contradiction analysis). *Contradiction-based analysis is warranted when evidence shows that a relational tension materially organizes praxis, while alternative generative mechanisms, multiple interacting tensions, observer position, historical contingency, and unrealized possibilities remain available for examination.*

The proposition gives the section its closing discipline. Contradiction is neither a universal explanation nor a merely rhetorical label. It is an analytically bounded way to identify tensions that organize praxis and generate pressures for transformation. The distinction between principal and secondary contradictions then permits a phase-sensitive account of orientation without erasing relational complexity. The following sections apply this architecture to the characteristic principal contradictions of research-dominant and application-dominant praxis.

6.4 The Principal Contradiction of Research-Dominant Praxis

This section specifies the contradiction that most characteristically organizes research-dominant praxis. Its role is to refine the general account of contradiction developed in Section 6.3 into a claim about the practical organization of inquiry. The objective is to explain why research requires provisional stabilization of concepts, representations, explanations, and methods while its objects remain only partially known, historically changing, relationally complex, and capable of generating forms that exceed inherited descriptions. The section proceeds through nine dimensions of this contradiction: limited knowledge, representation, conceptual stability, counterevidence, formalization, emergence, methodological adequacy, theoretical closure, and transformation of the epistemic-theoretical system. The method is relational and generative. Each dimension is treated as a relation between epistemic requirements and properties of the object of inquiry whose interaction can reorganize subsequent research.

Research-dominant praxis cannot proceed through indefinite openness alone. Inquiry requires names, distinctions, records, models, inferential rules, standards of relevance, and points of provisional closure. These stabilizations make comparison, criticism, cumulative learning, and coordinated work possible. At the same time, Chapter 5 established that relational knowledge is partial, representation-sensitive,

boundary- and scale-dependent, historically situated, and revisable. The principal contradiction of research-dominant praxis therefore concerns the need to stabilize an epistemic-theoretical system sufficiently for inquiry to proceed while preserving its capacity to be transformed by the reality it seeks to know.

Definition 6.38 (Principal contradiction of research-dominant praxis). The *principal contradiction of research-dominant praxis* is the historically situated tension between the practical need for sufficiently stable concepts, representations, explanations, methods, and standards of warrant and the continuing capacity of partially known relational reality to exceed, alter, or invalidate those epistemic-theoretical stabilizations.

Definition 6.38 identifies an organizing relation rather than a permanent law of research. Other contradictions can become principal in particular projects or phases. Institutional survival, ethical conflict, access, safety, or resource scarcity may temporarily organize research more strongly. The definition concerns the characteristic contradiction of research-dominant praxis when the activity is principally oriented toward the production and revision of warranted knowledge.

6.4.1 Limited Knowledge and Generative Reality

Research begins from an asymmetry between the reality under investigation and the knowledge presently available about it. The asymmetry is especially consequential when the target is generative. A generative relational system can alter its participants, capacities, classifications, institutions, and possibility structures through time. The object encountered later in an inquiry can therefore differ materially from the object represented at its beginning. Limited knowledge is then a condition of both incomplete access and continuing transformation.

This condition gives research its practical orientation. Inquiry is organized because what is already known is insufficient for the explanatory, descriptive, interpretive, or practical problem at hand. Dewey's account of reflective inquiry begins from problematic situations in which established habits and meanings cease to provide adequate guidance (Dewey 1910). GRE generalizes this insight cautiously. A research problem emerges when existing epistemic arrangements provide insufficient orientation toward a relational target whose relevant organization, history, or generative effects remain uncertain.

The relation between ignorance and inquiry is therefore structured. Researchers rarely confront an undifferentiated absence of knowledge. They inherit categories, prior findings, instruments, institutional archives, disciplinary expectations, and theoretical commitments. These resources make some questions observable and others difficult to formulate. Limited knowledge is consequently distributed across dimensions: the existence of a relation may be well supported while its historical formation remains uncertain; its current manifestation may be observable while its downstream generative effects remain weakly identified; its local organization may be clear while cross-scale consequences remain unresolved.

Definition 6.39 (Research-dominant epistemic tension). A *research-dominant epistemic tension* is the relation between a specified insufficiency in current knowledge and the requirement to construct sufficiently stable epistemic means for investigat-

ing a target that can remain partially accessible and generatively changing.

The definition prevents limited knowledge from becoming an abstract celebration of uncertainty. Research-dominant praxis seeks to reduce, reorganize, or more accurately locate uncertainty. It can produce stronger warrant concerning some dimensions while discovering additional uncertainty elsewhere. Progress can therefore consist in improved discrimination of what is known, how it is known, and where the current limits of warrant remain.

Generative reality intensifies the contradiction because successful inquiry can itself alter the conditions of later inquiry. New classifications can reorganize institutional practice; new instruments can reveal previously inaccessible traces; published findings can change participant behavior; theoretical innovations can redirect what later researchers regard as salient. The epistemic system develops in relation to an object that can also develop in relation to the epistemic system. Research-dominant praxis must therefore remain capable of distinguishing learning about an earlier configuration from observing a configuration transformed during the research process.

6.4.2 Representation and Relational Complexity

Research depends on representation. Relations are rendered through concepts, diagrams, narratives, datasets, classifications, equations, archival reconstructions, images, and computational objects. Representation enables portability and comparison, yet every representation selects. It foregrounds some dimensions, suppresses others, imposes boundaries, and translates heterogeneous phenomena into a tractable form. The contradiction becomes acute when relational complexity exceeds what a single representation can preserve without substantial loss.

Relational complexity can arise from multiplicity of participants, heterogeneous relation types, overlapping scales, changing boundaries, unequal visibility, temporally delayed effects, and recursive feedback. A compact representation can remain analytically useful even when it omits many of these dimensions. The epistemic problem concerns the fit between the omission and the intended claim. A representation designed to estimate aggregate association may be poorly suited to reconstructing institutional meaning; an ethnographic account rich in situated interaction may provide limited support for population-level prevalence; a network representation can preserve topology while leaving the substantive meaning of edges underdetermined.

Definition 6.40 (Representational adequacy under relational complexity). *Representational adequacy under relational complexity* is the degree to which a representation preserves the dimensions of a relational target that are materially relevant to the claim for which the representation is used, while making consequential exclusions, transformations, and uncertainties explicit.

This definition makes adequacy claim-relative. Representational completeness is neither required nor generally available. What matters is whether the representation preserves the structure needed for the inference being made. Chapter 5 developed this requirement epistemologically; research praxis makes it operational. Researchers must decide which complexity can be bracketed, which must remain visible, and when a representation requires supplementation by another representational form.

Longino's contextual empiricism emphasizes that evidential relevance depends partly on background assumptions and that critical interaction among differently positioned inquirers can expose assumptions that remain invisible within a single perspective (Longino 1990). For GRE, this supports a plural representational discipline. Multiple representations can reveal different relational dimensions, and their divergence can itself become evidence about where the target resists compression into one schema.

Claim 6.41 (Representational remainder). *When a representation is used to support a relational claim, the dimensions of the target that are intentionally excluded, transformed, or left unresolved constitute a representational remainder whose relevance should be reconsidered when the claim, scale, boundary, or practical purpose changes.*

Claim 6.41 gives the principal contradiction a practical consequence. Research requires simplification, yet simplification should retain a pathway back to what was simplified whenever later evidence makes the remainder consequential.

6.4.3 Stable Concepts and Historical Change

Conceptual stability is necessary for cumulative inquiry. Researchers need sufficiently stable terms to compare cases, preserve records, construct datasets, communicate disagreement, and identify revision. Conceptual stability also carries risk when the target changes historically. A category can remain linguistically identical while its institutional conditions, practical meaning, membership rules, or generative consequences shift.

Historical change therefore creates a tension between comparability and semantic fidelity. If concepts are revised at every local difference, longitudinal comparison becomes difficult. If concepts are held fixed despite substantial transformation, apparent continuity can be produced by the classification system itself. Hacking's historical work on categories and styles of reasoning is relevant here because it shows how objects of knowledge and classificatory practices can emerge together historically (Hacking 2002). Kuhn's analysis of scientific development likewise emphasizes that problem selection, standards, and conceptual organization are historically structured within research communities (Kuhn 1962).

GRE treats conceptual stability as a research achievement with explicit temporal scope. A concept can be stabilized for a phase of inquiry while remaining open to historically motivated revision. The relevant question concerns which dimensions must remain invariant for comparison and which dimensions can vary without destroying the analytical usefulness of the category.

Definition 6.42 (Conceptual stabilization). *Conceptual stabilization* is the provisional fixing of a concept's target, inclusion criteria, differentiating features, and inferential role for a specified research phase so that coordinated inquiry and comparison can proceed.

Proposition 6.43 (Historical revision of stabilized concepts). *A stabilized research concept should be reconsidered when evidence indicates that historical transformation has materially altered the relations, manifestations, mechanisms, or boundaries on which the concept's inferential role depends.*

The proposition does not require immediate replacement of every historically strained concept. Researchers can preserve older categories for archival continuity while introducing revised categories for current analysis. Versioned definitions, crosswalks, and explicit descriptions of semantic change allow historical comparability to coexist with conceptual revision. The principal contradiction is thereby managed through traceable transformation rather than a choice between permanent categories and continuous conceptual reinvention.

6.4.4 Theory and Counterevidence

Theory organizes research by specifying relevant objects, relations, mechanisms, expectations, and explanatory possibilities. Without theoretical stabilization, evidence can remain difficult to interpret because relevance itself is underdetermined. Yet the same theoretical organization can shield itself from counterevidence if every anomaly is reassigned to measurement error, auxiliary assumptions, exceptional cases, or future refinement.

The philosophy of science provides several important precedents for this tension. Popper makes continuing exposure to criticism central to scientific method (Popper 2002). Duhem and Quine, from different starting points, emphasize that empirical testing occurs within wider systems of assumptions, so discordant evidence does not mechanically identify which commitment requires revision (Duhem 1954; Quine 1951). These traditions jointly suggest that responsiveness to counterevidence requires judgment about where revision should occur.

GRE therefore treats counterevidence as relational. A finding counts as counterevidence relative to a specified theoretical expectation, measurement system, boundary, scale, and auxiliary structure. Its significance depends on how strongly the observation conflicts with the claim and on the credibility of the chain connecting evidence to target. Counterevidence can pressure a central proposition, expose a category failure, reveal a boundary problem, identify a missing mechanism, or indicate that the representation itself requires revision.

Definition 6.44 (Counterevidential pressure). *Counterevidential pressure* is the degree to which credible evidence strains the continued adequacy of a theoretical claim, concept, mechanism, representation, boundary specification, or auxiliary assumption within a research configuration.

Proposition 6.45 (Distributed revision under counterevidence). *Responses to counterevidence should identify the specific component or relation under pressure and compare plausible revision pathways rather than treating empirical discordance as automatically decisive for either preservation or rejection of the whole theoretical system.*

This discipline resists two symmetrical failures: insulating theory from revision and abandoning theoretical structure whenever discordant evidence appears. Research-dominant praxis requires enough stability for cumulative explanation and enough permeability for credible counterevidence to reorganize the system.

6.4.5 Formalization and Lived Complexity

Formalization can clarify assumptions, relations, constraints, and inferential consequences with a precision difficult to achieve in ordinary prose. It can reveal hidden inconsistency, support simulation, identify invariants, and permit comparison across cases. Its epistemic strength depends on the relation between the formal object and the lived or historically situated complexity that the formalization is intended to represent.

The relevant contradiction concerns tractability and preservation. Formal systems require explicit variables, domains, operators, mappings, or probability structures. Lived social and economic processes can involve tacit knowledge, ambiguous boundaries, shifting meanings, institutional memory, unequal agency, embodied experience, and historically changing categories. Formalization can preserve some of these dimensions through richer models, yet additional complexity can reduce identifiability, interpretability, or empirical estimability. Research-dominant praxis therefore requires judgment about which dimensions must enter the formal object and which can remain outside it for the present analytical purpose.

Definition 6.46 (Formalization gap). A *formalization gap* is the consequential difference between the structure represented by a formal model and the historically situated relational structure relevant to the claim for which the model is used.

A formalization gap is not automatically a defect. Every model is selective. The epistemic issue is whether the omitted or transformed dimensions alter the intended inference. A simple model can be preferable when it isolates a mechanism transparently; a richer model can be preferable when interaction, heterogeneity, or temporal structure is constitutive of the phenomenon. The appropriate degree of formalization is therefore target-relative.

The principal contradiction appears when formal elegance begins to stabilize the research object more strongly than evidence warrants. Once a model becomes technically productive, institutionally established, or pedagogically convenient, later observations can be translated into the model's categories even when the underlying relational structure has changed. Research praxis should consequently preserve a distinction between mathematical coherence, empirical adequacy, interpretive adequacy, and ontological commitment.

Remark 6.47 (Formal precision and epistemic scope). Greater formal precision strengthens conclusions conditional on the formal specification; it does not by itself expand the empirical or ontological scope for which that specification is warranted.

Remark 6.47 preserves formalism as a powerful epistemic instrument while preventing symbolic precision from becoming a substitute for relational adequacy.

6.4.6 Explanation and Emergence

Explanation seeks regularity, mechanism, dependence, interpretation, or structure sufficient to render a phenomenon intelligible. Emergence creates difficulty because a later pattern can depend on relations among components whose collective organization was not adequately represented by the explanatory vocabulary available at an earlier stage. The research problem therefore concerns how explanation can remain

cumulative while retaining sensitivity to novelty.

Emergence can be epistemic, relational, or generative. A phenomenon may appear emergent because earlier observations were incomplete; because interactions among already known components generate a higher-order organization; or because the system produces new capacities, relations, classifications, or institutional forms that alter subsequent dynamics. These cases require different explanatory responses. The first may require better access, the second a higher-order representation, and the third historical reconstruction of how new generative conditions formed.

Definition 6.48 (Emergence-sensitive explanation). An *emergence-sensitive explanation* is an explanation that specifies the level and historical conditions of its target, preserves the relations through which higher-order organization becomes possible, and remains open to revising its explanatory vocabulary when newly generated structures acquire consequential properties.

Emergence-sensitive explanation therefore avoids treating every unexpected event as evidence of a wholly new ontology. Novelty can arise from previously unobserved relations, nonlinear interaction, boundary change, institutional recombination, or path-dependent development. The explanatory task is to discriminate among these possibilities.

This task returns research to the principal contradiction. Explanation requires temporary closure around a mechanism or structure, while emergence can reopen what appeared settled. A research programme capable of learning from emergence preserves records of earlier explanatory commitments and makes visible the point at which a new phenomenon exceeds them. The transition itself becomes part of the object of inquiry.

6.4.7 Existing Methods and New Objects

Methods are historically developed instruments of inquiry. They carry assumptions about what can be observed, compared, measured, interpreted, sampled, modeled, and treated as evidence. New research objects can strain those assumptions. Machine-mediated social relations, novel institutional forms, rapidly changing classifications, cross-scale ecological-economic processes, and heterogeneous human–AI systems can generate targets that inherited methods capture only partially.

The tension is not resolved by novelty alone. A new object does not automatically require a new method. Existing methods can often be adapted, combined, or reinterpreted. Methodological innovation becomes warranted when the object's materially relevant properties systematically escape the observational, representational, inferential, temporal, or ethical capacities of the current methodological repertoire.

Definition 6.49 (Method–object adequacy). *Method–object adequacy* is the degree to which a method or coordinated set of methods can produce evidence and representations appropriate to the materially relevant properties of a specified research object and intended claim.

Claim 6.50 (Methodological pressure from new objects). *A new or transformed research object creates methodological pressure when its relevant relational properties repeatedly generate evidential or inferential failures that cannot be adequately addressed*

through ordinary adaptation of existing methods.

The claim makes methodological innovation evidence-sensitive. Researchers should identify where existing methods fail: inaccessible temporal dynamics, category instability, distributed agency, cross-scale dependencies, reflexive feedback, provenance loss, or inability to represent heterogeneous relations. The next methodological response can then be proportionate to the failure rather than motivated by novelty for its own sake.

Research institutions also influence method–object adequacy. Funding schedules, disciplinary review, publication formats, data infrastructures, and training systems can stabilize methods long after their original objects have changed. Bourdieu and Wacquant’s emphasis on reflexive analysis of scientific fields is relevant because methodological choices are made within institutions structured by positions, resources, and inherited dispositions (Bourdieu and Wacquant 1992). The principal contradiction of research-dominant praxis therefore includes the relation between epistemic innovation and institutional reproduction.

6.4.8 Theoretical Closure and Revisability

Research requires closure at multiple levels. A dataset must eventually be frozen for analysis; a manuscript must be submitted; a model version must be specified; a conclusion must be stated strongly enough to be criticized and used. Closure is therefore part of research praxis rather than a failure of openness. The problem concerns the conditions under which provisional closure remains compatible with later revision.

Premature closure can suppress counterevidence, alternative explanations, category instability, or unresolved uncertainty. Perpetual deferral can make research unusable because no claim becomes stable enough for comparison, replication, critique, teaching, or application. The principal contradiction appears as a practical problem of timing and scope: when is the epistemic-theoretical system sufficiently stabilized for the current purpose, and what must remain recoverable for later revision?

Definition 6.51 (Theoretical closure threshold). A *theoretical closure threshold* is the project-relative level of evidential support, conceptual stability, explanatory adequacy, and uncertainty disclosure judged sufficient to stabilize a theoretical claim or model for a specified research purpose and phase.

Closure thresholds should be explicit enough to make disagreement possible. Exploratory research can tolerate greater uncertainty than a claim intended to guide high-stakes intervention. A conceptual proposal can be stabilized with different evidential expectations from an empirical estimate. The relevant threshold is therefore indexed to claim type, purpose, consequence, and available alternatives.

Popper’s emphasis on exposure to criticism remains useful as a discipline against self-sealing theory (Popper 2002). GRE extends revisability beyond falsification narrowly conceived. Revision can arise from counterevidence, historical transformation, category failure, representational inadequacy, observer effects, ethical challenge, or emergence of new objects. A theoretically mature research practice therefore preserves the provenance of closure: why a conclusion was stabilized, which alterna-

tives were considered, which uncertainties remained, and what kinds of future evidence would warrant reopening the claim.

Proposition 6.52 (Revisable closure). *Theoretical closure supports cumulative research when the stabilized claim is sufficiently explicit for use and criticism while the evidential, conceptual, methodological, and historical conditions of its stabilization remain recoverable for subsequent revision.*

6.4.9 Research as Transformation of the Epistemic-Theoretical System

The preceding contradictions converge on a broader conception of research. Research-dominant praxis does more than add propositions to an existing stock of knowledge. It can transform the system through which future knowledge becomes possible. New concepts alter what can be distinguished; new instruments alter what can be observed; new methods alter what can count as evidence; new theories alter what can be explained; new archives alter what can be reconstructed; and new standards of criticism alter what can remain stabilized.

This transformation can be cumulative, corrective, or reorganizing. Some research extends an existing representation without revising its architecture. Other work changes category boundaries, introduces new relations, displaces an explanatory mechanism, links previously separate scales, or reconstructs the historical object itself. Kuhn's account of scientific revolutions provides one influential model of large-scale reorganization in scientific practice (Kuhn 1962). GRE does not require research change to follow a single revolutionary pattern. Epistemic-theoretical transformation can also occur incrementally through repeated local revisions whose cumulative consequences alter the research field.

Definition 6.53 (Epistemic-theoretical system). *An epistemic-theoretical system is the historically situated configuration of concepts, representations, evidential standards, methods, inferential practices, theoretical commitments, infrastructures, and institutional routines through which a research community renders objects knowable and claims assessable.*

Definition 6.54 (Epistemic-theoretical transformation). *Epistemic-theoretical transformation is a change in one or more components or relations of an epistemic-theoretical system that materially alters the conditions under which later research objects can be represented, investigated, explained, criticized, or revised.*

This conception clarifies why the principal contradiction is generative. The tension between stabilization and exceedance does not merely obstruct research. Responses to it can generate new research capacities. Counterevidence can produce revised concepts; representational failure can produce new instruments; emergent phenomena can produce new explanatory levels; historically transformed objects can produce new comparison strategies; and method-object mismatch can produce methodological innovation.

Proposition 6.55 (Generative research transformation). *Research-dominant praxis becomes generatively transformative when responses to epistemic contradiction alter the capacities, relations, representations, methods, or standards through which subsequent inquiry is organized.*

Proposition 6.55 also marks the transition toward the next section. Research-dominant praxis is principally organized around transforming the epistemic-theoretical conditions of knowing, whereas application-dominant praxis is more directly organized around transforming a practical-relational situation under incomplete knowledge. Both remain forms of praxis, and both contain knowing and action. Their characteristic contradictions differ in the point at which provisional closure is demanded and in the object that the praxis is principally oriented toward transforming.

6.5 The Principal Contradiction of Application-Dominant Praxis

This section specifies the contradiction that most characteristically organizes application-dominant praxis. Its role is to complement the research-dominant contradiction developed in Section 6.4 by examining situations in which practical orientation requires a decision, intervention, institutional response, or deliberate restraint before relevant knowledge can be completed. The objective is to explain how application proceeds when uncertainty, plural values, systemic interdependence, temporal pressure, and potentially irreversible consequences remain active. The section develops nine dimensions of this contradiction: necessity of action, decision under uncertainty, unintended consequences, plural values, urgency, systemic effects, reversibility, learning through action, and transformation of the practical-relational world. The method is relational and generative. Application is treated as an intervention into a field whose relations can respond to the intervention and thereby alter both later possibilities and the conditions of subsequent knowledge.

Application-dominant praxis differs from research-dominant praxis principally in its provisional point of closure. Research can often continue gathering evidence, revising representation, and refining explanation before a claim is stabilized for a particular purpose. Application frequently encounters a time at which a choice must acquire practical form even though evidence remains incomplete. The relevant choice may concern implementation, allocation, treatment, regulation, organizational design, public communication, infrastructure, protection, or the decision to preserve current arrangements. Each option enters a relational system whose responses cannot be known exhaustively in advance.

Definition 6.56 (Principal contradiction of application-dominant praxis). The *principal contradiction of application-dominant praxis* is the historically situated tension between the practical requirement to orient action within finite time and institutional conditions and the persistence of incomplete knowledge, uncertain consequences, plural values, and generative system responses at the point of decision and intervention.

Definition 6.56 identifies a characteristic organizing tension rather than a universal description of every applied activity. Some practical situations are highly standardized and well understood; others are dominated by legal authority, emergency survival, resource scarcity, or conflict among institutional mandates. The definition applies most strongly when action is consequential, knowledge remains materially

incomplete, and the intervention can reorganize later relations or possibility structures.

6.5.1 Necessity of Action and Incomplete Knowledge

Application-dominant praxis begins from a practical asymmetry. The actor may know that available knowledge is incomplete while also knowing that delay, omission, continuation of the status quo, or refusal to choose can have consequences. The practical field therefore contains more than the contrast between action and inaction. Delay and non-intervention can themselves preserve, redistribute, or intensify existing relational processes.

Chapter 5 developed incomplete knowledge as an epistemic condition. Application converts that condition into a problem of orientation. The operative question concerns what level and kind of warrant are sufficient for a specified intervention under the consequences of both action and delay. Manski's work on identification and decision emphasizes the importance of separating what evidence identifies from what follows only after stronger assumptions are introduced (Manski 2008). Application-dominant praxis extends this discipline into the decision environment: assumptions can be practically necessary, yet their epistemic status should remain visible when they support consequential action.

Definition 6.57 (Practical closure under incomplete knowledge). *Practical closure under incomplete knowledge* is the provisional stabilization of a course of action, restraint, or decision rule at a point where relevant uncertainty remains, because the practical field imposes a finite horizon for orientation.

Practical closure is therefore different from epistemic completion. A decision can be justified for a specified horizon while important uncertainties remain unresolved. The quality of praxis depends partly on whether these residual uncertainties are retained as conditions for monitoring and revision. A decision that suppresses its own uncertainty can harden provisional assumptions into institutional facts, while a decision that records uncertainty can preserve pathways for later correction.

The necessity of action also has a distributional structure. Some actors bear the consequences of delay more strongly than others, and some possess greater capacity to wait for additional evidence. A demand for more knowledge can therefore function differently across positions. Epistemic restraint remains important, yet prolonged inquiry can itself redistribute risk when the costs of waiting are unequal. Application-dominant praxis must consequently relate evidential incompleteness to the temporal and relational distribution of consequences.

6.5.2 Decision and Uncertainty

Decision transforms uncertainty from a descriptive feature of knowledge into a practical condition of selection. An actor must compare possible courses whose consequences are only partially specified, whose probabilities may be uncertain, and whose relevant outcomes can be heterogeneous. The decision problem is therefore rarely reducible to choosing the numerically largest expected quantity. Some consequences resist commensuration, some probabilities are poorly identified, and

some possibilities remain outside the current representation.

The epistemic confidence profiles developed in Chapter 5 provide a useful basis for application. Confidence concerning the existence of a relation can differ from confidence concerning its causal contribution, future persistence, cross-scale portability, or response to intervention. A practical decision should therefore inherit the multi-dimensional structure of epistemic uncertainty rather than compress it prematurely into a single certainty score.

Definition 6.58 (Decision-relevant uncertainty profile). A *decision-relevant uncertainty profile* records the dimensions of uncertainty that materially affect the comparison, implementation, monitoring, or revision of candidate courses of action within a specified practical horizon.

The profile is selective. It does not require representation of every conceivable unknown. Its purpose is to preserve uncertainties capable of changing the practical ranking, safety, reversibility, distributional consequence, or monitoring requirement of an intervention. This discipline also prevents false precision. Quantification can be useful when probabilities and outcomes are supportable, while qualitative or scenario-based representation may be more adequate when the structure of uncertainty remains only partially identified.

Decision also involves judgment. Aristotle's treatment of practical wisdom and Dewey's pragmatist account of inquiry both place practical reasoning within situations whose particulars matter and whose consequences become known through experience (Aristotle 2014; Dewey 1910). GRE draws a narrower methodological implication: application requires context-sensitive judgment concerning which uncertainties are decision-relevant, how they should constrain action, and which conditions should trigger reassessment.

Proposition 6.59 (Uncertainty-preserving practical judgment). *When materially decision-relevant uncertainty persists at the point of practical closure, application-dominant praxis should preserve that uncertainty in the design of implementation, monitoring, and revision rather than treating closure as evidence that uncertainty has disappeared.*

Proposition 6.59 links decision to later learning. It converts uncertainty from a residual weakness into a design condition for practical adaptation.

6.5.3 Intervention and Unintended Consequences

Intervention changes the relational field in which its consequences unfold. The intervention can alter incentives, expectations, classifications, resource distributions, institutional routines, visibility, strategic behavior, and the capacities of affected actors. Some effects therefore arise through pathways that were absent or negligible before implementation. Application cannot infer all consequences by extrapolating from the pre-intervention state.

The causal problem is especially important in generative systems. An intervention can initiate chains whose later effects depend on responses, adaptations, feedback, and interactions among multiple relations. Woodward's interventionist framework emphasizes the value of asking how outcomes would change under specified

interventions (Woodward 2003). GRE retains that logic while adding a practical caution: real interventions can transform the mechanism structure itself, so the post-intervention system may no longer satisfy all relations inferred from prior observations.

Definition 6.60 (Intervention-generated consequence). An *intervention-generated consequence* is a change whose occurrence depends materially on relational responses, adaptations, or feedback activated or reorganized by an intervention, including consequences that were weakly represented or absent from the initial intervention model.

Unintended consequences vary in epistemic status. Some are genuinely difficult to anticipate because they emerge through novel combinations or long feedback chains. Others were foreseeable but excluded by a narrow boundary, weak representation, institutional incentives, or unequal authority over what counted as relevant evidence. The practical response should therefore distinguish surprise generated by system complexity from surprise generated by avoidable epistemic omission.

Monitoring is one response, although monitoring alone cannot guarantee correction. Indicators can lag behind harm, categories can miss affected relations, and institutions can resist revision after resources and reputations become committed. Application-dominant praxis therefore benefits from pre-specified channels for detecting weak signals, receiving situated evidence, and revising the intervention before consequences become deeply stabilized.

6.5.4 Normative Commitment and Plural Values

Application is oriented toward some conception of what should be protected, changed, expanded, reduced, or preserved. Even technically framed interventions embed value judgments through target selection, outcome definition, weighting, eligibility rules, acceptable risk, time horizon, and the distribution of burdens. Application-dominant praxis therefore contains a normative dimension that cannot be delegated entirely to empirical evidence.

Plural values complicate practical orientation because relevant goods can be heterogeneous and only partially commensurable. Welfare, autonomy, capability, security, ecological integrity, procedural fairness, recognition, care, cultural continuity, and future possibility can conflict within the same intervention. Sen's work emphasizes the informational limitations of narrow evaluative spaces and the importance of capabilities and substantive freedoms in assessing social arrangements (Sen 1987; Sen 1999). Rawls similarly locates justice in the basic structure and institutional terms of cooperation rather than reducing evaluation to aggregate outcome alone (Rawls 1999). GRE does not treat either framework as exhaustive. Their relevance here is to demonstrate that practical evaluation can require multiple normative dimensions and institutional considerations.

Definition 6.61 (Normative configuration of application). The *normative configuration of application* is the explicit or implicit arrangement of values, priorities, rights, duties, acceptable risks, and distributional concerns through which a practical intervention is oriented and evaluated.

Making the normative configuration visible serves two functions. First, it separates empirical disagreement from disagreement about values or priorities. Second, it makes revision more disciplined: new evidence can alter beliefs about likely consequences without automatically settling how heterogeneous consequences should be valued.

Plurality also concerns whose values acquire practical authority. Institutional decision procedures can privilege professional, administrative, market, legal, or political valuations while marginalizing situated forms of knowledge and concern. The epistemic-justice analysis developed in Chapter 5 therefore has a practical extension. Inclusion in decision processes does not determine the correct outcome, but it can alter which effects become visible, which trade-offs are recognized, and which forms of loss receive representational standing.

6.5.5 Urgency and Epistemic Restraint

Urgency changes the feasible relation between inquiry and action. Time for evidence gathering, consultation, modelling, deliberation, and institutional coordination can contract while the consequences of error remain substantial. Application-dominant praxis must then establish forms of practical closure that preserve proportionate epistemic restraint within a compressed horizon.

Urgency has several sources. Physical hazards, rapidly compounding social harm, financial instability, ecological thresholds, legal deadlines, humanitarian need, or organizational breakdown can narrow the period available for decision. Institutional actors can also produce urgency rhetorically, using claims of emergency to reduce scrutiny or participation. Praxis therefore requires both temporal sensitivity and examination of how the time constraint itself was constituted.

Definition 6.62 (Urgency-adjusted epistemic restraint). *Urgency-adjusted epistemic restraint* is the calibration of claim strength, intervention scope, reversibility, monitoring, and review to the evidential limitations that remain under a constrained decision horizon.

This calibration allows urgent action without requiring rhetorical certainty. A provisional intervention can be strong in implementation while modest in epistemic claim, provided its mandate, duration, uncertainty, and review conditions remain explicit. Conversely, urgency can justify rapid action in one dimension while leaving broader structural transformation for a later phase in which evidence and participation can expand.

A useful practical principle is proportionality between epistemic uncertainty and commitment structure. When uncertainty is substantial, modular, staged, geographically limited, time-bounded, or otherwise revisable interventions can preserve learning capacity where circumstances permit. High-certainty language should not be manufactured merely to support institutional decisiveness.

6.5.6 Local Action and Systemic Effects

Application usually occurs through bounded sites: an organization changes a rule, a municipality redesigns a service, a regulator changes a requirement, a community re-

organizes access, or a project reallocates resources. The effects of these local actions can propagate across scales through markets, institutions, infrastructures, ecological relations, symbolic classifications, imitation, displacement, or strategic response.

The boundary and scale analysis of Chapter 5 therefore becomes a practical requirement. An intervention can succeed according to a local metric while shifting costs or constraints beyond the boundary of evaluation. It can also produce benefits at one scale while weakening conditions at another. Polycentric and institutional analyses associated with Ostrom demonstrate the importance of considering multiple centers of decision and nested institutional arrangements in complex governance problems (Ostrom 2005; Ostrom 2010). GRE extends this insight to application more generally: local interventions should be assessed for cross-boundary and cross-scale relations that materially affect the target.

Definition 6.63 (Systemic spillover of application). A *systemic spillover of application* is a materially relevant effect that propagates beyond the primary intervention boundary or scale through relational pathways connecting the intervention site to other actors, institutions, environments, or temporal horizons.

Systemic analysis does not require total system knowledge. Such a requirement would reproduce the contradiction by making action impossible whenever the field is complex. The practical task is to identify plausible pathways through which local success can coexist with displaced harm, delayed cost, institutional substitution, or cross-scale amplification.

This also changes evaluation. Outcome assessment should ask whether a favorable local result depended on externalizing constraints elsewhere. A program that improves measured performance by transferring difficult cases, a regulation that reduces one visible risk while shifting production into weakly observed jurisdictions, or an infrastructure project that improves present access while degrading future ecological capacity can appear successful under a narrow boundary. Systemic effects therefore reconnect application to the boundary discipline developed in Chapter 5.

6.5.7 Reversibility and Irreversibility

The consequences of application differ in reversibility. Some interventions can be withdrawn with limited residual effect; others reshape infrastructures, legal statuses, ecological stocks, institutional expectations, skills, dependencies, or technological pathways in ways that persist after formal reversal. The degree of reversibility therefore affects the burden of justification and the design of experimentation.

Economic history provides familiar cases in which early technical or institutional choices can become difficult to reverse because later investments and complementarities accumulate around them (David 1985). Ecological-economic reasoning likewise emphasizes material processes whose consequences can be thermodynamically or ecologically irreversible over relevant human horizons (Georgescu-Roegen 1971). GRE uses these examples as distinct mechanisms rather than a general claim that all application is path dependent or physically irreversible.

Definition 6.64 (Practical reversibility profile). A *practical reversibility profile* specifies which components and consequences of an intervention can plausibly be with-

drawn, repaired, compensated, or redirected within relevant temporal and institutional horizons, and which can persist through residual relations or path-forming effects.

Reversibility should be evaluated relationally. A formally reversible rule may create investments, dependencies, expectations, or classifications that remain after repeal. A pilot project may be administratively temporary while producing irreversible disclosure of personal information. A physical intervention may be technically removable while its ecological or distributive effects persist. The practical profile therefore includes residual effects, exit costs, lock-in mechanisms, and the distribution of capacity to recover.

Proposition 6.65 (Irreversibility-sensitive burden). *As plausible consequences become more difficult to reverse within the relevant horizon, the practical burden on prior justification, monitoring design, affected-party representation, and contingency planning generally increases.*

Proposition 6.65 is a design principle rather than a mechanical decision rule. Severe urgency can still require action with limited reversibility. The proposition indicates which aspects of practical scrutiny become more consequential when correction after implementation is structurally difficult.

6.5.8 Learning through Action

Action can generate knowledge unavailable before intervention. Implementation reveals operational constraints, behavioral responses, institutional frictions, unanticipated relations, and forms of situated knowledge that remain latent in planning documents. Dewey's pragmatism treats inquiry as an iterative transformation of problematic situations in which consequences inform subsequent judgment (Dewey 1910; Dewey 1939). Application-dominant praxis therefore contains an epistemic potential: intervention can become a source of evidence for later revision.

Learning through action requires more than observing outcomes. The intervention, context, assumptions, implementation variation, and changes in surrounding relations must be documented sufficiently to distinguish learning from retrospective storytelling. Unexpected success is as epistemically important as unexpected failure when the operative mechanism differs from the one originally assumed.

Definition 6.66 (Application-generated learning). *Application-generated learning is the revision of practical or epistemic understanding through evidence produced by the implementation, reception, consequences, and relational adaptation associated with an intervention.*

This learning can concern several objects: the target relation, implementation capacity, institutional constraints, stakeholder interpretation, mechanism viability, side effects, boundary conditions, or the adequacy of the original normative configuration. The knowledge generated by action can therefore transform both later application and research-dominant praxis.

Application-generated learning also depends on institutional memory. When failures are concealed, negative results disappear, implementation records are destroyed, or evaluation criteria are changed without provenance, action can generate

experience without generating cumulative knowledge. Preservation and revision infrastructures are therefore part of practical design rather than administrative afterthoughts.

The possibility of learning should not be used to excuse avoidable harm. Experimentation acquires stronger ethical and epistemic obligations as potential consequences become severe or irreversible. Learning through action is most defensible when uncertainty is explicit, exposure is proportionate, monitoring is capable of detecting relevant effects, and revision or exit remains feasible where the context permits.

6.5.9 Application as Transformation of the Practical-Relational World

Application-dominant praxis ultimately differs from a purely representational activity because it intentionally participates in the transformation of the practical-relational world. Decisions allocate resources, authorize actions, establish categories, alter rights, configure infrastructures, change incentives, produce expectations, and reshape the capacities through which later action becomes possible. Application therefore modifies the field within which its own future evaluation will occur.

Definition 6.67 (Practical-relational transformation). A *practical-relational transformation* is a change in relations, capacities, institutions, constraints, distributions, representations, or possibility structures generated in part through application-dominant praxis and materially relevant to subsequent practical activity.

The definition captures both intended and unintended transformation. A policy can alter institutional expectations even when its target outcome is not achieved. A technology can reorganize work relations independently of its measured productivity effect. A legal intervention can change the categories through which later claims become recognizable. A failed program can generate organizations, data infrastructures, or political commitments that continue after the program ends. Evaluation therefore extends beyond whether the immediate objective was reached.

This generative perspective clarifies the principal contradiction of application-dominant praxis. Action cannot wait for complete knowledge because complete knowledge is unavailable and the practical field continues to evolve. At the same time, action can alter the very relations whose incompleteness made the decision difficult. Application consequently operates through provisional closure in a field that is partly transformed by the closure itself.

Proposition 6.68 (Generative recursion of application). *When an intervention changes the relations, capacities, institutions, or possibility structures that condition later decisions, application-dominant praxis becomes recursively generative: the consequences of one practical closure partly constitute the field of subsequent practical closure.*

Proposition 6.68 gives the section its connection to the wider architecture of GRE. Application is simultaneously oriented by inherited relations and capable of reorganizing those relations. The central practical task is therefore neither the elimination of uncertainty nor the achievement of perfect control. It is the construction of forms of action whose scope, commitments, monitoring, reversibility, and revision remain

adequate to the incompleteness and generativity of the field in which they operate.

The research-dominant contradiction in Section 6.4 and the application-dominant contradiction developed here are analytically distinct, yet practical activity frequently moves between them. Research produces representations that orient action; action generates evidence that reorganizes research; institutional interventions transform the objects later studied; and revised knowledge redirects subsequent application. Section 139 develops this coupling explicitly.

6.6 Coupling between Research and Application

Sections 6.4 and 6.5 distinguished the characteristic contradictions of research-dominant and application-dominant praxis. The present section examines the relations through which these modes become coupled. Its role is to prevent their analytical distinction from becoming an image of practical separation. The objective is to specify how research can orient action, how action can generate evidence, how intervention can become a site of inquiry, and how knowledge, theory, institutions, and practical possibilities can transform one another through repeated movement between praxis modes. The section develops nine dimensions of this coupling: research-informed action, action-generated evidence, intervention as inquiry, practice-induced theory revision, research-generated action possibilities, institutional change as an epistemic event, co-evolution of knowledge and practice, co-evolution of theory and institution, and recursive movement between praxis modes. The method is relational and generative. Research and application are treated as distinguishable practical orientations whose outputs can become conditions, inputs, constraints, and objects of one another.

The coupling is therefore stronger than a linear model in which research first discovers truth and application subsequently implements it. Research may alter the categories through which a practical problem is recognized; intervention may produce evidence unavailable before action; institutions may change in response to research and thereby alter the phenomena later investigated; and practical failure may expose theoretical assumptions that were difficult to identify within research alone. The relation is also weaker than an identification of research with application. Distinctive epistemic, ethical, institutional, and practical responsibilities remain. Coupling concerns structured interaction across praxis modes rather than their collapse into one activity.

Definition 6.69 (Research–application coupling). *Research–application coupling* is the historically situated set of relations through which research-dominant and application-dominant praxis condition, inform, generate evidence for, transform, or redirect one another while retaining analytically distinguishable orientations and standards of provisional closure.

Definition 6.69 makes the degree and form of coupling an empirical and institutional question. Some domains maintain long intervals between research and intervention; others place inquiry and action in continuing contact. Coupling can be productive, weak, asymmetric, coercive, or distorted. A strong practical link does not by itself establish epistemic quality, and high-quality research does not by itself deter-

mine what should be done. The relevant question is how movement across the two modes is organized and what each movement generates.

6.6.1 Research-Informed Action

Research can orient application by changing what actors know, which relations they regard as salient, which consequences they anticipate, and which alternatives they consider feasible. This influence is broader than the direct transfer of a finding into a decision rule. Historical reconstruction can alter the interpretation of an institutional problem; qualitative inquiry can reveal meanings or dependencies omitted from administrative categories; formal models can clarify conditional consequences; and quantitative evidence can narrow uncertainty concerning prevalence, association, or causal contribution. Research-informed action therefore begins with translation from an epistemic object into a practical configuration.

The translation is selective. A research claim is ordinarily produced under a specified boundary, scale, population, historical period, representation, and uncertainty profile. Application introduces additional conditions: legal authority, time, resources, organizational capability, affected interests, plural values, reversibility, and systemic spillovers. The practical relevance of a finding consequently depends on how these conditions relate to those under which the finding was warranted. A result can be epistemically strong within its research domain while remaining weakly portable to a different practical field.

Definition 6.70 (Research-informed action). *Research-informed action* is application-dominant praxis whose orientation, design, monitoring, or revision is materially conditioned by warranted research claims together with an explicit practical translation across relevant boundaries, scales, values, and institutional conditions.

The phrase *research-informed* is deliberately narrower than research-determined. Research can constrain a practical claim, rule out some explanations, expose uncertainty, or identify plausible mechanisms without selecting a unique action. Practical orientation also contains normative and institutional judgments that cannot be derived from empirical evidence alone. Dewey's account of inquiry is useful here because it treats judgment as situated within problematic conditions rather than as mechanical deduction from antecedent propositions (Dewey 1910). GRE retains the distinction between evidence and practical judgment while emphasizing their relational dependence.

Proposition 6.71 (Practical translation requirement). *When a research claim is used to orient application beyond the conditions under which it was warranted, the practical use of that claim should specify the material differences in boundary, scale, population, historical setting, institutional capacity, and decision horizon that can alter its relevance.*

Proposition 6.71 makes translation part of responsible coupling. It also limits a common failure mode in which an evidential conclusion is rhetorically converted into a practical imperative without showing how the relation between research context and application context has been established.

6.6.2 Action-Generated Evidence

Application can generate evidence because intervention reveals responses, constraints, adaptations, and dependencies that remain latent under observation of the pre-intervention configuration. A policy can expose administrative bottlenecks; a new organizational rule can reveal previously hidden coordination relations; an infrastructure change can alter patterns of access; and a pilot intervention can reveal how actors adapt when an assumed condition is changed. Action therefore can produce traces whose evidential significance did not exist before the practical change.

This does not mean that consequences of action are automatically interpretable. The action changes the field from which evidence is drawn. Observed outcomes can reflect implementation differences, anticipation, strategic response, concurrent events, selection into participation, or changes in measurement. Woodward's interventionist account of causal explanation illustrates why interventions can be evidentially powerful while also requiring careful specification of what has been changed and what remains stable (Woodward 2003). In GRE, the same discipline extends to relational and generative claims: an intervention can reveal a dependency while simultaneously reorganizing other parts of the relational system.

Definition 6.72 (Action-generated evidence). *Action-generated evidence* is evidence whose availability, form, or discriminating power arises materially from a practical intervention, implementation process, institutional response, or deliberately maintained restraint within the relational field under investigation.

Action-generated evidence is therefore historically indexed to the intervention that produced it. Its interpretation should preserve what the system was before action, what was altered, how implementation occurred, which actors were affected, and what subsequent adaptations followed. The evidence can support learning about an earlier configuration, a transformed configuration, or the transition between them; these targets should remain distinct.

Claim 6.73 (Intervention-indexed evidence). *Evidence generated through application should be indexed to the intervention and implementation conditions that made it observable, because the same trace can support different inferences about the pre-intervention system, the transformed system, and the process connecting them.*

Claim 6.73 connects application-generated learning in Section 6.5 to research praxis. The practical field can become a source of new knowledge without being reduced to an experiment and without assuming that every intervention was designed for epistemic purposes.

6.6.3 Intervention as Inquiry

Some interventions are organized partly to learn. A pilot programme, staged institutional change, adaptive implementation, field experiment, prototype, or reversible organizational modification can be designed so that action both addresses a practical problem and produces evidence about the relations that organize it. In such cases, intervention occupies a hybrid position between praxis modes. Its immediate orientation includes practical transformation, while its design also preserves an epistemic

question.

Dewey's broader pragmatist conception of inquiry emphasizes the transformation of problematic situations through operations whose consequences contribute to later judgment (Dewey 1910; Dewey 1925). GRE draws a limited methodological implication from this lineage. Intervention can function as inquiry when it is structured to discriminate among relational or generative explanations, when relevant changes and observations are documented, and when the practical consequences of the intervention remain ethically and institutionally accountable.

Definition 6.74 (Intervention as inquiry). An *intervention as inquiry* is a practical transformation whose design includes an explicit epistemic target, a specified relation between intervention and expected evidence, procedures for observing relevant responses, and conditions for revising the interpretation or the intervention itself.

The definition excludes the retrospective relabeling of any action as research merely because something was learned from it. Learning is common after action; inquiry requires a more explicit architecture of question, intervention, observation, interpretation, and revision. Ethical constraints also remain. An intervention cannot acquire legitimacy merely by promising knowledge. Exposure to risk, consent, authority, distribution of consequences, and reversibility remain practical and normative considerations independent of epistemic value.

Intervention as inquiry is particularly useful when relevant relations are activated only under changed conditions. Institutional resilience, strategic adaptation, coordination capacity, and latent dependencies may become visible when the field is perturbed. Yet the inference remains local to the intervention and its context. A response to one perturbation need not reveal how the system would respond to another. The epistemic advantage lies in disciplined access to otherwise difficult relations, not in unrestricted generalization.

6.6.4 Practice-Induced Theory Revision

Practical activity can expose theoretical insufficiency. A theory may describe observed regularities adequately while failing when actors respond strategically to implementation, when institutional rules change, when neglected values become practically consequential, or when an intervention reveals a relation absent from the original representation. Practical failure can therefore function as counterevidence, but practical success can also create pressure for revision when success occurs through mechanisms different from those anticipated by the theory.

The relevant object of revision may be a substantive claim, an auxiliary assumption, a boundary condition, a classification, a mechanism, or the theory's account of how its concepts map onto institutional practice. Longino's analysis of the role of background assumptions in evidential reasoning is relevant because disagreement between expectation and observation can reveal assumptions that remained tacit within an accepted explanatory framework (Longino 1990). Application adds a distinctive source of pressure: background assumptions can become operationalized and encounter consequences in a transformed field.

Definition 6.75 (Practical counterevidence). *Practical counterevidence* is evidence

generated in or through application that materially weakens a theoretical claim, mechanism, boundary condition, classification, or transfer assumption relative to the practical configuration in which it was used.

Practical counterevidence should not be interpreted mechanically. A failed intervention can result from implementation failure rather than theoretical failure; a successful intervention can result from compensating mechanisms; and practical outcomes can be judged differently under different value configurations. Revision therefore requires reconstruction of the pathway linking theory, intervention design, implementation, and outcome.

Proposition 6.76 (Practice-sensitive theoretical revision). *When practical outcomes diverge materially from theoretically informed expectations, revision should identify whether the divergence concerns the theory, its boundary conditions, the translation into application, the implementation process, or a transformation of the relational field itself.*

This proposition protects both theory and practice from premature attribution. The practical field can correct theory, while theory can also reveal that an apparent implementation failure arose because the intervention did not instantiate the conditions it was intended to test or realize.

6.6.5 Research-Generated Action Possibilities

Research does more than evaluate an existing menu of actions. It can generate new possibilities for action by making relations visible, creating classifications, inventing instruments, reconstructing histories, formalizing previously diffuse constraints, or identifying mechanisms through which intervention becomes conceivable. A practical possibility can therefore be generated epistemically before it becomes institutionally available.

The process is visible when a newly identified category makes a population administratively recognizable, when a measurement infrastructure allows a condition to be monitored, when a causal mechanism suggests a different intervention point, or when historical research reveals that an apparently fixed institution has changed before and can therefore be imagined otherwise. Hacking's analysis of historically constituted categories and objects provides one precedent for treating classification as active within the worlds it describes (Hacking 2002). MacKenzie's study of financial models similarly shows that representations can become incorporated into practice and contribute to reshaping the domain represented (MacKenzie 2006). GRE generalizes this possibility cautiously without assuming that every research representation is performative.

Definition 6.77 (Research-generated action possibility). *A research-generated action possibility is a practically relevant course of action, intervention point, institutional arrangement, monitoring capacity, or form of coordination that becomes materially conceivable or feasible through knowledge, representations, instruments, classifications, or infrastructures produced in research praxis.*

This generativity has epistemic and political consequences. Research can expand possibility structures by revealing alternatives, but it can also narrow them by sta-

bilizing a problem representation around a limited set of measurable variables or institutionally familiar interventions. The design of research can thus condition the practical imagination of later actors even before a specific recommendation is made.

Remark 6.78 (Possibility generation and recommendation). Generating an action possibility is distinct from recommending it. Research can make an intervention intelligible or feasible while leaving its normative desirability, distributional effects, institutional legitimacy, and comparative practical value unresolved.

The distinction in Remark 6.78 preserves the separation between epistemic generativity and normative judgment established throughout the book.

6.6.6 Institutional Change as Epistemic Event

Institutions organize action, but they also organize what can be known. Rules determine which transactions are recorded, which identities receive official recognition, which decisions require documentation, who can access archives, what counts as a reportable event, and which categories acquire administrative continuity. Institutional change can therefore be an epistemic event because it changes both the practical relations under study and the infrastructures through which those relations become observable.

North treats institutions as humanly devised constraints that structure interaction and change through time (North 1990). Ostrom's institutional analysis similarly emphasizes rules, action arenas, participants, and the diverse institutional arrangements through which interaction is organized (Ostrom 2005). GRE adds an epistemic emphasis: when these arrangements change, the relation between reality, manifestation, trace, and representation can also change. A newly required record may create evidence where earlier practice left few traces; a changed eligibility rule can alter the population represented by an administrative category; a decentralized institution can redistribute both decision authority and observational access.

Definition 6.79 (Institutional epistemic event). An *institutional epistemic event* is an institutional change that materially alters the production, accessibility, classification, preservation, interpretation, or practical relevance of evidence concerning the relational field.

The definition does not imply that institutional change is reducible to epistemic change. Institutions also distribute resources, authority, rights, obligations, risks, and capacities. The epistemic event is one dimension of a broader transformation. It matters because comparisons across an institutional transition can otherwise confuse changes in the underlying relation with changes in how the relation becomes legible.

Institutional change can therefore require re-epistemization. A time series may contain a break because a category changed; testimony may acquire new strategic incentives after a rule change; previously hidden relations may become formally recognized; or old records may become newly interpretable because later institutional developments reveal their significance. Coupling between research and application is especially dense at such moments because the practical transformation changes both the object of inquiry and the conditions of future inquiry.

6.6.7 Co-Evolution of Knowledge and Practice

Repeated coupling can produce co-evolution rather than a sequence of isolated feedback events. Knowledge changes practice; practice generates evidence; evidence reorganizes knowledge; and revised knowledge conditions the next practical intervention. Over longer periods, neither side can be adequately reconstructed as an independent trajectory. Their histories become partially interdependent.

The term *co-evolution* is used here in a restrained sense. Nelson's analysis of technology, industrial structure, and supporting institutions provides an economic precedent for studying reciprocal development among distinct but interacting domains rather than attributing change to a single direction of causation (Nelson 1994). GRE applies a similar relational discipline to knowledge and practice. The claim is not that all knowledge develops through application or that all practice is research-driven. It is that, where repeated reciprocal conditioning is evidenced, the trajectories should be reconstructed together.

Definition 6.80 (Knowledge–practice co-evolution). *Knowledge–practice co-evolution* is a historically extended process in which changes in warranted knowledge materially condition practical organization while changes in practice materially alter the evidence, objects, questions, or inferential conditions of subsequent knowledge production.

Co-evolution implies more than mutual influence. The interaction becomes developmentally consequential when each trajectory changes the conditions under which the other subsequently changes. A new measurement system may make a regulatory strategy feasible; regulation may generate a new dataset; that dataset may enable a revised theory; and the revised theory may support a different institutional design. The relevant unit of analysis is then a recursively connected history rather than a series of independent transfers.

Proposition 6.81 (Reciprocal generative conditioning). *When knowledge and practice repeatedly alter the conditions of one another's subsequent development, the coupling should be analyzed as reciprocal generative conditioning rather than as one-directional transfer from research to application or from experience to theory.*

This proposition preserves asymmetry where it exists. Some phases may be strongly research-led, others practice-led, and others weakly coupled. Co-evolution concerns the historical pattern of reciprocal conditioning, not equal causal weight at every moment.

6.6.8 Co-Evolution of Theory and Institution

A more specific form of coupling occurs between theory and institution. Theories can supply categories, models, performance criteria, causal narratives, and expectations that enter institutional design. Institutions can in turn stabilize concepts, generate data, fund particular questions, define legal or administrative categories, and shape which theoretical problems become practically salient. The relation can therefore become recursive even when no actor intends a comprehensive co-evolutionary process.

Historical work on economic development offers precedents for this kind of re-

ciprocal analysis. Murmann's study of firms, technological knowledge, and national institutions reconstructs development through interactions among knowledge, organizations, and institutional arrangements rather than through a single independent causal stream (Murmann 2003). The performativity literature provides another, more specific possibility: models can become embedded in institutional practice and thereby influence the domain from which later observations are drawn (MacKenzie 2006). GRE treats these as examples of mechanisms through which theory–institution coupling can occur, not as a claim that institutional reality is generally produced by theory.

Definition 6.82 (Theory–institution co-evolution). *Theory–institution co-evolution* is a historically extended relation in which theoretical representations materially condition institutional categories, rules, instruments, or evaluation practices while institutional development materially conditions the evidence, problems, concepts, and selection pressures through which theory is subsequently revised.

The epistemic danger is circular confirmation. If a theory shapes the institution that produces the data later used to evaluate the theory, empirical fit can partly reflect institutional incorporation of the theory rather than independent confirmation. The opposite danger also exists: institutional categories can become so entrenched that theoretical inquiry inherits them as if they were natural divisions of the object. Reflexive research should therefore reconstruct how categories and evidence were institutionally produced before using their apparent stability as support for theory.

Caution 6.83 (Institutionally generated confirmation). Observed conformity between a theory and an institutionally organized domain should be interpreted cautiously when the theory, its classifications, or its instruments have materially contributed to the organization of that domain or to the production of the evidence used for evaluation.

Caution 6.83 links the praxis account back to the recursive representation problem developed in Chapter 5. A theory can be epistemically informative and practically generative at the same time; these properties require separate assessment.

6.6.9 Recursive Movement between Praxis Modes

The preceding subsections make research–application coupling recursive. Research-informed action can generate evidence; that evidence can revise theory; revised theory can generate new possibilities for action; institutional implementation can change future evidence; and the transformed field can redirect subsequent research. The distinction between research-dominant and application-dominant praxis therefore remains necessary, but the active mode can change repeatedly within a single programme, institution, or historical trajectory.

A movement between modes occurs when the principal orientation and point of provisional closure change. A research phase may stabilize a claim sufficiently to support a practical decision. Application may then become dominant because implementation, responsibility, timing, and consequences organize the activity. Unexpected outcomes can reopen an epistemic problem and return the activity toward research-dominant praxis. A later intervention can again shift the centre of gravity toward application. Hybrid phases arise when these orientations are simultaneously

consequential and cannot be institutionally separated without substantial loss.

Definition 6.84 (Recursive praxis-mode movement). *Recursive praxis-mode movement* is the repeated phase-dependent reorganization of a praxis configuration between research-dominant, application-dominant, and hybrid orientations as knowledge, practical demands, interventions, consequences, and institutional conditions alter one another.

The definition avoids treating recursion as automatic cycling. A programme can remain application-dominant for long periods, research can become institutionally isolated from practice, and organizations can suppress evidence that would otherwise reopen inquiry. Recursive movement therefore depends on infrastructures of monitoring, preservation, contestation, communication, authority, and revision. Coupling can be blocked as well as enabled.

Proposition 6.85 (Praxis-mode recursion). *When outputs of one praxis mode materially alter the conditions that organize the next phase of knowing, judgment, or action, the subsequent mode should be identified from its current orientation and closure conditions rather than inherited from the institutional label of the preceding phase.*

Proposition 6.85 completes the initial architecture of Chapter 6. Praxis is unified without being homogeneous; research and application are distinguishable without being isolated; their characteristic contradictions differ; and their repeated coupling can transform knowledge, institutions, practical possibilities, and the relational field itself. The remaining sections turn more closely toward research praxis. The next section begins by treating research itself as a relational practice constituted through relations among researchers, objects, participants, communities, institutions, instruments, and infrastructures.

6.7 Research as Relational Practice

The preceding sections established research-dominant praxis as a mode within a wider field of praxis and examined its characteristic contradictions and its recursive coupling with application. This section develops the relational constitution of research itself. Its role is to specify the principal relations through which inquiry is organized before the chapter turns in the next section to the more specific problem of the researcher's position within a relational field. The objective is therefore neither to reduce research to interpersonal interaction nor to treat relations as a background context surrounding an otherwise self-sufficient investigator. Research is approached as a historically situated configuration involving researchers, objects of inquiry, participants, communities, institutions, instruments, infrastructures, categories, and channels through which observations and representations are produced. The discussion proceeds from inquiry within relational systems to researcher–object, researcher–participant, and researcher–community relations; it then examines research institutions, instruments and infrastructures, generative effects, and reflexive consequences. The method is analytical and reconstructive: the section identifies distinct relational interfaces and asks how each can condition access, evidence, interpretation, practical possibility, and later inquiry.

6.7.1 Inquiry within Relational Systems

Research rarely enters a domain that is relationally empty before observation begins. Economic transactions are embedded in legal, organizational, technical, familial, ecological, and symbolic relations. Administrative categories are sustained by institutional routines. Scientific objects are approached through existing languages, instruments, archives, and disciplinary conventions. Even apparently isolated measurements depend on material and social arrangements that make the measured event detectable, recordable, and comparable. Inquiry therefore takes place within relational systems whose organization partly conditions what can become an epistemic object.

Bourdieu and Wacquant's methodological relationalism provides one important precedent for treating positions, practices, and observable properties through relations rather than isolated substances (Bourdieu and Wacquant 1992). GRE adopts a more general and deliberately open formulation. The relevant relational system may include social positions, material infrastructures, legal statuses, ecological dependencies, technical interfaces, historical inheritances, or combinations among them. The point is methodological: a research object can be partially constituted by relations that are external to the immediate unit of observation yet materially relevant to its persistence, manifestation, or transformation.

Definition 6.86 (Relational research configuration). *A relational research configuration is the historically situated set of relations among researchers, objects, participants, communities, institutions, instruments, infrastructures, representations, and wider field conditions that materially condition how an inquiry can be conducted and what can become observable, interpretable, or revisable within it.*

The definition does not imply that every relation in the surrounding world must be reconstructed before research can proceed. Such a requirement would make inquiry impossible. It instead places a burden on researchers to identify relations that are plausibly relevant to the target claim and to state the boundary within which those relations are treated. The boundary remains revisable when anomalies, missingness, intervention effects, historical evidence, or cross-scale dependencies indicate that apparently external relations have become explanatorily important.

Relational inquiry also changes the status of methodological independence. A sample, archive, model, or measurement procedure may be analytically isolated for practical reasons while remaining relationally dependent on the processes that generated it. Independence is therefore an achieved property of a design or argument, not an automatic property of separated data points. Chapter 5 developed this problem epistemically through boundary, scale, and partial observation. Research praxis adds a practical question: which relations must be preserved, monitored, or made explicit so that the inquiry remains capable of recognizing its own dependencies?

Proposition 6.87 (Relational adequacy of inquiry). *The adequacy of a research design depends partly on whether the relations material to the target claim are represented, controlled, traced, or explicitly left uncertain rather than silently excluded by the operational boundary of the study.*

Proposition 6.87 does not privilege larger studies over smaller ones. A narrowly bounded inquiry can be highly informative when its limits are explicit and when the

target relation is appropriately localized. The problem arises when a local design is interpreted as if its operational boundary coincided with the boundary of the phenomenon.

6.7.2 Researcher–Object Relations

The relation between researcher and object varies across domains. A historical archive does not respond strategically to an investigator in the same way that an organization, market participant, or research participant may respond. A distant astronomical object is differently accessible from a legal institution whose categories are partly constituted through interpretation and practice. Yet in each case the object is encountered through a relation of access, measurement, representation, or interpretation. The epistemic object is therefore never identical to an unmediated totality of whatever exists independently of inquiry.

Longino’s contextual empiricism is relevant because evidential relevance depends on background assumptions and because critical interaction can expose assumptions that remain invisible from a single standpoint (Longino 1990). GRE extends this concern to the researcher–object relation itself. Choice of scale, variable, archive, instrument, category, temporal window, and model can make some dimensions of the object available while rendering others peripheral or invisible. These choices can be justified; the relational point is that they participate in the conditions under which the object appears epistemically.

Definition 6.88 (Researcher–object relation). A *researcher–object relation* is the structured relation through which an object of inquiry becomes accessible to observation, measurement, interpretation, reconstruction, or formal representation under specified material, conceptual, institutional, and historical conditions.

This definition separates object dependence from object construction. Some objects may exist independently of the research relation, while the specific object represented in a study can still depend on classificatory and instrumental choices. Ontological suspension allows the inquiry to preserve this distinction without requiring a universal answer to whether every research object is socially or conceptually constituted.

The relation can also be dynamic. A theoretical model can redirect measurement; measurement can reveal an anomaly; the anomaly can alter the model; the revised model can change what is considered relevant evidence. The researcher–object relation is then historically extended rather than confined to a single act of observation. This extension matters particularly in generative inquiry because the object may itself change while the means of knowing it also change.

A further complication arises when the object can respond to research. Publication of a market model, a risk category, a legal interpretation, or an organizational ranking can become part of subsequent practice. Hacking’s historical work on classification and MacKenzie’s account of financial models provide different precedents for understanding how representations can enter the domains they describe (Hacking 2002; MacKenzie 2006). GRE treats such responsiveness as a contingent possibility rather than a universal property of objects. When it occurs, the researcher–object relation acquires a reflexive dimension developed further in Subsection 6.7.8.

6.7.3 Researcher–Participant Relations

Research involving human participants introduces relations of communication, interpretation, access, trust, vulnerability, authority, and representation. Participants can provide testimony, contest categories, strategically manage disclosure, reinterpret questions, or withdraw cooperation. Researchers can control interview structure, sampling, recording, coding, publication, and the institutional channels through which findings gain authority. The research relation therefore influences both evidence production and the distribution of epistemic power.

Fricker's account of testimonial and hermeneutical injustice provides a specific vocabulary for examining credibility deficits and unequal participation in shared interpretive resources (Fricker 2007). GRE does not treat these concepts as a complete theory of research relations, but they clarify why participant testimony cannot be analyzed solely as a neutral data channel. Credibility is allocated within social and institutional relations, and some experiences can be difficult to articulate within the categories available to a research programme.

Definition 6.89 (Participant relation in inquiry). *A participant relation in inquiry is the historically and institutionally situated relation through which a person or group becomes involved in producing, communicating, contesting, withholding, interpreting, or being represented by evidence within a research process.*

The participant relation therefore includes more than informed consent at entry. It can continue through interpretation, representation, publication, archival preservation, secondary analysis, and downstream application. A participant may have little control over these later stages even when initial participation was voluntary. The relational architecture of research should consequently distinguish consent to participate from authority over interpretation, access to findings, contestability of representation, and control over later uses.

Power asymmetry does not imply that participant accounts automatically override other evidence. Epistemic justice requires neither unrestricted deference nor the abandonment of evidential comparison. It requires that testimonial position, access, incentives, vulnerability, interpretive resources, and opportunities for contestation are made relevant to the assessment of evidence rather than treated as external ethical considerations.

Proposition 6.90 (Participant-sensitive evidential interpretation). *Evidence produced through participant relations should be interpreted together with the conditions of communication, authority, vulnerability, credibility allocation, and representational control that materially shape what can be expressed, recorded, and retained.*

This proposition also applies when participants possess epistemic advantages. Practitioners, local communities, workers, patients, administrators, or other situated actors may observe relations unavailable to external researchers. Their proximity does not guarantee comprehensive knowledge, but it changes the distribution of access and therefore the design of inquiry.

6.7.4 Researcher–Community Relations

A research project can also enter relations with communities that exceed the set of formally enrolled participants. Communities may host fieldwork, maintain archives, provide language and interpretive context, sustain ecological or cultural knowledge, experience downstream consequences, or become objects of public representation. The unit called a “community” is itself heterogeneous and can contain internal disagreement, unequal authority, contested membership, and multiple relations to the research problem.

Researcher–community relations therefore cannot be reduced to a single representative voice. A local organization, public official, elder, advocacy group, online forum, or institutional gatekeeper may provide access without possessing authority to speak for everyone affected. Conversely, treating a community as infinitely fragmented can erase collective histories and institutions that materially organize relations. The methodological task is to reconstruct the relevant forms of collective organization while preserving internal differentiation.

Definition 6.91 (Researcher–community relation). A *researcher–community relation* is the set of relations through which inquiry gains access to, represents, learns from, affects, or becomes accountable to a historically situated collectivity whose members or shared conditions are materially connected to the research process or its consequences.

Ostrom’s work on institutional diversity and collective-action arrangements is useful here because collectivities can organize rules, monitoring, participation, and resource governance through varied institutional forms rather than through a single centralized representative structure (Ostrom 2005; Ostrom 1990). GRE draws a narrower research implication: community relations should be approached through the actual institutions, practices, conflicts, and channels of participation through which collective action and knowledge are organized.

Community relations also have temporal depth. A research group can leave data infrastructures, classifications, expectations, disappointments, or relationships of trust that shape later projects. Repeated extraction of information without reciprocal access, preservation, or accountability can alter willingness to participate and change the evidential field encountered by subsequent researchers. Research praxis is therefore cumulative not only through publications but also through the histories of relations that research institutions leave behind.

Remark 6.92 (Community continuity and project closure). The administrative closure of a project does not necessarily end its researcher–community relations. Data retention, publication, reputational effects, institutional memory, later reuse, and downstream application can extend the relation beyond the funded or observed research period.

Remark 6.92 anticipates the later discussion of preservation and cumulative research. It also shows why project-based ethics can be insufficient when consequences persist across longer relational trajectories.

6.7.5 Research Institutions as Relational Systems

Researchers usually operate within institutions that allocate resources, define roles, authorize access, evaluate outputs, preserve records, and regulate acceptable methods. Universities, laboratories, archives, funding agencies, journals, professional associations, public agencies, firms, and community organizations can therefore be treated as relational systems that participate in knowledge production rather than as neutral containers around it.

Institutional relations influence which questions receive resources, which forms of evidence are inexpensive or accessible, which risks are permissible, which outputs count toward evaluation, and which collaborations can be sustained. Bourdieu and Wacquant's analysis of fields and positions provides one framework for examining how institutional position and accumulated forms of capital shape practice (Bourdieu and Wacquant 1992). GRE retains the general insight while avoiding the claim that every research institution should be represented through one sociological vocabulary.

Definition 6.93 (Research institution as relational system). *A research institution as a relational system is an organized configuration of roles, rules, resources, evaluative practices, infrastructures, authority relations, and external dependencies that conditions the production, circulation, preservation, and revision of knowledge.*

Institutional organization can generate epistemic advantages. Stable archives, peer criticism, specialized equipment, long-term funding, interdisciplinary teams, and replication infrastructures can make knowledge possible that isolated individuals could not produce. The same organization can also generate blind spots through metric incentives, disciplinary boundaries, access restrictions, short funding cycles, reputational pressures, or concentration of infrastructural control.

The relation between institution and inquiry is therefore bidirectional. Institutions shape research, while successful methods, classifications, technologies, and research programmes can reshape institutions. Section 6.6 described this more broadly as theory–institution and knowledge–practice co-evolution. Here the emphasis is internal to research praxis: changes in evaluation, funding, publication, or technical infrastructure can reorganize the relations through which future inquiry is carried out.

Proposition 6.94 (Institutional conditioning of epistemic possibility). *The set of practically available research questions and methods is partly conditioned by institutional relations that allocate time, access, authority, infrastructure, recognition, and preservation capacity.*

This proposition does not imply institutional determinism. Researchers can work against prevailing incentives, create alternative infrastructures, form new collaborations, or pursue questions outside dominant evaluation systems. Such resistance itself requires relational conditions, including time, resources, networks, or alternative institutions capable of sustaining it.

6.7.6 Instruments and Infrastructures

Research relations are mediated materially. Instruments extend perception, transform phenomena into traces, standardize observations, and sometimes create new objects of comparison. Infrastructures coordinate storage, computation, communication, access, and reuse. Their epistemic role is therefore deeper than convenience: they condition what can be detected, at what resolution, by whom, over what temporal horizon, and with what possibility of verification.

Frischmann's analysis of infrastructure as a shared input enabling heterogeneous downstream activities provides a useful economic precedent for treating infrastructural access as generative rather than merely consumptive (Frischmann 2012). Applied to research, a telescope, database, archive, computing cluster, survey platform, laboratory protocol, identifier system, or open repository can support many downstream inquiries whose specific forms were not predetermined when the infrastructure was created.

Definition 6.95 (Research infrastructure). A *research infrastructure* is a relatively durable material, technical, organizational, or informational arrangement that supports multiple acts of observation, representation, coordination, analysis, preservation, or verification across one or more research programmes.

Instruments and infrastructures are analytically distinct. An instrument can mediate a specific act of observation, while infrastructure coordinates repeated or distributed research activity. In practice they overlap: a sensor network is both a set of instruments and an infrastructure; a computational model may depend on shared software, data standards, and hardware. The distinction remains useful because infrastructure creates dependency relations extending beyond the immediate study.

Dependence raises questions of access and epistemic autonomy. When only a small set of institutions can operate a costly instrument, obtain proprietary data, or access frontier computation, the resulting asymmetry concerns more than efficiency. It can shape which questions are feasible, who can reproduce findings, and which research communities can contest dominant representations. Conversely, open infrastructures can broaden participation while introducing other dependencies, including maintenance burdens, standardization pressures, and vulnerability to common technical failures.

Caution 6.96 (Infrastructure and evidential authority). The scale, precision, or computational sophistication of a research infrastructure should not be treated as independent evidence for the validity of the representations it produces. Infrastructure expands or reorganizes epistemic capacity while leaving questions of calibration, category choice, model fit, missingness, and interpretation open.

Caution 6.96 is especially important in AI-assisted and large-scale computational research. Greater productive capacity can generate more candidate patterns, models, and analyses while increasing the importance of judgment concerning which outputs deserve epistemic attention.

6.7.7 Research as Generative Process

Research does not merely retrieve information from an unchanged world. It can generate concepts, measurements, datasets, classifications, instruments, methods, infrastructures, theoretical objects, questions, communities, skills, institutional capacities, and practical possibilities. Some of these products remain internal to research; others circulate into administration, markets, law, education, technology, or public discourse. Research is therefore a generative process even when its dominant orientation remains epistemic.

Hacking's account of historically changing classifications and MacKenzie's study of models incorporated into financial practice illustrate two mechanisms through which research representations can participate in later reality (Hacking 2002; MacKenzie 2006). The general GRE claim is broader but weaker: research outputs can become inputs into subsequent relational processes. Whether they do so, how strongly, and with what consequences requires separate empirical reconstruction.

Definition 6.97 (Generative research process). *A generative research process is an inquiry whose activities or outputs materially contribute to the formation, stabilization, transformation, or suppression of later capacities, relations, representations, institutions, methods, infrastructures, questions, or practical possibilities.*

The definition includes generativity within the research system itself. A reusable dataset can enable later inquiry; a failed model can generate a new conceptual distinction; a methodological criticism can change evaluation standards; an archive can preserve materials that allow future re-epistemization. These effects need not involve direct practical intervention outside research.

Generativity also creates responsibility for preservation and provenance. When later work depends on earlier classifications, datasets, code, instruments, or interpretive decisions, hidden assumptions can propagate across generations of inquiry. A generative research system should therefore preserve sufficient context for downstream users to identify how an epistemic resource was produced and under what limits it can be reused.

Proposition 6.98 (Recursive generativity of research). *Research becomes recursively generative when the concepts, evidence, methods, infrastructures, or institutions produced in one phase materially alter the conditions under which later research questions can be posed, observed, evaluated, or revised.*

Proposition 6.98 links research praxis to the wider GRE concern with transformation of generative conditions. A research programme can therefore be evaluated partly by what kinds of future inquiry it enables or forecloses, while such evaluation remains distinct from the truth of any particular claim it produces.

6.7.8 Reflexive Consequences of Inquiry

Once research is treated as relational and generative, reflexivity becomes a practical requirement rather than an optional philosophical supplement. Inquiry can change participant expectations, community relations, institutional categories, incentives, public narratives, market behavior, administrative visibility, and the researcher's own conceptual repertoire. These effects can alter the field from which subsequent

evidence is drawn.

Bourdieu and Wacquant develop reflexivity as a way of objectifying the social and intellectual conditions of scholarly practice (Bourdieu and Wacquant 1992). Longino emphasizes organized criticism and plural perspectives as conditions supporting objectivity in the presence of background assumptions (Longino 1990). GRE connects these insights to the chapter's praxis framework: reflexivity concerns the capacity to reconstruct how inquiry participates in the relations through which its own evidence, categories, and consequences are produced.

Definition 6.99 (Reflexive consequence of inquiry). *A reflexive consequence of inquiry is a change in the relational field, epistemic system, participants, institutions, representations, or researcher that is materially produced by the conduct, communication, or institutionalization of the inquiry and that can condition subsequent observation, interpretation, judgment, or action.*

Reflexivity therefore differs from self-description. A positional statement can be informative while remaining insufficient if it does not identify how position, access, classification, communication, or publication could affect the inquiry. The relevant question is causal and relational: through which pathways can research activity alter what is later observed or how it is interpreted?

These pathways vary. An interview can change how a participant articulates an experience; publication of a classification can influence institutional uptake; a ranking can redirect organizational behavior; an experimental intervention can modify the process later measured; a long-term field relation can create trust that changes disclosure. Some effects improve epistemic access, while others generate reactivity or dependence. Reflexivity therefore does not presume that influence is contamination. It requires that influence become an explicit object of inquiry when it matters to the target claim.

Proposition 6.100 (Reflexive monitoring requirement). *When the conduct or communication of research plausibly alters relations material to the target claim, the inquiry should document the relevant pathway, distinguish pre-existing from research-induced conditions where possible, and revise its interpretation or design when those effects materially change the evidential field.*

The proposition completes the section's movement. Research is relational because its objects, participants, communities, institutions, and instruments are connected through conditions of access, authority, mediation, and consequence. It is generative because these relations can produce new capacities, representations, infrastructures, and practical possibilities. It is reflexive because research can become part of the field it studies and thereby alter the conditions of subsequent knowledge. The next section turns from this relational architecture to the researcher's more specific situatedness within it: historical position, institutional position, language, material conditions, power, access, distance, movement across fields, and transformation through inquiry.

6.8 The Researcher within the Relational Field

Section 6.7 treated research as a relational practice constituted through objects, participants, communities, institutions, infrastructures, and reflexive consequences. The present section narrows the analysis to the researcher as a situated participant within that field. Its role is to specify how historical location, institutional position, language, material conditions, power, access, relational distance, and movement across fields condition observation and interpretation without reducing knowledge to the researcher's standpoint. The section therefore develops a positional account of inquiry in which evidence remains answerable to relational reality while the pathways through which evidence becomes available are historically and materially differentiated. The discussion proceeds from situated observation to dimensions of researcher position, then to mobility across fields and transformation of the researcher through inquiry.

Definition 6.101 (Researcher position). A *researcher position* is the historically situated configuration of institutional, linguistic, material, epistemic, and power relations through which a researcher gains access to a field, encounters evidence, interprets representations, communicates claims, and participates in the consequences of inquiry.

Definition 6.101 treats position as relational rather than as a fixed personal attribute. A researcher can occupy several positions simultaneously, and relevant aspects of position can change across phases of a project. The same researcher may be institutionally central and locally unfamiliar, linguistically competent and materially constrained, technically privileged and dependent on community gatekeepers, or historically distant from the events being reconstructed while possessing archival access unavailable to contemporaries. Positional analysis therefore requires specification of which relation matters for the claim under investigation.

6.8.1 Situated Observation

Observation occurs from within conditions of access, instrumentation, categorization, attention, and prior understanding. This situatedness affects which manifestations become available, how they are recorded, and which contrasts become salient. It does not follow that observation is exhausted by the observer's position. The epistemic architecture developed in Chapter 5 remains in force: evidence is mediated and partial, while relational reality can constrain observation independently of what the researcher expects or prefers.

Definition 6.102 (Situated observation). A *situated observation* is an evidential encounter whose accessibility, resolution, salience, and interpretation are materially conditioned by the researcher's position within the relevant relational field.

The definition contains two distinct claims. First, the route to evidence is position-dependent. A researcher who can observe an administrative process from inside an institution may encounter documents, informal routines, and decision sequences that remain unavailable to an external observer. Second, position-dependence does not establish that every interpretation supported from that position has equal warrant. Claims remain constrained by provenance, competing evidence, inferential dis-

cipline, and the properties of the object under investigation.

Longino's contextual empiricism provides a useful precedent for treating evidential relevance as dependent partly on background assumptions while retaining organized criticism as a resource for objectivity (Longino 1990). Bourdieu and Wacquant similarly insist that scholarly practice itself can be made an object of reflexive analysis (Bourdieu and Wacquant 1992). GRE uses these insights to formulate situated observation as a reconstructable component of research design rather than as a general declaration that all perspectives are equivalent.

Proposition 6.103 (Positional disclosure and evidential interpretation). *When a researcher's position materially affects access, salience, interaction, or interpretation, the relevant positional relation should be documented to the degree needed for readers or collaborators to evaluate its likely effect on the evidential claim.*

The relevant degree varies by study. A positional relation can be central in ethnography, participant observation, archival access, interviewing, or research conducted inside an organization, while it may have a narrower role in the interpretation of a public dataset. Positional disclosure is therefore claim-relative rather than a uniform autobiographical requirement.

6.8.2 Historical Position

Researchers occupy historical positions from which earlier and contemporary relations become differently visible. Concepts available to describe a phenomenon, archives preserved from earlier periods, prevailing standards of evidence, and knowledge of downstream consequences all depend partly on temporal location. Historical position therefore changes both epistemic opportunity and epistemic risk.

Gadamer's account of historically effected understanding emphasizes that interpretation occurs through historically formed horizons rather than from a timeless standpoint (Gadamer 2004). Hacking's historical ontology likewise demonstrates how objects of inquiry and classificatory possibilities can emerge through changing conceptual and institutional practices (Hacking 2002). For GRE, the methodological implication is that the researcher should distinguish the historical constitution of an interpretive vocabulary from the historical reality of the relations being reconstructed.

Definition 6.104 (Historical research position). *A historical research position is the temporal location of an inquiry together with the concepts, records, institutions, consequences, and standards of interpretation that are available from that location.*

Later researchers can possess epistemic advantages because longer trajectories have become observable. They may see consequences, institutional transformations, or previously inaccessible archives. The same distance can create loss. Tacit practices disappear, documents are destroyed, categories change, witnesses die, and later concepts can be projected backward onto periods in which they did not organize experience in the same way.

Historical position therefore requires a double discipline. Researchers should use later knowledge where it genuinely expands evidential access while resisting retrospective determinism. Knowledge of what eventually happened does not show that the later outcome was already inevitable, nor does the availability of a contemporary

category establish that historical actors inhabited the same classificatory world.

Caution 6.105 (Retrospective positional privilege). Historical distance can enlarge the evidential field while also introducing retrospective categories, selective survival of records, and outcome knowledge. Later observation should therefore be treated as differently situated rather than automatically superior.

6.8.3 Institutional Position

Institutional position concerns the researcher's location within organizations and organized fields of knowledge production. Affiliation, disciplinary membership, rank, contractual status, funding relations, professional networks, publication venues, and formal authority can affect access to data, credibility, time, equipment, collaborators, and audiences. They can also affect what kinds of questions carry professional reward or institutional risk.

Bourdieu and Wacquant analyze scholarly and social fields through positions, resources, and relations rather than through isolated actors (Bourdieu and Wacquant 1992). GRE adopts a limited version of this orientation: institutional position is one set of relations conditioning inquiry, and its relevance must be shown rather than presumed.

Definition 6.106 (Institutional research position). An *institutional research position* is the researcher's location within organizational and disciplinary relations that allocate authority, resources, recognition, access, obligations, and exposure to evaluation.

Institutional position can generate epistemic capacity. A laboratory appointment may provide equipment and technical expertise; an archival affiliation may open collections; a public-agency role may provide access to administrative records; a long-term university position may allow research that requires many years. These capacities can coexist with institutional blind spots. Evaluation metrics can narrow acceptable outputs, funding conditions can privilege specified problem frames, disciplinary conventions can stabilize inherited categories, and confidentiality obligations can limit what can be shared.

Institutional reflexivity should therefore examine both enablement and constraint. The fact that research is institutionally supported does not invalidate it, just as institutional independence does not guarantee superior judgment. The relevant question is how institutional relations alter the production, circulation, contestability, and preservation of the evidence and claims at issue.

Proposition 6.107 (Institutional-position audit). *When institutional position materially affects access, incentives, disclosure, or evaluative authority, research design should record the relevant dependency and consider how the claim could be checked from positions with different institutional relations.*

This proposition gives plural criticism a practical role. Independent replication, cross-institutional collaboration, community review, open documentation, and adversarial evaluation can each reduce particular positional dependencies, though none removes situatedness altogether.

6.8.4 Linguistic Position

Language is simultaneously a medium of access, interpretation, categorization, and relation. Researchers encounter testimony, archives, legal categories, technical vocabularies, metaphors, and ordinary practices through linguistic repertoires that are unevenly distributed. Linguistic position therefore concerns more than translation accuracy. It shapes which distinctions can be recognized, which communities can be addressed directly, and which concepts become available for theoretical reconstruction.

Wittgenstein's account of meaning through use and language-games is relevant because a term's practical significance depends on its role within forms of linguistic activity rather than on an isolated lexical correspondence (Wittgenstein 2009). Gadamer similarly treats language as a medium through which understanding is historically articulated (Gadamer 2004). Bourdieu adds a power-sensitive dimension by emphasizing linguistic markets and symbolic authority (Bourdieu 1991).

Definition 6.108 (Linguistic research position). A *linguistic research position* is the researcher's situated repertoire of languages, disciplinary vocabularies, classificatory conventions, translation practices, and communicative relations through which evidence and interpretation become expressible.

Translation can expand relational access while also introducing transformation. A legal or administrative term may lack a stable equivalent in another language; an apparently ordinary word may carry institutional histories that disappear in literal translation; a technical concept imported from another discipline can reorganize the object by foregrounding some relations and suppressing others. These effects become especially important in interdisciplinary and cross-cultural inquiry.

GRE therefore treats translation as an epistemic operation whose remainder should remain visible where it affects the argument. Preserving source-language terms, documenting competing translations, consulting situated speakers, and distinguishing researcher-created analytical categories from participant categories are among the available practices. Their necessity depends on the target claim rather than on a universal rule that every term must remain untranslated.

Remark 6.109 (Linguistic plurality and conceptual revision). Encounter with another linguistic repertoire can reveal distinctions that the researcher's prior vocabulary did not make salient. Linguistic difference can therefore generate conceptual revision in addition to creating translation difficulty.

6.8.5 Material Position

Research also depends on material conditions. Time, income, mobility, housing stability, equipment, computing resources, physical access, documentation capacity, legal status, and organizational support can change which questions are practicable and how long an inquiry can remain open. Material position is therefore part of the generative conditions of knowledge production.

This point complements the infrastructural analysis in Section 6.7. Infrastructure concerns durable arrangements supporting many inquiries, whereas material position concerns the researcher's concrete relation to those arrangements and to the re-

sources required for a particular research trajectory. Two researchers may inhabit the same disciplinary field while having very different ability to travel, acquire data, maintain long-term field relations, purchase access, hire assistance, or absorb the opportunity cost of slow research.

Definition 6.110 (Material research position). A *material research position* is the configuration of resources, temporal capacity, mobility, equipment, security, and infrastructural access that conditions the researcher's practical ability to observe, preserve, analyze, communicate, and revise inquiry.

Material position affects method choice in ways that can be mistaken for purely intellectual preference. Short funding cycles can favor readily measurable outcomes; expensive instruments can concentrate inquiry in well-resourced institutions; unstable employment can reduce the feasibility of long historical or ethnographic projects; limited computing access can constrain model exploration. These constraints do not mechanically determine conclusions, yet they shape the feasible set of research practices from which conclusions can emerge.

Material asymmetry also affects cumulative knowledge. A project capable of maintaining archives, code, data documentation, and long-term personnel may preserve conditions for later re-epistemization that a resource-constrained project cannot sustain. Evaluation of research systems should therefore distinguish scientific merit from the material capacities required to render work visible, reproducible, and durable.

Proposition 6.111 (Material feasibility and methodological choice). *Observed method choice can reflect both epistemic judgment and material feasibility. Methodological evaluation should therefore examine whether relevant alternatives were rejected on epistemic grounds, rendered impracticable by material conditions, or excluded through a combination of both.*

6.8.6 Power and Access

Access to relational fields is organized through power. Gatekeepers authorize entry, institutions classify records, participants decide what to disclose, organizations can impose confidentiality, and researchers themselves can control publication, coding, interpretation, and public visibility. Power therefore affects both who can observe and who can determine how observations circulate.

Foucault's analysis of power relations emphasizes structured action upon action rather than a simple possession held by one actor (Foucault 1982). Fricker's account of epistemic injustice identifies credibility and interpretive inequalities that can shape participation in knowledge practices (Fricker 2007). These literatures support a GRE distinction between access capacity and epistemic warrant. Powerful access can reveal otherwise hidden evidence, while also creating dependence, selective visibility, strategic disclosure, or constraints on contestation.

Definition 6.112 (Power-mediated research access). *Power-mediated research access* is access to evidence, participants, sites, infrastructures, or representational channels whose availability and conditions are materially structured by relations of authority, dependence, vulnerability, gatekeeping, or control.

The same researcher can be powerful in one relation and dependent in another. A university affiliation may confer authority when requesting an interview while leaving the researcher dependent on an organization for site access. A technical specialist may control analytical tools while depending on local actors for interpretation. An external researcher may possess publication power while lacking the situated knowledge held by participants.

For this reason, power analysis should avoid reducing the research field to a single hierarchy. A more useful approach reconstructs who can grant or withdraw access, who can refuse participation, who controls categories and records, whose testimony receives credibility, who bears disclosure risk, who can challenge a representation, and who retains the capacity to circulate a competing account.

Proposition 6.113 (Access–warrant separation). *Expanded access increases the potential evidential field but does not by itself establish stronger warrant. Claims remain dependent on provenance, selection processes, representational adequacy, competing evidence, and the power relations through which access was produced.*

This separation is particularly important when privileged access is treated rhetorically as proof of superior knowledge. Insider status, elite interviews, proprietary datasets, or confidential archives can each expand evidence while simultaneously narrowing independent contestability.

6.8.7 Relational Distance

Research often describes observers as close to or distant from their objects, yet relational distance has several dimensions. A researcher can be geographically close and institutionally distant, socially embedded and analytically unfamiliar, linguistically fluent and historically removed, or professionally detached while maintaining long-term personal relations. A single continuum from insider to outsider therefore compresses distinct epistemic conditions.

Definition 6.114 (Relational distance profile). *A relational distance profile is a claim-relative description of the researcher's proximity to or separation from relevant actors, practices, institutions, languages, histories, infrastructures, and consequences of the field under investigation.*

Different distances generate different epistemic opportunities. Proximity can support tacit understanding, trust, rapid recognition of anomalies, and access to informal relations. Distance can support comparison, make normalized practices visible, reduce particular dependencies, and expose assumptions that insiders rarely articulate. Each can also create characteristic blind spots. Proximity may normalize local categories or increase relational obligations; distance may miss tacit context or interpret formal representations too literally.

GRE therefore avoids a universal ideal of optimal distance. The relevant question is whether the distance profile is appropriate to the target claim and whether complementary positions can correct predictable limitations. Longino's emphasis on critical interaction among differently situated knowers is relevant because positional diversity can become epistemically productive when there are actual channels for criticism and uptake (Longino 1990).

Proposition 6.115 (Complementarity of relational distance). *Where distinct positions provide access to different manifestations or interpretive resources, combining evidence across relational distances can increase warrant when disagreements, provenance, and translation conditions remain explicit.*

Complementarity should not be confused with simple averaging. Some positions can possess better evidence for a particular claim; others may be systematically constrained or strategically misinformed. The analytical task is to explain why a position matters and what evidential relation connects it to the target.

6.8.8 Movement across Fields

Researchers move. They cross disciplines, institutions, countries, languages, communities, professional roles, and practical domains. Such movement changes position and can reveal relations that remain difficult to see from a stable location. It can also produce discontinuity, translation problems, loss of trust, or misapplication of concepts developed elsewhere.

Movement across fields is especially important for interdisciplinary inquiry. A concept can acquire new significance when transferred into another research domain, yet its evidential and ontological commitments may not travel intact. Section 6.6 described recursive movement between research and application modes. Movement across fields is related but distinct: the researcher's relational coordinates change even when the dominant mode of praxis remains research.

Definition 6.116 (Positional transition across fields). *A positional transition across fields is a change in the researcher's relational location produced by movement among disciplinary, institutional, linguistic, cultural, geographic, or practical fields, with corresponding changes in access, categories, authority, obligations, and interpretive resources.*

Such transitions can be generative. A methodological practice learned in one field may become useful in another; a concept taken for granted in one discipline may appear contingent from another; an institutional comparison may reveal alternative arrangements. Gadamer's language of changing horizons provides one philosophical vocabulary for understanding how encounters can transform the conditions of interpretation (Gadamer 2004). GRE places this transformation within a wider relational account that also includes material and institutional movement.

Cross-field movement creates a specific methodological obligation: transfer should preserve a record of what changed. A researcher entering another field should identify which categories were retained, which meanings shifted, which relations became newly observable, and which forms of competence remain limited. This practice reduces the risk that mobility becomes a source of unacknowledged conceptual extraction.

Caution 6.117 (Mobility and transferable authority). Authority gained in one field does not automatically transfer to another. Cross-field inquiry should distinguish portable methodological skill from field-specific competence, access, and interpretive authority.

6.8.9 Transformation of the Researcher through Inquiry

The researcher is not positionally fixed over the life of an inquiry. Repeated encounters can change language, habits of attention, theoretical commitments, institutional relations, ethical sensitivities, technical skills, social networks, and judgments about which questions matter. Inquiry can therefore transform the researcher who later observes and interprets the field.

Dewey's account of experience emphasizes reciprocal transformation through interaction between organism and environment (Dewey 1925). Bourdieu's theory of practice likewise provides resources for understanding historically acquired dispositions rather than treating practical perception as context-free cognition (Bourdieu 1977). GRE uses these precedents to treat researcher transformation as an empirical and reflexive feature of research trajectories.

Definition 6.118 (Researcher transformation through inquiry). *Researcher transformation through inquiry* is a durable change in the researcher's interpretive repertoire, capacities, dispositions, relations, attention, or practical orientation generated through participation in the research process.

Transformation can improve inquiry. Researchers may acquire language competence, learn to recognize distinctions previously invisible to them, revise stereotypes, develop technical capability, or build relations that permit deeper access. Transformation can also generate new dependencies and blind spots. Long immersion may normalize local assumptions; theoretical investment can increase attachment to a framework; professional rewards can make a research programme difficult to abandon; emotionally significant relations can alter judgment in ways that require reflection rather than simple celebration or suppression.

The appropriate methodological response is longitudinal reflexivity. Researchers can record major changes in access, categories, commitments, and interpretation across phases of inquiry, especially when those changes alter the evidential field. Early notes, preregistered expectations where suitable, versioned conceptual maps, methodological memos, and preservation of rejected interpretations can make such transformations inspectable rather than reconstructing them only after the final argument has stabilized.

Proposition 6.119 (Researcher transformation and epistemic revision). *When inquiry materially transforms the researcher's capacities, relations, or interpretive categories, later judgments should distinguish changes attributable to newly available evidence from changes generated through the researcher's evolving position, while allowing the two processes to interact where separation is incomplete.*

This proposition completes the positional argument of the section. The researcher enters inquiry from a historical, institutional, linguistic, material, and power-laden position; encounters the field through specific relational distances; can move across fields; and can be transformed through the process of inquiry itself. Researcher position is therefore neither an external bias to be eliminated nor a sovereign standpoint from which reality is constituted. It is a changing part of the relational architecture through which evidence becomes accessible and knowledge becomes possible. The next section develops a complementary discipline at the level of ontology: inquiry can proceed with explicit and sufficient commitments while suspending claims whose set-

tlement exceeds the requirements of the research problem.

6.9 Inquiry under Ontological Suspension

This section develops the practical implications of ontological suspension for research praxis. Chapter 4 introduced ontological suspension as a disciplined withholding of stronger ontological commitment where such commitment is neither warranted nor required by the explanatory task. The present section asks how that principle should operate while research is actually being designed, conducted, compared across domains, and revised. Its objective is to show how inquiry can construct workable objects, select sufficient commitments, compare multiple descriptions, and revise assumptions without requiring final settlement of every metaphysical question raised by the domain. The section proceeds through seven tasks: research without final ontological settlement, provisional objects, minimal ontological commitment, domain-specific commitment, multiple ontological descriptions, revision of ontological assumptions, and the practical limits of suspension. The method is methodological and comparative. It treats ontology as consequential for research while resisting the inference that every inquiry must begin from a completed metaphysical system. Philosophical precedents concerning ontological commitment, empirical adequacy, and suspension provide useful resources, although GRE's use of ontological suspension remains a narrower research discipline rather than an adoption of any one broader philosophical programme (Quine 1948; Fraassen 1980; Husserl 2012).

Definition 6.120 (Inquiry under ontological suspension). *Inquiry under ontological suspension* is research practice that states and uses the ontological commitments required to identify its objects, relations, mechanisms, and evidential targets while withholding stronger commitments whose settlement is not presently necessary or warranted.

Definition 6.120 gives suspension a positive research role. It does not remove ontology from inquiry. Every empirical record, formal model, interview category, institutional archive, legal classification, historical narrative, or computational representation depends on distinctions concerning what kinds of objects can be identified, what counts as persistence, which relations are relevant, and what differences matter. The discipline lies in making those commitments proportionate to the research task and revisable when their consequences become operative.

6.9.1 Research without Final Ontological Settlement

Research frequently proceeds before the ultimate ontology of its objects has been settled. Economists can study money, firms, markets, expectations, assets, and institutions while disagreeing about the metaphysical status of social objects. Legal scholars can analyze offices, rights, obligations, and legal persons while holding different philosophies of normativity or institutional fact. Researchers can investigate memory, identity, trust, collective agency, artificial systems, ecological relations, or subjective continuity while deeper disputes about mind, personhood, agency, emergence, or social reality remain open. Inquiry becomes possible because the relevant local claims often require less than final ontological agreement.

The practical significance of this point is methodological. If research required prior resolution of every stronger ontological disagreement connected to its object, many research programmes would be unable to begin. Conversely, ignoring ontology altogether can hide assumptions in operational definitions, measurement instruments, classifications, and models. Ontological suspension provides a middle discipline: identify the ontological question, determine whether its resolution changes the target claim or research design, and proceed with explicitly bounded commitments where the stronger dispute remains non-operative.

Quine's classic formulation of ontological commitment emphasizes that theories carry implications about what they say there is (Quine 1948). GRE accepts the need to make such implications visible while distinguishing the commitments needed for a specific inquiry from a complete metaphysical inventory. Van Fraassen's constructive empiricism likewise provides one historical precedent for separating empirical adequacy from stronger realist commitment, although GRE does not reduce inquiry to observable phenomena and explicitly treats relational realities as possible epistemic targets under mediated access (Fraassen 1980). Husserl's language of suspension provides another historical lineage, but GRE's procedure is narrower than transcendental phenomenological epoché: it is a claim-specific discipline for research under incomplete ontological settlement rather than a suspension of the natural standpoint as such (Husserl 2012).

Proposition 6.121 (Operational sufficiency of suspended inquiry). *An inquiry can remain epistemically and methodologically substantive under unresolved stronger ontology when its operative objects, identity criteria, evidential targets, causal or relational claims, and inferential boundaries are sufficiently specified for the research problem.*

The proposition places a burden on specification. Suspension cannot compensate for an undefined object or an incoherent measurement relation. A study of institutional trust, for example, may suspend whether trust is ultimately a psychological state, a social relation, an emergent property, or a mixed phenomenon only if it states what observable, relational, historical, or behavioral features count for the local claim. Where competing ontologies imply different observations, interventions, or identity conditions, the disagreement becomes operative and can no longer remain merely bracketed.

6.9.2 Provisional Objects

Research objects are often stabilized provisionally before their ontological boundaries are fully known. A “firm,” “community,” “market,” “household,” “algorithmic agent,” “public,” “crisis,” or “institution” may function as an object of inquiry because the research requires a manageable unit, even though its boundaries, internal heterogeneity, persistence conditions, or relation to neighboring objects remain contested. Treating such an object as provisional avoids two opposite errors: assuming that the research category transparently corresponds to a final ontological kind, and assuming that provisionality makes the category analytically arbitrary.

A provisional object is constituted through an explicit research relation. The analyst identifies a target, specifies the features and boundaries relevant to the inquiry, records exclusions and uncertainties, and remains prepared to revise the object when

evidence shows that the initial construction is inadequate. The object can still refer to realities that exceed its representation. Giere's purposive account of scientific representation is useful here because models and representations select aspects of a target for specified purposes rather than reproducing the target by identity (Giere 2004). GRE extends the same discipline to the construction of research objects more generally.

Definition 6.122 (Provisional research object). A *provisional research object* is a target of inquiry whose identity, boundary, or internal organization is specified sufficiently for a current research task while remaining explicitly open to revision when evidence, scale, history, or alternative descriptions materially alter that specification.

Provisionality should therefore be documented rather than merely asserted. Researchers can state which features determine inclusion, how temporal persistence is handled, which scale is privileged, what internal variation is suppressed, and what neighboring relations remain outside the present object. Such documentation becomes especially important when a provisional object later acquires administrative or theoretical authority. A category created for analysis can become embedded in datasets, policy systems, institutional records, or subsequent scholarship and thereby acquire performative effects that exceed its original research purpose.

Remark 6.123 (Provisionality and cumulative inquiry). A provisional object can support cumulative research when successive studies preserve enough provenance to show how its boundaries, identity criteria, and operational definitions have changed. Cumulativity does not require permanent category identity.

This remark connects ontological suspension to historical research practice. What a field calls the same object may change as instruments, institutions, classifications, and theories change. Preserving these transformations helps later researchers determine whether apparent continuity reflects continuity of the object, continuity of the label, or a more complex historical relation between them.

6.9.3 Minimal Ontological Commitment

Ontological suspension requires some positive commitments. Research cannot identify an object, compare observations, infer persistence, or test a mechanism without assuming enough about what can exist and how relevant entities or processes can be distinguished. The appropriate standard is therefore not ontological neutrality. It is *minimal sufficient commitment*: the inquiry should commit to the least ontological structure adequate for the claim while making additional commitment when the research problem requires it.

Minimality is target-relative. A descriptive study of transaction records may need commitments about events, agents, institutional identifiers, and temporal ordering without requiring a theory of personhood. A study of responsibility in human–AI interaction may require a richer account of agency, delegation, authority, and subjecthood because those distinctions affect the interpretation of action. A longitudinal study of organizational continuity requires explicit persistence criteria. A model of ecological feedback may require commitments about entities, flows, environments, and causal dependence at more than one scale. The same research programme can therefore operate with different degrees of ontological commitment across its ques-

tions.

Definition 6.124 (Minimal sufficient ontological commitment). A *minimal sufficient ontological commitment* is the least set of explicit assumptions concerning relevant objects, relations, identity conditions, persistence, and causal or generative capacities needed for a specified research claim to be coherent and assessable.

Minimality should not become an aesthetic preference for conceptual austerity regardless of explanatory loss. An ontology that is too thin can obscure mechanisms, differences, or forms of agency that matter to the target. The discipline is economical rather than reductive: additional categories should be introduced when they improve the adequacy of the inquiry and withheld when they add stronger claims without changing what the evidence or explanation can support.

Proposition 6.125 (Commitment proportionality). *Ontological commitment should increase when additional distinctions materially change identification, explanation, prediction, comparison, intervention, or normative responsibility relevant to the research problem, and can remain suspended where stronger distinctions leave those tasks unchanged.*

Proposition 6.125 supplies a practical test. If two ontological accounts generate the same operational object, evidence interpretation, and explanatory consequences for the present inquiry, the stronger dispute can remain open. If they imply different identity criteria, causal expectations, or interventions, the dispute has become methodologically active and requires explicit treatment.

6.9.4 Domain-Specific Commitment

Research takes place within domains that already possess operational ontologies. Law uses persons, rights, duties, offices, jurisdictions, acts, and procedures. Economics uses prices, assets, liabilities, firms, contracts, households, labor, and forms of capital. Biology, ecology, computation, psychology, education, engineering, and political science likewise employ objects and identity conditions shaped by their own histories and practical requirements. Ontological suspension should not flatten these domain distinctions into a generic vocabulary of relations.

Domain-specific commitment permits inquiry to use operationally meaningful objects while keeping their relation to stronger ontology open. A corporation can be treated as a legal and economic object with rights, liabilities, governance structures, and causal effects without deciding whether organizations possess agency in exactly the same ontological sense as human persons. A computational agent can be treated as a system that receives inputs, produces actions, and enters institutional relations without assuming equivalence between machine subjecthood and human subjectivity. A household can be analyzed as an economic unit for one question while another inquiry decomposes it into intra-household relations because distribution, care, or power makes the unitary representation inadequate.

Definition 6.126 (Domain-specific ontological commitment). A *domain-specific ontological commitment* is an explicit commitment to the objects, identity conditions, relations, and operational distinctions required by a particular field of inquiry, maintained without presuming that those commitments exhaust the object's possible de-

scriptions at other scales or in other domains.

The definition has two implications for interdisciplinary research. First, translation into a common analytical vocabulary should preserve the domain distinctions that carry causal, legal, institutional, or practical significance. Second, interdisciplinary inquiry should record where a term changes meaning across domains. “Agent,” “value,” “capital,” “information,” “risk,” “responsibility,” and “identity” can function differently in economics, law, computation, psychology, or philosophy. Ontological suspension allows several uses to remain locally valid while requiring explicit adjudication when the differences become consequential for a shared claim.

Hacking’s historical work is relevant because categories and objects of inquiry can emerge, stabilize, and transform through changing practices of classification and reasoning (Hacking 2002). A domain ontology should therefore be treated as historically situated rather than as an unchanging dictionary. Its operational force can be substantial even when its categories remain revisable.

Caution 6.127 (Domain ontology and practical authority). The operational necessity of a domain category does not establish its complete descriptive adequacy, ontological fundamentality, or normative legitimacy. Research should distinguish practical use from stronger claims about what the category ultimately captures.

6.9.5 Multiple Ontological Descriptions

Some objects can be described coherently through more than one ontology. A person can be described biologically, psychologically, legally, economically, narratively, relationally, or computationally for different research purposes. An institution can be described through rules, organizational roles, material infrastructures, repeated practices, symbolic classifications, or networks of dependence. A market can be represented through transactions, expectations, legal arrangements, infrastructures, strategic interaction, historical institutions, or distributed informational processes. Ontological suspension creates room for such plurality without converting plurality into equivalence.

Multiple descriptions can be complementary when they select different aspects of the same target. They can also compete when they assign different identity conditions, explanatory priorities, or causal mechanisms. The research task is to determine what each description preserves, what it omits, and whether their disagreement changes the target claim. Perspectival accounts of scientific representation are helpful here because they emphasize that observations and models are produced from structured perspectives while remaining answerable to the world and to comparative criticism (Giere 2006). GRE extends this lesson by treating ontological descriptions themselves as potentially plural and target-relative.

Definition 6.128 (Ontological description set). An *ontological description set* is a specified collection of alternative or complementary accounts of the objects and relations relevant to an inquiry, together with their scopes, identity criteria, explanatory roles, and known incompatibilities.

The set concept discourages opportunistic switching. A researcher should not use one ontology to secure a result and another to avoid its consequences without ex-

plaining the transition. Where descriptions are jointly used, the mapping between them should state what is preserved. A legal person and an organizational network may correspond in some respects while diverging in responsibility, persistence, and authority. A psychological state and a behavioral measure may be related without being identical. A relational field model and an institutional classification may reveal different structures of the same setting.

Proposition 6.129 (Plural description discipline). *Multiple ontological descriptions can coexist within one research programme when their scopes and translation relations are explicit, their disagreements remain visible, and stronger incompatibilities are investigated whenever they generate different evidential, explanatory, or practical consequences.*

The proposition avoids both premature unification and unrestricted pluralism. Some descriptions will prove empirically inadequate; others may become obsolete; some may be useful only at one scale; still others may reveal structures that a dominant ontology systematically hides. Ontological plurality becomes epistemically productive when disagreement is inspectable and when evidence can bear on the consequences of the competing descriptions.

6.9.6 Revision of Ontological Assumptions

Ontological assumptions can become objects of revision during inquiry. A study may begin by treating actors as independent units and later discover that their identities depend on institutional positions. A longitudinal project may find that the criterion used to identify the “same” organization fails after merger, fragmentation, or legal transformation. A computational model may reveal that an assumed binary category obscures a continuous or multi-dimensional structure. Field research may show that participant distinctions differ from the categories imposed by an administrative dataset. Historical evidence may demonstrate that a supposedly stable object is a recent institutional formation.

Revision occurs when the current ontology stops supporting adequate reconstruction of the target. This can appear as persistent anomaly, category instability, unexplained residuals, contradictory observations, failed interventions, translation breakdown, or inability to preserve identity across relevant transformations. Because assumptions occur in clusters, evidence may leave open which commitment requires revision. The holist problems emphasized by Duhem and Quine remain relevant: empirical tension does not always identify a single assumption whose rejection will repair the account (Duhem 1954; Quine 1951). Research therefore requires comparative revision rather than automatic abandonment of whichever category is most visible.

Definition 6.130 (Ontological assumption revision). *Ontological assumption revision is the documented modification of an inquiry’s commitments concerning objects, identity, persistence, relations, levels, or capacities when evidence or explanatory failure shows that the previous commitments are inadequate for the research task.*

A disciplined revision should preserve the history of the change. Researchers can record the earlier assumption, the evidence that made it problematic, alternative reconstructions considered, the new commitment adopted, and which results require

reinterpretation. This record matters because changing ontology can change the meaning of earlier data. If a “household” is redefined, a time series may no longer compare the same unit. If an “event” becomes a process, timing and causal attribution may need revision. If an actor becomes a distributed configuration, responsibility and intervention targets can change.

Proposition 6.131 (Revision propagation). *When an ontological assumption materially organizes measurement, classification, identity, or causal attribution, revision of that assumption should trigger review of the downstream claims and representations that depended on it.*

Revision is thus generative within research praxis. A changed ontological assumption can reorganize instruments, datasets, questions, models, and institutional relations, creating a new epistemic field for subsequent inquiry. This recursive effect connects ontological revision to the broader account of research as generative practice developed earlier in the chapter.

6.9.7 Practical Limits of Suspension

Ontological suspension has practical limits. Research sometimes reaches questions for which stronger ontological commitment is unavoidable because action, measurement, responsibility, or interpretation depends on the answer. An ethics protocol may need a working account of who counts as a participant. A legal study of responsibility may need criteria for agency and attribution. A clinical or educational intervention may require operational criteria for the subject or condition being treated. A computational governance system may need to distinguish tool, agent, delegate, and accountable institution. An ecological study may require explicit organism, population, or system boundaries because the intervention changes with the level selected.

The relevant limit is reached when continued suspension would prevent coherent design or conceal consequential alternatives. A research programme can postpone stronger ontology only while the suspended dispute remains non-operative for the tasks at hand. When competing ontologies imply different measurements, inclusion criteria, causal mechanisms, risk assignments, intervention targets, or normative responsibilities, researchers must either adjudicate among them, design the inquiry to compare them, or state a provisional commitment strong enough to proceed.

Definition 6.132 (Operative ontological threshold). *The operative ontological threshold is the point at which an unresolved ontological disagreement begins to produce materially different research objects, evidential interpretations, mechanisms, decisions, interventions, or responsibilities within the inquiry.*

This threshold is itself target- and phase-relative. Early exploratory research can often sustain wider suspension than later measurement or intervention. A descriptive project may defer a question that becomes unavoidable during causal attribution. Application-dominant praxis may require provisional closure because action cannot wait for final settlement. Conversely, new evidence can reopen a commitment that previously seemed adequate.

Suspension also has an institutional limit. Funding systems, databases, laws, ethics procedures, and technical infrastructures often require categorical decisions. Re-

searchers may therefore be compelled to operationalize an object more sharply than their theory warrants. The appropriate response is to distinguish institutional closure from ontological completion. A working category can be adopted for coordination while its provisionality, exclusions, and uncertainty remain documented.

Proposition 6.133 (Practical discipline of ontological suspension). *Ontological suspension is methodologically appropriate while stronger disagreement remains non-operative for the target inquiry; once the disagreement crosses the operative ontological threshold, research should make the competing commitments explicit and adopt, compare, or provisionally adjudicate them in proportion to the practical and epistemic consequences involved.*

This proposition completes the section's practical account. Ontological suspension neither eliminates ontology nor converts it into an indefinitely postponed philosophical problem. It organizes the timing and scope of commitment. Research begins with sufficiently specified objects, uses minimal and domain-sensitive commitments, permits multiple descriptions where their relations are explicit, revises assumptions when evidence requires it, and lifts suspension when stronger disagreements become operative. The result is a research praxis able to remain metaphysically restrained while still constructing objects, choosing methods, producing evidence, and acting under finite conditions. The next section turns from this disciplined restraint to a different moment of inquiry: encounter, through which something in the field becomes available to research before its eventual significance has been fully determined.

6.10 Encounter in Research

Section 6.9 established ontological suspension as a discipline for inquiry that permits sufficiently specified objects and commitments while stronger metaphysical questions remain open. The present section turns to an earlier and more elementary moment of research praxis: encounter. Its role is to describe how something becomes available to inquiry before its importance, explanatory role, or theoretical significance has been settled. The objective is to distinguish several forms of encounter—with existence, contingency, difference, anomaly, repetition, and unexpected relation—and to identify the historical, relational, and instrumental conditions through which encounters become possible. The discussion treats encounter as an epistemically consequential event within research praxis while preserving the distinction between encounter, salience, significance, and warranted interpretation. This distinction prepares the transition to the next section, where the problem becomes how some encounters acquire salience before their significance is known.

Definition 6.134 (Research encounter). *A research encounter is an event or episode within inquiry in which an object, trace, pattern, difference, absence, recurrence, or relation becomes available to a research praxis in a form capable of affecting subsequent attention, representation, interpretation, or investigation, whether or not its significance is immediately recognized.*

Definition 6.134 is intentionally broader than planned observation. An encounter can arise through a designed experiment, an interview, archival work, field observation, a model residual, an instrument reading, a failed intervention, a repeated ad-

ministrative irregularity, or a relation noticed across previously separated domains. Some encounters are actively sought; others emerge while the researcher is pursuing a different problem. Their epistemic role depends on what becomes available and on how the research process records, preserves, compares, and later interprets it.

6.10.1 Encounter with Existence

The most elementary research encounter is the encounter with something that resists being treated as merely hypothetical within the current inquiry. A trace is found in an archive; an instrument registers a signal; a participant describes a relation that had not entered the research design; a transaction appears in a dataset; a legal document establishes an institutional act; an observed practice persists despite expectations that it would disappear. Such encounters provide a practical sense that the inquiry is answerable to something beyond its existing conceptual organization.

Under ontological suspension, encounter with existence does not settle ultimate ontology. The relevant claim is narrower. Something has become evidentially available within a specified relation among object, observer, representation, and research setting. That availability can constrain inquiry even when the stronger ontological status of the encountered object remains open.

Definition 6.135 (Encounter with existence). An *encounter with existence* is a research encounter in which a manifestation, trace, resistance, or effect provides reason to treat some object, event, relation, or process as evidentially operative within the scope of inquiry.

This definition preserves the architecture developed in Chapters 4 and 5. Manifestation does not provide transparent access to ontological reality, and the presence of a trace does not by itself determine the relation that generated it. The encounter nevertheless matters because the field can constrain the researcher's expectations. Peirce's account of inquiry beginning from genuine doubt is relevant here: inquiry becomes substantive when an unsettled condition exerts pressure on belief rather than remaining a merely verbal question (Peirce 1877). Dewey's treatment of experience likewise emphasizes interaction with conditions that can interrupt established habits and reorganize subsequent inquiry (Dewey 1925).

Remark 6.136 (Existence and evidential resistance). An encounter can be epistemically important because it resists an existing representation while still leaving open several competing accounts of what the encountered object or relation is.

Encounter therefore precedes ontological closure. Its immediate contribution is to enlarge or disturb the evidential field.

6.10.2 Encounter with Contingency

Research also encounters contingency: events, conjunctions, opportunities, failures, or exposures whose occurrence was not entailed by the current research plan. Contingency in this sense is broader than randomness. A contingent encounter can be causally structured while remaining unforeseen, timing-dependent, or dependent on a conjunction of conditions that the research design did not anticipate.

A researcher may meet an informant because an interview is cancelled, discover a

relevant archive while following a different citation, observe an institutional failure during an unusual transition, or notice a theoretical relation while working across disciplines. The epistemic importance of such events cannot be inferred from their accidental appearance alone. Their role arises from the interaction between the contingent event and an existing research configuration capable of recording, interpreting, and following it.

Definition 6.137 (Contingent research encounter). A *contingent research encounter* is an encounter whose occurrence, timing, or accessibility depends on conditions that were not required by the active research design and whose research relevance emerges only through subsequent relation to the inquiry.

Dewey's discussion of existence as containing precarious as well as stable conditions provides one philosophical precedent for treating contingency as a normal feature of inquiry rather than as an external disturbance (Dewey 1925). GRE adds a relational emphasis: contingency becomes epistemically productive through the relation among event, prepared concepts, available instruments, researcher attention, historical circumstance, and later interpretation.

Proposition 6.138 (Contingency and epistemic preparedness). *The research value of a contingent encounter depends partly on whether the surrounding praxis possesses sufficient conceptual, evidential, institutional, and recording capacity to preserve the encounter for later examination.*

Proposition 6.138 explains why the same event can remain irrelevant in one research setting and become generative in another. Preparedness does not predetermine meaning. It supplies conditions under which an unforeseen event can enter an inspectable research trajectory.

6.10.3 Encounter with Difference

Difference becomes research-relevant when an encounter reveals that cases, actors, relations, times, scales, or representations previously treated as equivalent behave differently in ways that matter to the inquiry. Difference can arise through comparison, translation, field movement, longitudinal observation, or the juxtaposition of heterogeneous evidence.

Research often begins with categories that compress variation. Such compression is necessary for description and comparison, yet an encounter may expose a remainder that the category suppresses. Two institutions classified identically can operate through different informal relations. The same legal rule can produce different practices across organizations. A variable with the same recorded value can arise from different processes. A concept transported across languages can acquire a different practical field of meaning.

Definition 6.139 (Difference encounter). A *difference encounter* is a research encounter in which a previously assumed equivalence, continuity, comparability, or shared category becomes insufficient for representing a contrast that is relevant to the research target.

Difference need not immediately invalidate the category. It may reveal a subcategory, a scale effect, a boundary condition, a historical transformation, or a different

generative pathway. The appropriate response is therefore diagnostic. Researchers can ask which feature differs, whether the difference persists, what relation produces it, and whether the existing representation should be refined, localized, or replaced.

Hacking's historical work is relevant because objects and classifications can acquire different forms across changing styles of reasoning and institutional practices (Hacking 2002). A difference encounter can therefore reveal more than variation among stable objects; it can reveal that the conditions under which objects become comparable have themselves changed.

Caution 6.140 (Difference and premature taxonomy). An encountered difference should not automatically be converted into a new durable category. Its stability, explanatory relevance, scale, and historical conditions require examination before categorical institutionalization.

6.10.4 Encounter with Anomaly

An anomaly is a difference indexed to an expectation. It arises when an observation, trace, result, or event conflicts with what an active theory, model, classification, procedure, or background regularity leads the researcher to anticipate. The epistemic status of an anomaly therefore depends on both the encountered material and the expectation against which it appears anomalous.

Kuhn's analysis of scientific practice makes anomaly central to the historical dynamics of research, while also showing that anomalies do not automatically dissolve the frameworks within which they are recognized (Kuhn 1962). GRE adopts this restrained lesson. An anomaly can indicate measurement error, sampling variation, an unmodeled condition, a boundary failure, historical change, a new relation, or inadequacy in the current theoretical architecture. Its value lies in opening a disciplined diagnostic problem.

Definition 6.141 (Research anomaly). A *research anomaly* is an encounter whose manifestation is materially inconsistent with an expectation generated by the active evidential, classificatory, methodological, or theoretical organization of inquiry.

Anomalies differ in depth. A local residual may require a parameter adjustment; a repeated contradiction may expose an omitted relation; an unexpected historical sequence may challenge an assumed mechanism; a new object may require revision of the ontology through which the inquiry was constructed. The appropriate response depends on persistence, provenance, reproducibility where relevant, and comparison with alternative explanations.

Proposition 6.142 (Anomaly preservation). *When an anomalous encounter is sufficiently credible to challenge an active expectation, the anomaly and the expectation against which it was identified should both be preserved so that later inquiry can reconstruct whether the tension arose from evidence, representation, method, boundary, or theory.*

Preserving both sides of the tension is important. If later revisions erase the earlier expectation, the historical generativity of the anomaly can become invisible.

6.10.5 Encounter with Repetition

Encounter is often associated with novelty, yet repetition can also become epistemically consequential. A single event may appear incidental, while recurrence across times, actors, sites, or instruments can make a relation newly available to inquiry. Repetition can reveal persistence, regularity, institutional reproduction, patterned omission, recurrent failure, or a stable manifestation process.

Repeated encounter does not establish identity or necessity. Section 120 showed that persistence requires an explicit identity criterion, and Chapter 5 treated repeated observation as distinct from historical continuity. The same discipline applies here. What repeats may be a surface manifestation generated by different relations, or different manifestations may express one persistent relation.

Definition 6.143 (Repetition encounter). A *repetition encounter* is the recognition that manifestations, traces, absences, practices, or relational configurations recur across observations in a way that makes their continuity, reproduction, or common generative conditions available for investigation.

Repetition can change the epistemic status of what was previously background noise. A recurring administrative discrepancy may indicate a routine practice; repeated testimony across differently positioned participants may reveal a distributed relation; persistent model residuals may signal structural misspecification; recurrent failures of an intervention may expose a constraint omitted from the design.

Remark 6.144 (Repetition and generative reproduction). Repeated manifestations can motivate inquiry into reproduction mechanisms, yet recurrence alone does not identify the relation or process that generates the repetition.

This distinction allows repetition to become a source of inquiry without turning regularity directly into explanation.

6.10.6 Encounter with Unexpected Relation

Some encounters reveal a relation between objects, domains, scales, histories, or practices that the research design had previously treated as separate. An unexpected relation can appear through comparative work, interdisciplinary movement, qualitative testimony, statistical association, archival coincidence, network reconstruction, or the juxtaposition of theories developed for different problems.

The encounter is epistemically distinctive because the novelty lies in the connection itself. A researcher may discover that an apparently technical classification reorganizes access to resources, that an economic pattern depends on a legal category, that a local practice is stabilized by a distant infrastructure, or that a recurring conceptual problem in one discipline has an analogue in another. Such encounters can generate new questions before they support new answers.

Definition 6.145 (Unexpected relational encounter). An *unexpected relational encounter* is the emergence within inquiry of a plausible connection among objects, processes, domains, scales, or representations whose relation was not part of the active research architecture.

Plausibility here is intentionally preliminary. An unexpected relation can be spu-

rious, metaphorical, scale-dependent, or produced by a shared third condition. The discovery of a possible connection therefore opens an evidential task: specify the relation, identify manifestations, examine alternatives, reconstruct relevant histories, and test whether the connection survives changes in boundary and representation.

Proposition 6.146 (Relational discovery and inferential restraint). *An unexpected relational encounter can justify expansion of inquiry before it justifies a substantive relational or generative claim. The evidential burden increases when the proposed connection moves from analogy or co-occurrence toward mechanism, persistence, or generative attribution.*

This proposition connects encounter to the epistemic standards of Chapter 5. Discovery enlarges the research space; warrant determines what can responsibly be claimed within that enlarged space.

6.10.7 Historical Conditions of Encounter

What researchers can encounter depends partly on historical conditions. Instruments become available, archives are preserved or destroyed, categories enter institutional use, new objects emerge, technologies create previously impossible traces, and disciplinary vocabularies make some differences easier to articulate. Encounter is therefore historically distributed even when the encountered relation has a history independent of the researcher's conceptual vocabulary.

Kuhn shows how paradigmatic organization structures the problems and observations available within scientific practice (Kuhn 1962). Hacking's account of historical ontology likewise emphasizes the emergence of concepts, classifications, and objects through historically specific practices (Hacking 2002). GRE uses these insights to distinguish the history of an object or relation from the history of its encounterability. A relation may operate before researchers possess the concepts or instruments needed to identify it.

Definition 6.147 (Historical encounter condition). *A historical encounter condition is a historically specific configuration of concepts, institutions, records, technologies, practices, and social relations that affects whether and how a target can become available to inquiry.*

Historical conditions can create both visibility and absence. A new administrative system can produce rich records while suppressing relations that fall outside its categories. Digital infrastructure can make interaction traceable at scale while creating forms of behavior optimized for the platform that records them. Archival preservation can reveal past institutions while systematically underrepresenting informal actors whose activities were weakly documented.

The methodological implication is that absence of encounter requires historical interpretation. Researchers should ask whether the target was absent, unrecorded, inaccessible, conceptually unavailable, institutionally excluded, or lost through preservation practices. Historical reconstruction of encounter conditions therefore becomes part of evidential provenance.

6.10.8 Relational Conditions of Encounter

Encounter is also relationally conditioned in the present. Access often depends on trust, gatekeeping, institutional membership, language, collaboration, timing, participant willingness, and the researcher's position described in Section 6.8. What appears to be an individual moment of discovery may therefore have a distributed relational infrastructure.

A fieldworker may encounter a practice because a participant grants access. An archival discovery may depend on cataloguing work performed by others. A dataset may become available through institutional agreements. An interdisciplinary connection may arise through a collaborator who translates concepts across fields. A computational anomaly may become visible because engineers preserved diagnostic logs. Encounter therefore has contributors whose role can disappear when discovery is narrated as the achievement of a single observer.

Definition 6.148 (Relational encounter condition). A *relational encounter condition* is a relation or configuration of relations that materially affects access to, recognition of, preservation of, or interpretive engagement with a potential research encounter.

Longino's account of knowledge production through critical interaction among differently positioned inquirers provides one relevant precedent for understanding epistemic work as socially organized (Longino 1990). For GRE, the stronger implication is generative: relations among researchers, participants, institutions, communities, and infrastructures can create the conditions under which new encounters become possible.

Caution 6.149 (Attribution of discovery). Narratives of discovery should distinguish the person who first articulates an encounter from the relational and infrastructural conditions that made the encounter possible, especially when access, preservation, translation, or interpretation was distributed across contributors.

This caution anticipates later questions of collective and distributed knowledge production while remaining focused on the immediate conditions of encounter.

6.10.9 Instrument-Mediated Encounter

Many research encounters occur through instruments. Instruments include laboratory devices, surveys, legal databases, archives, sensors, statistical procedures, visualization systems, computational models, machine-learning pipelines, and classificatory infrastructures. Instruments extend perception and comparison, yet they also select, transform, aggregate, and represent what becomes available.

Instrument mediation therefore creates a double epistemic task. Researchers need to understand what the instrument makes accessible and how the instrument participates in producing the form of the encounter. A sensor samples at a specified resolution; a survey supplies response categories; an archive preserves selected records; a network model represents relations as edges; an algorithmic detector identifies patterns according to training data and design choices. The resulting encounter is neither a transparent copy of reality nor merely an artifact of the instrument. Its warrant depends on reconstructing the mediation.

Definition 6.150 (Instrument-mediated encounter). An *instrument-mediated en-*

counter is a research encounter whose accessibility or form depends materially on a device, procedure, representational system, or computational infrastructure that transforms aspects of the target into inspectable traces.

Instrument-mediated encounter connects directly to the epistemology of manifestation and representation in Chapter 5. The instrument can make previously inaccessible relations observable while introducing resolution limits, missingness, thresholds, classification effects, or feedback into the field. When instruments change historically, the space of possible encounters can change with them.

Proposition 6.151 (Instrument provenance in encounter). *When an encounter depends materially on an instrument, the instrument's relevant selection, transformation, resolution, and error conditions should remain part of the provenance of the resulting research object or trace.*

Instrument provenance becomes especially important when a surprising result is visible only under one pipeline or representation. Replication may then require reproduction of the mediating conditions as well as access to the underlying target.

6.10.10 Encounter without Immediate Significance

A research encounter can occur without becoming immediately important. A detail may be recorded and ignored, a discrepancy may remain unexplained, a fieldnote may acquire relevance years later, or an association may appear trivial until another theory makes its structure intelligible. Encounter and significance therefore belong to different moments of praxis.

This temporal separation is epistemically important. If research preserves only what already appears meaningful, later inquiry inherits an evidential field filtered by earlier judgments of relevance. At the same time, unlimited preservation is impossible: recording has costs, ethical constraints, privacy consequences, and practical limits. The methodological problem is therefore selective preservation under uncertainty about future significance.

Definition 6.152 (Deferred significance). *Deferred significance* is the condition in which a recorded encounter acquires research importance only after later evidence, concepts, comparisons, historical developments, or relational reconstructions alter its interpretive context.

Deferred significance connects encounter to the book's broader account of historical re-epistemization. Later knowledge can make an earlier trace newly interpretable without implying that its later meaning was already fully contained in the original encounter. The relation between encounter and significance can itself be historically generated.

Proposition 6.153 (Preservation under uncertain significance). *Research practices should preserve encounters beyond their currently recognized significance when the expected future epistemic value, uniqueness, or irreproducibility of the trace justifies the material, ethical, and governance costs of preservation.*

The proposition is intentionally conditional. Some traces should be discarded, anonymized, or left uncollected because preservation would impose disproportionate risk. Others merit preservation precisely because they cannot easily be

encountered again. The key is to make the selection logic inspectable rather than allowing present salience to function as an invisible filter on the future evidential field.

Encounter therefore marks an opening rather than a completed judgment. Something becomes available: an existence, contingency, difference, anomaly, repetition, unexpected relation, or instrumentally mediated trace. Historical and relational conditions shape whether that encounter occurs and whether it survives. Its significance may remain unknown. The next section examines the intermediate problem that follows: how some encounters become salient enough to attract attention before their eventual epistemic, theoretical, practical, or normative significance has been established.

6.11 Salience before Significance

Section 6.10 distinguished encounter from later judgments of importance and showed that a research object, anomaly, recurrence, or relation can enter inquiry before its significance is known. The present section examines the intermediate process through which some encounters become sufficiently prominent to attract sustained research attention. Its role is to separate *salience* from both mere availability and attributed significance. The objective is to identify several conditions through which salience can arise—attention, surprise, contrast, repetition, and anomaly—while also showing why salience can diverge from epistemic, theoretical, practical, or normative importance. The final subsections widen the analysis from individual attention to the historical and institutional distribution of attention. The discussion therefore treats salience as a relational and historically organized condition of research praxis rather than as a reliable indicator of what ultimately deserves inquiry. This prepares Section 145, where the problem shifts from what attracts attention to how researchers judge significance, worthiness, and generative promise.

Definition 6.154 (Research salience). *Research salience* is the condition in which an encountered object, trace, pattern, difference, relation, or question acquires sufficient prominence within a research praxis to attract or sustain attention before its epistemic, theoretical, practical, or normative significance has been established.

Definition 6.154 deliberately places salience between encounter and judgment. An encounter can remain weakly noticed; a salient encounter can later prove unimportant; and an important phenomenon can remain non-salient for long periods. Chapter 2 reconstructed psychological, phenomenological, and economic lineages of attention and salience in its section on appearance, perception, and salience. The present section uses that groundwork more narrowly for research praxis: it asks how selective prominence organizes what researchers follow, preserve, compare, formalize, and eventually judge.

6.11.1 Salience of Encounter

An encounter becomes salient when it stands out sufficiently within the active research field to reorganize attention. The relevant field can include observations, con-

cepts, cases, instruments, hypotheses, anomalies, conversations, archival materials, model outputs, or unresolved practical problems. Salience therefore concerns relative prominence within a configuration rather than an intrinsic property carried by an object independently of context.

This relational character is important. The same observation can be salient in one research configuration and ordinary in another. A small discrepancy can become prominent when a theory predicts near identity, while a much larger difference may remain unsurprising in a highly variable field. An archival phrase can become salient after a conceptual distinction has been learned. A familiar institutional practice can become newly prominent when comparison with another site reveals that it is historically contingent rather than necessary. Salience can therefore be generated by changes in the object, the surrounding comparison field, or the researcher's conceptual and practical orientation.

Definition 6.155 (Salience relation). A *salience relation* is a relation between an encountered element and a research configuration through which that element becomes comparatively prominent for attention, recording, comparison, or follow-up inquiry.

The definition helps prevent an object-centered interpretation of salience. What stands out does so against a background. Merleau-Ponty's treatment of figure-ground organization provides one relevant philosophical lineage for this contextual structure of perception (Merleau-Ponty 2012). GRE does not import the full phenomenological theory into research methodology. The narrower inheritance is that prominence depends partly on an organized field within which something can become figure rather than remain background.

Remark 6.156 (Salience and significance). Salience identifies a condition of selective prominence. Significance requires a further judgment concerning why the salient object matters and for which epistemic, theoretical, practical, or normative purpose.

This distinction makes salience epistemically useful without allowing attention itself to certify importance.

6.11.2 Attention

Salience becomes practically consequential through attention. Research fields usually contain more potentially relevant material than an individual or institution can examine simultaneously. Attention therefore operates as a selective resource: some encounters are followed, recorded, discussed, replicated, formalized, or funded, while others remain peripheral.

William James's classical treatment of attention emphasizes selective focalization among simultaneously possible objects or trains of thought (James 1890). Simon later expressed a related organizational problem in information-rich environments: abundance of information consumes the scarce attention of recipients and creates a need to allocate that attention (Simon 1971). These accounts differ in level and purpose, yet both support a basic research-praxis point. Increased informational availability does not remove selection; it can intensify the problem of selection.

Definition 6.157 (Research attention allocation). *Research attention allocation* is the

distribution of finite observational, interpretive, temporal, computational, and institutional effort among potentially research-relevant encounters, objects, questions, and relations.

Attention allocation is broader than conscious concentration by an individual researcher. Search interfaces, literature databases, conference programmes, citation systems, review procedures, laboratory schedules, grant calls, journal scopes, data pipelines, and institutional priorities can all participate in determining what receives sustained attention. The resulting allocation may be explicit or emerge from many local decisions.

Attention also has temporal structure. A phenomenon can receive a brief burst of attention without generating sustained inquiry, while another can acquire durable salience through repeated observation, institutional commitment, or cumulative evidence. Research praxis therefore needs to distinguish immediate attentional capture from longer-term allocation of investigative effort.

Proposition 6.158 (Attention and research trajectory). *Because sustained inquiry requires selective allocation of finite effort, patterns of attention can materially condition which encounters develop into articulated problems, preserved evidence, mature theories, or practical interventions.*

Proposition 6.158 does not imply that attention creates the truth of what is studied. It states that attention helps organize which parts of a partially accessible field receive the work required for stronger warrant.

6.11.3 Surprise

Surprise is one route through which an encounter becomes salient. A result differs from expectation; a participant gives an unanticipated answer; a model fails in an unexpected region; a historical sequence violates an assumed trajectory; an institution behaves differently from analogous cases. Surprise directs attention because an active expectation has been disturbed.

Surprise is therefore relational to an expectation structure. The same event can be surprising to one theoretical framework and unsurprising to another. A novice may be surprised by a regular feature that experts already anticipate, while an expert may notice a subtle deviation invisible to a novice. Surprise consequently provides information about the relation between encounter and prior expectation as well as about the encountered object itself.

Definition 6.159 (Research surprise). *Research surprise* is a salience-generating discrepancy between an encounter and an active expectation, representation, prediction, habitual classification, or anticipated relation within inquiry.

This definition links surprise to the researcher's epistemic-theoretical system developed in Section 137. A surprise can expose a local prediction failure, an omitted variable, a category mistake, an unmodeled boundary condition, a historically novel process, or a more fundamental inadequacy in the current theory. The appropriate interpretation remains open at the moment of salience.

Caution 6.160 (Surprise and novelty). Surprise should not be treated as direct evidence that the encountered phenomenon is objectively novel, theoretically deep, or

historically unprecedented. It can arise from limited prior knowledge, local expectation, instrumentation, or an inappropriate comparison class.

Surprise therefore invites inquiry rather than completing it. Its research value lies partly in making expectation structures inspectable.

6.11.4 Contrast

Contrast produces salience when an encounter stands out relative to neighboring cases, alternatives, baselines, or representations. Differences in magnitude, direction, category, timing, spatial position, relational role, or visual form can all make something prominent. Contrast is especially important because research often depends on comparative organization: without a background or reference class, many differences cannot become perceptually or analytically salient.

Behavioral-economic salience theory offers a specific formal example in which attributes that stand out relative to alternatives receive disproportionate decision weight (Bordalo et al. 2012). GRE uses *research salience* more broadly and does not assume the same mechanism. The comparison is nevertheless useful because it emphasizes that salience can depend on relational contrast rather than absolute magnitude.

A contrast can be generated by research design. Comparative cases, counterfactual models, visualizations, standardized measures, difference-in-differences structures, historical periodization, or alternative textual interpretations can make previously diffuse variation visible. Design therefore participates in the production of salience. A researcher who changes the comparison set can change what stands out even when the underlying observations remain unchanged.

Definition 6.161 (Contrast-generated salience). *Contrast-generated salience* is prominence produced through the relation between an encounter and a comparison structure that makes a difference more inspectable than it was within the previous research configuration.

The epistemic implication is double. Deliberate comparison can reveal important structure, yet poorly chosen contrasts can manufacture prominence around incidental differences. Comparison design therefore belongs to the provenance of salience.

6.11.5 Repetition

Section 6.10 treated repetition as a form of encounter. Repetition can also generate salience. An isolated irregularity can be dismissed as noise, while recurrence across observations, sites, actors, periods, or instruments can make the pattern difficult to ignore. The research significance of repetition, however, depends on more than frequency alone.

Repeated exposure can operate in several directions. Recurrence may increase salience because it suggests persistence or reproduction. It may also reduce salience through habituation: a phenomenon becomes so familiar that it recedes into the background. Routine administrative exclusion, chronic infrastructural failure, persistent unpaid work, or stable measurement bias may become less noticeable precisely because they are ordinary. Repetition therefore has an ambiguous relation to attention.

Proposition 6.162 (Dual effect of repetition on salience). *Repetition can increase salience when recurrence becomes evidence of a pattern requiring explanation, while repeated familiarity can also normalize a phenomenon and reduce its attentional prominence.*

This dual effect matters for research praxis. A method designed only to detect unusual deviations may systematically under-attend to persistent conditions that are important because they are stable. Conversely, a method that treats every recurrence as evidence of common generation can confuse repeated manifestation with shared mechanism. The epistemic task is to reconstruct what the repetition represents and how the attention regime responds to familiarity.

Remark 6.163 (Ordinariness as a research problem). The absence of surprise should not be treated as evidence of the absence of significance. Durable relations can become epistemically backgrounded through familiarity, institutional normalization, or routine measurement.

This point prepares the later discussion of importance without initial salience.

6.11.6 Anomaly

Anomaly is another route from encounter to salience. Section 143 described an anomaly as an encounter that sits uneasily with an active expectation, category, model, or procedure. Here the focus shifts to what happens when that mismatch captures research attention.

Kuhn's historical account of normal science is relevant because anomalies acquire meaning within paradigmatically organized puzzle-solving rather than as theory-independent facts announcing their own importance (Kuhn 1962). GRE retains this contextual lesson while avoiding a direct transfer of Kuhn's larger historical model. An anomaly becomes salient relative to a research architecture that specifies what counts as expected, residual, failed, or unresolved.

Some anomalies deserve sustained attention because they reveal a systematic mismatch. Others disappear after correction of coding errors, instrument calibration, sampling artifacts, or misclassification. Still others remain unresolved for long periods without becoming decisive. Salience is therefore an invitation to diagnostic work rather than a verdict on theoretical status.

Definition 6.164 (Anomaly salience). *Anomaly salience* is the prominence acquired by an encounter because it conflicts with, escapes, or remains insufficiently represented by an active expectation, category, model, or research procedure.

Proposition 6.165 (Anomaly triage). *The appropriate response to a salient anomaly is to discriminate among possible sources of mismatch—including data production, instrumentation, representation, boundary choice, model specification, historical transformation, and the target process itself—before assigning broader theoretical significance.*

Anomaly triage keeps the research process open to revision while preventing every mismatch from being inflated into a foundational crisis.

6.11.7 Salience without Importance

Salient objects can be unimportant. Novelty, vividness, controversy, large effect size, visual contrast, institutional publicity, or technical sophistication can attract attention without corresponding to the most consequential research problem. The gap between salience and importance is therefore not an exceptional failure; it is a structural possibility whenever attention is selectively organized.

Research salience can be amplified by publication incentives, available datasets, methodological fashion, dramatic cases, reputational competition, or the ease with which a phenomenon can be represented. A highly measurable problem may receive more attention than a difficult-to-measure relation whose effects are more consequential. A spectacular failure can dominate discussion while routine processes generate larger cumulative effects. A technically challenging question can attract effort because it is tractable within existing methods even when its substantive importance remains modest.

Definition 6.166 (Salience–significance gap). A *salience–significance gap* occurs when the degree of attention attracted by an encounter or problem diverges materially from the significance later warranted for the relevant epistemic, theoretical, practical, or normative purpose.

The definition is retrospective only in part. Researchers can often identify reasons to suspect such a gap before significance is settled: attention may be driven by media visibility, instrument convenience, novelty, disciplinary fashion, or one unusually dramatic case. These signals do not justify dismissing the salient object. They justify making the source of salience explicit.

Caution 6.167 (Attentional prominence). Attentional prominence should not be used as a proxy for explanatory depth, social importance, normative urgency, or generative potential without an additional argument connecting the source of salience to the relevant criterion of significance.

Section 145 will develop that additional judgment problem.

6.11.8 Importance without Initial Salience

The converse problem is equally important. A phenomenon can matter greatly while initially attracting little attention. Its effects may be slow, distributed, familiar, weakly represented, institutionally inconvenient, difficult to measure, or located outside established disciplinary categories. Importance can therefore precede salience in the world even when recognition of importance follows salience in the research process.

Several classes of case are especially vulnerable to low initial salience. Background infrastructures can be noticed mainly when they fail. Maintenance work can disappear behind visible innovation. Long-horizon ecological change can be difficult to perceive within short research cycles. Informal relations can leave fewer administrative traces than formal transactions. Distributed contributions can be overshadowed by visible outcome points. Common experiences can be treated as analytically uninteresting because they lack contrast. These examples differ substantively, yet they share a research-praxis problem: what matters may not automatically solicit

attention.

Definition 6.168 (Latent research importance). *Latent research importance* is the condition in which an object, relation, process, or problem possesses potentially substantial epistemic, theoretical, practical, or normative relevance while remaining weakly salient within the active attention regime of inquiry.

Latent importance is difficult to detect precisely because the relevant object is not already prominent. Methodological pluralism, historical comparison, participation by differently positioned researchers and communities, long-horizon observation, preservation of low-salience traces, and deliberate examination of background conditions can all enlarge the chance that such objects become available for judgment. Longino's emphasis on critical interaction among differently positioned inquirers is relevant here because heterogeneous perspectives can expose background assumptions and neglected evidence that remain invisible within a more homogeneous research community (Longino 1990).

Proposition 6.169 (Search beyond salience). *A research praxis concerned with generative and relational processes should allocate some investigative capacity to low-salience background relations, slow transformations, ordinary practices, and weakly represented phenomena when there are reasons to suspect that conventional attention mechanisms systematically under-register them.*

The proposition does not require indiscriminate search. It requires awareness that attention regimes have blind spots and that some research effort may need to be directed toward what does not naturally stand out.

6.11.9 Historical Distribution of Attention

Research attention is historically distributed. The same object can be central in one period and peripheral in another because instruments, concepts, public problems, political conditions, disciplinary structures, or available archives change. Historical shifts can also reorganize the background against which salience is produced. A phenomenon that once appeared ordinary can become newly problematic; an older controversy can lose attention despite remaining unresolved; new categories can make previously dispersed evidence mutually legible.

Kuhn's account of normal science illustrates one way in which historically organized research traditions structure puzzle selection and expectations (Kuhn 1962). Hacking's historical work on categories and styles of reasoning provides another relevant lineage for understanding how objects of inquiry become available through historically formed conceptual and classificatory conditions (Hacking 2002). GRE adds a praxis emphasis: historical conditions distribute not only concepts but also attention, instruments, time, repositories, career incentives, and pathways through which encounters can become sustained research problems.

Definition 6.170 (Historical attention regime). *A historical attention regime* is a temporally situated configuration of concepts, problems, instruments, institutions, practices, and expectations that conditions which research encounters are likely to become salient and which are likely to remain backgrounded.

Historical attention regimes can create cumulative advantages. Once a problem re-

ceives sustained study, it generates methods, datasets, terminology, specialized journals, trained researchers, and funding structures that make further work easier. Another problem of comparable or greater importance may remain difficult to study because it lacks such infrastructure. This path dependence does not make established research illegitimate. It makes the historical production of salience relevant to understanding why some knowledge domains become dense while others remain sparse.

Remark 6.171 (Retrospective salience). Later historical developments can make earlier traces newly salient. Such retrospective salience should be distinguished from the attention actually available to historical actors at the time.

The distinction protects historical interpretation from projecting present priorities backward while still allowing later research to reorganize the evidential field.

6.11.10 Institutional Distribution of Attention

Attention is also institutionally distributed. Research organizations, funders, journals, universities, laboratories, data infrastructures, professional associations, states, firms, communities, and digital platforms participate in selecting which questions receive resources and visibility. Institutional attention is not reducible to intentional agenda setting by a single actor. It can emerge from funding rules, evaluation metrics, administrative categories, publication formats, infrastructure investments, ethical restrictions, proprietary access, or accumulated disciplinary routines.

Simon's analysis of attention under information abundance is especially relevant at this organizational level because institutions must allocate scarce attentional capacity among competing informational demands (Simon 1971). The allocation becomes epistemically consequential when it determines which encounters are investigated deeply enough to produce cumulative evidence. Institutional organization can therefore amplify salience through repeated calls, dedicated programmes, specialist venues, standardized indicators, or data availability.

Definition 6.172 (Institutional attention allocation). *Institutional attention allocation* is the distribution of organizational visibility, time, resources, infrastructure, evaluative recognition, and access across research objects, questions, methods, and communities.

Institutional allocation can productively concentrate effort. Complex scientific problems often require durable infrastructures and coordinated communities. Concentration nevertheless has opportunity costs. Resources directed toward one research trajectory are unavailable elsewhere, and institutional categories can make some problems easier to articulate than others. A relational account therefore examines both the knowledge generated by concentrated attention and the alternatives left weakly developed.

Proposition 6.173 (Institutional salience and epistemic plurality). *When institutional attention is strongly concentrated, maintaining epistemic plurality requires channels through which low-salience questions, alternative representations, minority interpretations, and emerging objects can remain visible enough to receive critical examination.*

This proposition connects attention to the later sections on methodological pluralism, researcher power, epistemic justice, collective knowledge production, and open

cumulative research practice. Its immediate point is narrower: salience is partly produced by institutional relations, and those relations shape the future research field.

The distinction established across this section can now be stated clearly. Encounter concerns what becomes available to inquiry. Salience concerns what becomes sufficiently prominent to attract or sustain attention. Significance concerns the further judgment that an encountered and perhaps salient object matters according to specified epistemic, theoretical, practical, aesthetic, or normative criteria. Surprise, contrast, repetition, and anomaly can generate salience, yet none guarantees importance. Historical and institutional arrangements distribute attention unevenly, making some objects highly visible and leaving others weakly attended despite possible importance. Research praxis therefore requires both responsiveness to salience and disciplined distance from it. Section 145 turns to the next problem: the forms of judgment through which researchers attribute significance, select worthy questions, and evaluate generative promise.

6.12 Judgment in Research

Section 6.11 distinguished encounter, salience, and significance. An encounter can become prominent without thereby becoming important, while an important relation or problem can remain weakly salient within an established attention regime. The present section develops the mediating problem of judgment. Its role is to explain how researchers move from selective prominence toward provisional assessments of epistemic, theoretical, practical, aesthetic, or normative significance. The objective is neither to reduce judgment to subjective preference nor to turn it into an algorithmic ranking procedure. Instead, the section treats research judgment as a historically situated, relationally conditioned, evidence-constrained, and revisable moment of praxis. The discussion distinguishes aesthetic, epistemic, and normative judgment; examines the attribution of significance and the worthiness of questions; separates difficulty from importance; analyzes elegance, surprise, and generative promise; and concludes with the plurality, conflict, and revisability of research judgment. This prepares Section 146, where judgment begins to orient the selection and sustained organization of inquiry.

Definition 6.174 (Research judgment). A *research judgment* is a provisional assessment through which an encounter, question, representation, explanation, method, or research trajectory is evaluated relative to one or more epistemic, theoretical, practical, aesthetic, or normative criteria within a specified research context.

Definition 6.174 makes judgment broader than verification. Some judgments concern whether evidence warrants a claim; others concern whether a question is worth sustained inquiry, whether a representation exhibits useful simplicity or coherence, whether a research trajectory is ethically acceptable, or whether an unexpected finding has sufficient generative promise to preserve and develop. These judgments can interact while remaining analytically distinct.

6.12.1 Aesthetic Judgment

Aesthetic judgment enters research when researchers experience or assess qualities such as elegance, economy, symmetry, simplicity, depth, surprising fit, explanatory shape, or a sense that disparate elements belong together. Such judgments can arise before a complete evidential account is available. A conjecture can appear beautiful before it is proved; a model can appear elegant before its empirical limits are known; a research question can feel generative before its tractability is established.

Kant's analysis of aesthetic judgment provides a classical philosophical vocabulary for distinguishing judgments of taste from straightforward determinations of objective properties, while emphasizing their distinctive claim to communicability (Kant 1987). GRE does not import Kant's aesthetics as a general theory of scientific judgment. The relevant lesson is narrower: an aesthetic response can have a recognizable structure without functioning as a direct measurement of truth. Dewey's processual account of aesthetic experience is also pertinent because it places aesthetic quality within temporally organized interaction rather than treating beauty as a detached property of an isolated object (Dewey 1934).

Definition 6.175 (Aesthetic research judgment). An *aesthetic research judgment* is an assessment of the form, coherence, economy, elegance, surprise, felt fit, or generative appeal of a research object, question, representation, explanation, or trajectory, made without treating those qualities as sufficient evidence of truth or normative desirability.

Aesthetic judgment can be epistemically productive because it helps allocate attention. A researcher may notice an unexpectedly compact relation, a symmetry among cases, a striking mismatch, or an elegant reformulation that makes previously disconnected observations mutually intelligible. The judgment can motivate further investigation even when its evidential status remains provisional.

Scientific history also cautions against treating aesthetic preference as timeless. McAllister's analysis of aesthetic evaluations in science shows that criteria of beauty and preference in theory assessment can themselves have histories and can shift during scientific change (McAllister 1996). Aesthetic judgment can therefore be research-generative while remaining historically formed and open to correction.

Caution 6.176 (Aesthetic warrant). Aesthetic attractiveness can justify attention, preservation, comparison, or further inquiry, yet it does not by itself establish empirical adequacy, explanatory correctness, causal attribution, or normative legitimacy.

6.12.2 Epistemic Judgment

Epistemic judgment concerns whether a claim, explanation, representation, or method is sufficiently supported for the purpose at hand. It draws on the architecture developed in Chapter 5: provenance, manifestation, boundary and scale, uncertainty, alternative explanations, historical conditions, and revisability all affect what can responsibly be claimed.

Definition 6.177 (Epistemic research judgment). An *epistemic research judgment* is an assessment of the warrant, reliability, explanatory adequacy, inferential reach, uncertainty, or revisability of a research claim or representation relative to specified

evidence and scope conditions.

Epistemic judgment is required because evidence rarely interprets itself. Researchers decide whether a discrepancy is material, whether a representation is sufficiently adequate for its target, whether an inference exceeds its evidential base, whether alternative explanations remain live, and whether a claim is mature enough for provisional acceptance. Such judgments can be disciplined without becoming mechanical.

Longino's account of scientific objectivity as depending partly on critical interaction is relevant because it locates epistemic evaluation within practices of criticism, uptake, and heterogeneous perspectives rather than within isolated individual cognition alone (Longino 1990). Popper's emphasis on criticism and continuing exposure of theories to possible refutation provides another important lineage for treating epistemic judgment as provisional rather than final (Popper 2002). GRE retains this revisability while allowing that different claims require different evidential architectures.

Proposition 6.178 (Scope-sensitive epistemic judgment). *The adequacy of an epistemic judgment depends on the relation among the claim, evidence, representation, boundary, scale, temporal horizon, and uncertainty profile rather than on a context-free level of confidence alone.*

Proposition 6.178 prevents strong local warrant from being silently transported to broader claims. A finding can be well supported within one setting while remaining uncertain across another population, historical period, scale, or relational configuration.

6.12.3 Normative Judgment

Research judgment also has normative dimensions. Researchers and institutions assess whether questions should be pursued, whether methods impose acceptable burdens, whether classifications are harmful, whether data access is legitimate, whether participation is fair, whether foreseeable uses require caution, and whether some knowledge should be preserved, restricted, or contested. These judgments are distinct from judgments of truth while remaining capable of shaping what research becomes possible.

Definition 6.179 (Normative research judgment). *A normative research judgment is an assessment concerning the permissibility, responsibility, fairness, value, priority, or practical acceptability of a research object, question, method, relation, representation, or foreseeable consequence.*

Dewey's theory of valuation is useful here because it treats valuation as situated activity involving desires, ends, appraisals, and consequences rather than as the passive recognition of fixed value properties (Dewey 1939). GRE extends this situated orientation by asking which relations and generative effects participate in the formation of research values and priorities.

Normative judgment does not authorize researchers to replace evidence with preferred outcomes. A method can be normatively attractive while producing weak evidence, and an empirically robust finding can arise from a research process that raises serious ethical concerns. Maintaining this distinction is necessary for transparent re-

search praxis.

Remark 6.180 (Normative conditions and epistemic consequences). Normative constraints can have epistemic consequences because they alter access, participation, admissible intervention, data preservation, and representational practice. Their epistemic effects should therefore be analyzed without reducing the normative judgment itself to an epistemic one.

The broader relation between aesthetic and normative conditions across research- and application-dominant praxis will be developed later in Section 159. The present section remains focused on how such judgments operate within research significance and question selection.

6.12.4 Attribution of Significance

Significance is attributed when a researcher or research community judges that an encounter, relation, anomaly, question, result, or representation matters relative to a specified horizon. The horizon may be epistemic, theoretical, methodological, practical, historical, normative, or aesthetic. Attribution is therefore stronger than salience and more structured than immediate interest.

Definition 6.181 (Research significance attribution). *A research significance attribution is a provisional judgment that an encounter, object, question, relation, finding, or representation warrants sustained attention because of its expected or demonstrated relevance to one or more specified research aims or value horizons.*

Significance attribution should identify the relevant criterion. A result may matter because it challenges a central assumption, opens a new measurement pathway, connects previously separated literatures, reveals a neglected population, threatens an established intervention, preserves a historically fragile trace, or exposes a relation with large downstream consequences. These are different grounds for significance and should not be compressed into a single language of “importance.”

The distinction also creates room for uncertainty. Significance can be attributed prospectively, before its consequences are known, or retrospectively, after later developments reveal that an earlier encounter mattered more than initially recognized. Deferred significance from Section 143 is one case of such retrospective reorganization.

Proposition 6.182 (Explicit significance criterion). *When significance influences substantial allocation of research attention, resources, representation, or institutional support, the principal criterion or criteria through which significance is being attributed should be made as explicit and contestable as the research context reasonably permits.*

This requirement does not eliminate judgment. It makes the basis of judgment available for criticism and later revision.

6.12.5 Worthiness of Questions

A research question can be grammatically well formed, technically tractable, and answerable with available methods while still being judged unworthy of sustained inquiry. Conversely, a difficult or presently unanswerable question can be worth pre-

serving because it exposes a deep conceptual tension, opens a new empirical domain, connects otherwise separated problems, or may become answerable under future methods and evidence.

Peirce's insistence that genuine inquiry begins from real and living doubt is relevant here because it distinguishes substantive uncertainty from merely placing propositions into interrogative form (Peirce 1877). Dewey similarly treats inquiry as emerging from problematic situations that require reconstruction rather than from questions detached from lived or intellectual difficulty (Dewey 1910).

Definition 6.183 (Question worthiness judgment). A *question worthiness judgment* is a provisional assessment that a research question deserves preservation, formulation, or sustained inquiry because of its potential contribution to knowledge, explanation, methodological development, practical understanding, normative clarification, or future generative possibility.

Question worthiness is not identical to immediate utility. Some questions matter because they reorganize a field, reveal the inadequacy of existing categories, or prepare conceptual resources whose later uses cannot yet be specified. Nor is worthiness identical to novelty. A familiar question can become newly worthy when historical conditions change, new evidence becomes available, or neglected relations become visible.

Caution 6.184 (Question prestige). The prestige of a question, the reputation of those pursuing it, or the institutional resources already attached to it should not be treated as sufficient evidence of its research worthiness.

The judgment of worthy questions therefore links the current section to Section 146, where inquiry becomes oriented through selection and sustained commitment.

6.12.6 Difficulty without Significance

Research cultures can easily conflate technical difficulty with intellectual significance. A proof may be extraordinarily hard, a model computationally demanding, an experiment expensive, or a dataset difficult to obtain. These features can indicate genuine methodological achievement, yet they do not establish that the underlying question matters according to epistemic, theoretical, practical, or normative criteria.

Difficulty is relational to available capacities. A problem can be hard because methods are immature, data are inaccessible, institutions impose friction, or the object is genuinely complex. Conversely, a consequential question can become technically easy once a suitable representation or instrument is developed. Difficulty therefore measures a relation among problem, method, infrastructure, and current capability rather than significance itself.

Definition 6.185 (Research difficulty). *Research difficulty* is the degree of intellectual, technical, evidential, computational, organizational, or material demand imposed by a research task relative to the capacities and infrastructures available to a specified research configuration.

Proposition 6.186 (Difficulty–significance separation). *Research difficulty and research significance should be evaluated on distinct dimensions because a task can be*

difficult yet weakly significant, or highly significant yet comparatively tractable under current conditions.

This separation matters especially under scarce attention. If difficulty itself becomes a prestige signal, research systems can allocate disproportionate effort toward technically impressive but weakly generative problems while background questions with substantial long-horizon importance remain neglected. The opposite error is also possible: technically modest work can be underestimated despite providing crucial descriptive, archival, maintenance, replication, or integrative functions.

Difficulty can still matter indirectly. Solving a difficult problem can generate methods, instruments, datasets, or concepts with broader applicability. In that case, significance arises from the generated capacities or relations, not from difficulty alone.

6.12.7 Elegance, Surprise, and Generative Promise

Elegance and surprise can become especially powerful research signals when they suggest that a small conceptual change may reorganize a larger problem-space. A compact model can connect previously separated observations; an unexpected symmetry can reveal a hidden relation; a surprising empirical result can expose a new mechanism; an elegant question can make a previously diffuse domain investigable.

McAllister's work on aesthetic evaluation in science is relevant because it documents the role of aesthetic criteria in theory assessment while emphasizing their historical variability (McAllister 1996). GRE adds the idea of *generative promise*: an aesthetic or surprising encounter can matter because it appears capable of generating further questions, representations, methods, explanations, or research relations.

Definition 6.187 (Generative promise in research). *Generative promise in research* is a provisional judgment that an encounter, question, concept, representation, or result may generate a comparatively rich set of subsequent inquiries, distinctions, methods, explanations, or empirical access pathways if developed further.

Generative promise is prospective. It cannot be fully known at the time of judgment because the future trajectory has not yet occurred. A researcher may therefore preserve or develop an elegant conjecture because of the possibilities it opens while clearly distinguishing this prospective judgment from present epistemic warrant.

Proposition 6.188 (Generative-promise discipline). *Judgments of generative promise are most useful when the anticipated forms of further generation are articulated sufficiently to permit later comparison with the trajectory that actually develops.*

This proposition transforms vague enthusiasm into a revisable research expectation. A question thought promising because it may connect domains, expose mechanisms, create data, or generate new formalizations can later be assessed against those anticipated pathways.

6.12.8 Historical Formation of Research Taste

Researchers do not encounter elegance, importance, rigor, or promising questions from outside history. Disciplinary training, canonical examples, available instruments, dominant theories, funding systems, publication conventions, and prior

successes all contribute to the formation of research taste. What appears obvious, beautiful, trivial, profound, rigorous, or fashionable can therefore vary across periods and communities.

Kuhn's analysis of normal science shows how paradigmatic commitments help organize exemplary problems, standards, and puzzle selection within scientific communities (Kuhn 1962). Bourdieu's analysis of taste, although developed in a wider sociological context, provides a useful counterweight to accounts that treat evaluative preference as socially unconditioned (Bourdieu 1984). McAllister's history of aesthetic evaluation in science provides a more domain-specific precedent for treating scientific aesthetic criteria themselves as historically formed (McAllister 1996).

Definition 6.189 (Research taste). *Research taste* is a historically and relationally formed disposition through which researchers or research communities tend to recognize some questions, forms, explanations, methods, and styles of evidence as especially elegant, interesting, important, promising, or worthy of attention.

Research taste is neither pure arbitrary preference nor a transparent reading of intrinsic significance. It can embody accumulated practical wisdom while also reproducing blind spots. A mature research community may recognize fruitful problem forms rapidly because experience has sedimented into judgment; the same sedimentation can make unfamiliar forms difficult to appreciate.

Remark 6.190 (Taste and inheritance). Research taste should be examined both as a potential repository of historically accumulated judgment and as a possible mechanism through which inherited exclusions, prestige structures, and methodological habits are reproduced.

This double character explains why plurality and revisability become central in the remaining subsections.

6.12.9 Relational Conditions of Judgment

Judgment is conditioned by relations among researchers, institutions, communities, objects, infrastructures, and audiences. Peer review, mentorship, collaboration, disciplinary competition, publication incentives, funding structures, participant relations, and public controversy can all influence what appears credible, elegant, urgent, or worthwhile. The relational condition of judgment extends the account of researcher position from Section 141 and institutional attention from Section 144.

Definition 6.191 (Relational judgment conditions). *Relational judgment conditions* are the interpersonal, institutional, infrastructural, disciplinary, and historical relations that shape the formation, expression, contestation, uptake, and revision of research judgments.

Longino's emphasis on critical interaction is particularly relevant because judgments can be strengthened when assumptions and standards are exposed to criticism from differently positioned inquirers (Longino 1990). Relational conditioning, however, also creates asymmetry. Junior researchers may suppress judgments that conflict with powerful supervisors; communities with weak institutional representation may struggle to make significance claims visible; proprietary infrastructures can privilege some evaluative standards over others.

The existence of relational conditioning does not imply that judgments reduce to social power. Evidence, internal coherence, reproducibility where appropriate, historical adequacy, explanatory performance, and practical consequences can constrain evaluative communities. The point is that these constraints are interpreted and acted upon through relations.

Proposition 6.192 (Contestable judgment conditions). *Research judgment is strengthened when the conditions through which evaluations are formed and authorized remain sufficiently visible and contestable for alternative evidence, interpretations, and value perspectives to enter critical examination.*

6.12.10 Plurality of Judgment

A single research object can support several legitimate forms of judgment. A model may be elegant yet empirically fragile. A question may be epistemically important but normatively risky. A method may be highly reliable for one target while too costly or exclusionary for another. A result may be theoretically modest but practically consequential. Plurality therefore concerns both multiple criteria and multiple evaluative positions.

Definition 6.193 (Judgment profile). *A judgment profile* is an explicit representation of the distinct aesthetic, epistemic, theoretical, practical, and normative evaluations attached to a research object or trajectory, together with their principal grounds and uncertainties.

The profile prevents premature compression into a single overall score. It also makes disagreement more informative. Two researchers may agree on evidential strength while differing on normative priority, or agree on importance while differing on elegance or methodological feasibility. Making these dimensions explicit can reveal where disagreement actually lies.

Plurality also allows research systems to preserve heterogeneous projects. Some work may prioritize foundational theory, some empirical description, some archival preservation, some instrument building, some replication, some normative analysis, and some application-oriented knowledge. Their significance need not be rendered commensurable through one evaluative metric.

Remark 6.194 (Plurality and commensurability). Plural judgment does not require that all evaluative dimensions be reducible to a common metric. Comparison can proceed through articulated trade-offs, thresholds, incompatibilities, and domain-specific criteria.

6.12.11 Conflict among Forms of Judgment

Judgments can conflict. An aesthetically elegant model may require assumptions that weaken empirical adequacy. A normatively urgent problem may lack mature methods. A theoretically deep question may offer little immediate practical value. A practically useful classification may obscure relations that matter for explanation or justice. Such conflicts are normal features of research praxis rather than defects that can always be eliminated through better information.

Definition 6.195 (Research judgment conflict). A *research judgment conflict* occurs when two or more evaluative dimensions support materially different orientations toward the same research object, question, representation, method, or trajectory.

Conflict requires articulation of what is being traded off. If an elegant model is retained despite known empirical limitations because it generates useful hypotheses, that role should be stated. If a high-risk line of inquiry is restricted despite epistemic promise, the normative basis should be explicit. If a difficult question is pursued for long-horizon theoretical reasons, immediate utility should not be retroactively invented as justification.

Proposition 6.196 (Non-substitution among judgments). *When aesthetic, epistemic, practical, and normative judgments conflict, strength on one dimension should not be used silently as evidence on another dimension; the relation among the competing judgments should be made explicit.*

This principle is especially important for aesthetic judgment. Elegance can motivate inquiry without substituting for evidence. Normative urgency can motivate resource allocation without establishing causal claims. Empirical robustness can establish a finding without settling whether the research trajectory should receive priority.

6.12.12 Revisability of Research Judgment

Research judgment is revisable because evidence, concepts, methods, values, historical conditions, and downstream consequences change. A question dismissed as trivial can later become central; an elegant theory can lose appeal when its hidden assumptions become visible; an initially marginal method can become indispensable after new data or instruments appear; a normatively accepted research practice can later be reassessed as affected communities acquire greater representational authority.

Definition 6.197 (Revisable research judgment). A *revisable research judgment* is an evaluation whose grounds, scope, historical conditions, and relevant alternatives remain sufficiently inspectable that later evidence, criticism, conceptual change, or practical consequences can alter the judgment without erasing its earlier rationale.

Revisability does not require indecision. Research communities need provisional commitments in order to allocate attention, resources, and time. The requirement is that commitment preserve enough provenance for later reconstruction. Why was a question judged worthy? Which criteria made a theory elegant? Which uncertainties were accepted? Which alternatives were rejected? Which normative concerns were considered? Such records make later re-epistemization and institutional learning possible.

Proposition 6.198 (Judgment provenance). *Research judgments that materially shape long-horizon attention, exclusion, resource allocation, or theoretical closure should preserve sufficient provenance for later inquiry to reconstruct the principal criteria, evidence, uncertainties, and relational conditions under which the judgment was made.*

The argument of this section can now be summarized. Salience does not become significance automatically. Significance is attributed through forms of judgment that

can be aesthetic, epistemic, normative, theoretical, and practical. These judgments have different criteria and should remain distinguishable even when they interact. Worthy questions are not reducible to difficult questions; elegance and surprise can indicate generative promise without establishing truth; research taste has histories and relational conditions; multiple judgments can coexist or conflict; and judgment remains revisable through preserved provenance and criticism. Section 146 therefore turns from evaluation to orientation: how provisional judgments begin to organize which problems are formulated, which questions receive sustained effort, and how inquiry is directed under uncertain future value.

6.13 Orientation of Inquiry

Section 6.12 established that research judgment mediates between salience and significance. The present section develops the next moment of praxis: orientation. Its role is to explain how provisional judgments begin to organize which problems are formulated, which questions are sustained, which forms of attention are protected, and where finite intellectual and institutional resources are committed. The objective is to make selection visible as part of research rather than treating a research agenda as given before inquiry begins. The discussion proceeds from selection, problem formation, and question formation to attention, intellectual effort, institutional resources, long-horizon commitment, inquiry beyond immediate utility, plural research orientations, and orientation under uncertain future value. The method is relational and historical. Orientation is treated as a configuration among judgments, researchers, institutions, available concepts, infrastructures, time horizons, and anticipated possibilities. This prepares Section 147, where the problem shifts from what receives sustained inquiry to the plurality of methods through which an oriented inquiry can proceed.

6.13.1 Selection before Investigation

Investigation begins within a field that has already been selectively organized. Some phenomena have been named, some records preserved, some variables measured, some anomalies remembered, and some questions granted institutional legitimacy. Even an apparently open-ended inquiry therefore begins after earlier acts of selection. At the level of an individual researcher, selection concerns which encounter is pursued, which doubt is sustained, which literature is read, and which alternative is deferred. At the level of a research institution, selection also concerns funding, staffing, infrastructure, access, publication, and the preservation of work that may matter later.

The selectivity of inquiry follows from finite attention and finite practical capacity. Simon's account of information-rich environments is useful here because it identifies attention as a scarce resource when informational inputs are abundant (Simon 1971). Research faces an analogous condition. The space of possible observations, hypotheses, questions, models, archives, and comparisons is larger than the set that can receive sustained investigation. Selection therefore occurs even where explicit prioritization is absent.

Definition 6.199 (Research orientation). A *research orientation* is a provisionally stabilized configuration of judgments, commitments, attention, questions, and resource allocations that directs inquiry toward some problems, objects, relations, and possible futures while leaving others weakly pursued, deferred, or outside the active research horizon.

Orientation is broader than a topic choice. Two researchers may study the same empirical domain while orienting inquiry toward different relations: one toward mechanism, another toward historical transformation, another toward classification, another toward normative consequences. Likewise, a single orientation can traverse several objects if the organizing problem concerns a relation that appears across them.

Proposition 6.200 (Selection antecedence). *Because sustained investigation requires finite attention, time, and material support, the selection of research objects and problems is analytically prior to many later methodological choices, even when that selection remains revisable during inquiry.*

This proposition gives orientation an epistemic status without treating initial selection as final. Research can encounter evidence that reorganizes its own agenda. The important point is that selection is already active before method selection, measurement, or formal explanation begins.

6.13.2 Problem Formation

A research problem is more structured than an encounter and more open than a determinate research question. It organizes a field of concern by identifying a tension, inadequacy, unexplained pattern, missing relation, practical difficulty, or conceptual instability that deserves sustained inquiry. Dewey's account of reflective thought is especially relevant because a problematic situation requires transformation before it becomes sufficiently determinate for investigation (Dewey 1910). The problem is formed through inquiry into what the difficulty consists in.

Problem formation includes boundary work. A researcher deciding that declining participation is a problem of institutional trust, economic insecurity, administrative burden, demographic change, or measurement can direct the subsequent inquiry toward different relations and evidence. These formulations may overlap, but they do not produce identical research trajectories. Scale and temporal horizon matter as well. A phenomenon framed as a short-run behavioral response can become a different problem when situated within a longer institutional history.

Definition 6.201 (Research problem formation). *Research problem formation* is the process through which an indeterminate difficulty, encounter, tension, absence, or possibility is organized into a sufficiently articulated field of inquiry with provisional boundaries, relevant relations, historical context, and criteria for further question formation.

Problem formation therefore carries inherited assumptions. Concepts determine which differences can be named; archives determine which histories can be reconstructed; measurement systems determine which patterns become visible; institutional classifications determine which populations or events are legible. Section 6.9

established that such working commitments can remain under ontological suspension. The same discipline applies here: a problem can be formulated strongly enough for inquiry without converting its initial representation into a final account of the object.

Remark 6.202 (Problem provenance). For consequential or long-horizon projects, recording how a problem was initially formed can support later revision by making visible the boundaries, concepts, excluded alternatives, and practical concerns that organized the original inquiry.

This record becomes especially important when later evidence reveals that an initially peripheral relation was constitutive of the problem itself.

6.13.3 Question Formation

Question formation narrows a problem into a form that can guide a particular movement of inquiry. A question can seek description, comparison, explanation, mechanism, historical reconstruction, interpretation, evaluation, formal characterization, or practical understanding. Several questions can therefore arise from one problem, and a single question can be reformulated as the relational field becomes better understood.

Peirce's distinction between living doubt and merely verbal questioning remains useful because an interrogative sentence does not by itself establish an active inquiry (Peirce 1877). Dewey similarly treats the determination of a problem as part of reflective investigation rather than as a ready-made input (Dewey 1910). Research on problem finding adds another precedent for distinguishing the generation of a problem from solving a task whose terms are already fixed (Getzels and Csikszentmihalyi 1976).

Definition 6.203 (Research question formation). *Research question formation* is the articulation of a provisional interrogative structure that specifies which property, relation, mechanism, trajectory, interpretation, or evaluation within a research problem is to be investigated and what kind of epistemic advance would count as a meaningful response.

Question formation depends on available representational resources. A new concept can make a previously diffuse relation askable; a new instrument can turn an imperceptible difference into an empirical question; digitized archives can permit comparisons that earlier researchers could not feasibly formulate. Question formation is therefore generative: it can expand the space of subsequent inquiry.

Questions also inherit exclusions. A question framed around average treatment effects can obscure heterogeneous pathways; a question framed around institutional compliance can background lived experience; a question framed around individual preference can exclude relation-level formation of preference. Such limitations do not automatically invalidate the question. They make its orientation explicit and create grounds for complementary questions.

Proposition 6.204 (Question plurality within a problem). *A research problem can support several materially different questions whose coexistence reveals distinct epistemic targets rather than a defect requiring immediate reduction to one canonical formula-*

tion.

This plurality becomes one basis for the methodological pluralism developed in Section 147.

6.13.4 Research Attention

Salience can initiate attention, but orientation concerns whether attention becomes sustained, organized, and protected over time. Research attention is therefore distinct from momentary notice. It includes repeated return to an object, maintenance of records, reading across a literature, development of instruments, cultivation of expertise, and willingness to preserve unresolved questions through periods of weak immediate payoff.

The scarcity of attention becomes especially consequential when candidate information is abundant (Simon 1971). Research communities can generate more papers, datasets, anomalies, hypotheses, and computational outputs than any individual or institution can examine deeply. Under such conditions, orientation increasingly concerns the governance of sustained attention rather than access to information alone.

Definition 6.205 (Research attention commitment). A *research attention commitment* is a provisional allocation of sustained cognitive and interpretive focus to a problem, question, object, or relation across a specified period, together with practices that preserve continuity of observation, memory, and revision.

Attention commitments can be weak or strong. A low-cost exploratory scan may preserve many possibilities. A strong commitment may involve years of specialist training, repeated field access, or maintenance of a longitudinal dataset. The strength of commitment should therefore be distinguished from the significance initially attributed to the problem. High significance can justify exploration without yet justifying deep commitment, while modest early salience can later develop into a durable programme.

Attention also has opportunity costs. Sustained focus on one line of inquiry can reduce sensitivity to others. Section 6.11 showed that institutional attention regimes can amplify this effect. Research orientation should therefore include some capacity to review what sustained attention is displacing.

6.13.5 Allocation of Intellectual Effort

Intellectual effort includes more than time spent reading or writing. It includes conceptual development, model construction, archival reconstruction, language acquisition, instrument learning, replication, coding, field immersion, negative-result analysis, and the difficult work of maintaining questions whose answers remain uncertain. Allocation of such effort gives orientation a practical form.

Definition 6.206 (Intellectual effort allocation). *Intellectual effort allocation* is the distribution of finite cognitive, interpretive, technical, and learning capacity across research problems and activities in light of their judged significance, uncertainty, feasibility, generative promise, and opportunity costs.

This allocation rarely follows a single metric. A highly significant question may re-

ceive modest effort because evidence is currently inaccessible. A technically tractable subproblem may receive concentrated effort because solving it creates infrastructure for later work. A replication may deserve attention despite low novelty because it stabilizes a field. An exploratory project may deserve limited resources because its expected informational gain is high even though its probability of success is uncertain.

The allocation problem is therefore dynamic. Learning can change feasibility, and feasibility can change significance. A researcher who acquires a language or method may suddenly gain access to a domain that had previously been too costly to investigate. Conversely, a project can become less worthy of continued effort when its assumptions fail repeatedly or when another research group resolves the core uncertainty.

Proposition 6.207 (Revisable effort allocation). *Intellectual effort should be treated as a revisable commitment whose continuation depends partly on evidence generated during the research trajectory, rather than as a sunk justification for preserving an orientation unchanged.*

This reduces the pressure to defend an existing project merely because substantial effort has already been invested in it.

6.13.6 Allocation of Institutional Resources

Research orientation becomes institutional when it allocates laboratories, archives, compute, grants, staff, field access, publication space, data infrastructure, and durable organizational attention. These allocations can shape the future research field because resources affect which questions become feasible and which capabilities survive between projects.

The sociology of undone science provides a particularly direct precedent. Frickel and colleagues show that socially identified research needs can remain unfunded, incomplete, or institutionally neglected, making patterns of non-knowledge visible as objects of analysis (Frickel et al. 2010). Kuhn's account of normal science likewise shows that disciplinary organization supports some legitimate problem forms and standards while leaving others peripheral (Kuhn 1962). Longino's emphasis on critical interaction adds the importance of institutional conditions that allow alternative assumptions and evidence to enter effective scrutiny (Longino 1990).

Definition 6.208 (Institutional research allocation). *Institutional research allocation is the distribution of organizational resources, infrastructures, access rights, evaluative attention, and preservation capacity among competing or complementary research orientations.*

Institutional allocation has a generative effect. A funded instrument creates future measurement possibilities. A maintained archive enables questions that can be asked decades later. A training programme creates communities capable of interpreting specialized evidence. Conversely, discontinuing an infrastructure can close future inquiry even when its present output appears modest.

Proposition 6.209 (Resource-generativity). *Institutional research allocations should be evaluated partly by the capacities, access pathways, archives, communities, and fu-*

ture research options they generate or maintain, in addition to their immediate outputs.

This proposition does not imply that every infrastructure deserves indefinite continuation. It requires that closure decisions consider the loss of future capability as well as current utilization.

6.13.7 Long-Horizon Commitment

Some inquiries require commitment across a horizon longer than ordinary evaluation cycles. Longitudinal observation, language acquisition, preservation of endangered archives, slow theoretical development, ecological monitoring, replication programmes, and institution-building can produce little visible output during early phases. Their epistemic value depends partly on continuity.

Definition 6.210 (Long-horizon research commitment). A *long-horizon research commitment* is a sustained orientation toward a problem, infrastructure, evidential field, or capability whose expected epistemic or generative contribution depends materially on continuity across a period longer than short-cycle project evaluation.

Long-horizon commitment creates two opposing risks. Premature withdrawal can destroy accumulated capability and make certain questions impossible to answer. Excessive persistence can produce lock-in, insulating inherited questions or methods from counterevidence. The solution is not continuous instability. Long-horizon projects often require stable rules, personnel, and infrastructures precisely so that they can generate interpretable histories.

A disciplined long-horizon commitment therefore combines continuity with periodic review. Review can ask whether the original problem remains significant, whether the evidence trajectory supports continued investment, whether the project has generated unexpected capabilities, whether neglected alternatives have become more compelling, and whether the conditions under which the commitment was made have changed.

Proposition 6.211 (Continuity with review). *Long-horizon inquiry is strengthened when continuity of core evidential or infrastructural functions is paired with explicit intervals for revising the problem formulation, evaluative criteria, and justification for continued commitment.*

This arrangement preserves cumulative possibility while keeping research judgment revisable.

6.13.8 Inquiry beyond Immediate Utility

Research orientation cannot be exhausted by presently specifiable utility. Some inquiries begin from curiosity, conceptual tension, historical interest, aesthetic attraction, or a desire to understand a relation whose later consequences are unknown. Veblen's discussion of "idle curiosity" provides an early economic-social account of knowing that is not ordinarily directed by an immediate utilitarian aim, while also recognizing that knowledge acquired through such inquiry can later become technologically consequential (Veblen 1914).

Inquiry beyond immediate utility should not be romanticized. Finite resources,

ethical risk, opportunity cost, and public responsibility still apply. The point is that present utility is only one evaluative dimension. A project can be worthy because it preserves evidence, clarifies a conceptual problem, creates a method, generates unexpected connections, or enlarges the future space of questions even when a direct application cannot yet be named.

Definition 6.212 (Inquiry beyond immediate utility). *Inquiry beyond immediate utility* is research whose present justification rests substantially on epistemic, conceptual, historical, exploratory, aesthetic, or generative grounds whose future practical uses remain unspecified or uncertain at the time of commitment.

The distinction between immediate utility and eventual use matters. Later application does not retroactively transform the original motivation into an instrumental one. Conversely, the possibility of unforeseeable future use is too weak to justify every speculative project. Orientation still requires judgment concerning significance, cost, risk, neglected alternatives, and the kind of possibility the inquiry is expected to preserve or generate.

Remark 6.213 (Non-instrumental justification and responsibility). A research orientation can be justified without immediate application while remaining answerable to ethical constraints, resource limits, and the consequences generated by the practices through which inquiry is conducted.

This preserves exploratory freedom within the broader field of praxis established in Section 6.1.

6.13.9 Plural Research Orientations

A healthy research field can contain several orientations at once. Some work can be descriptive, some explanatory, some interpretive, some historical, some formal, some methodological, some archival, some critical, some normative, and some application-directed. Their contributions can unfold on different timescales and through different kinds of output. The plurality of research judgment established in Section 6.12 therefore has an institutional analogue: a research system need not compress all orientations into one ranking criterion.

Longino's account of social epistemology provides one basis for valuing heterogeneous perspectives within critical communities (Longino 1990). Habermas's analysis of knowledge and human interests, despite belonging to a different theoretical tradition, also illustrates how inquiry can be organized by distinct epistemic orientations rather than one uniform relation to knowledge (Habermas 1971). GRE does not adopt either framework as a complete taxonomy. Their relevance lies in resisting the assumption that all research must be justified through one orientation.

Definition 6.214 (Research orientation portfolio). A *research orientation portfolio* is a deliberately plural configuration of research commitments whose differences in target, method, time horizon, evidential form, and evaluative criterion are preserved while their complementarities, tensions, and resource demands remain open to comparison.

Plurality reduces some forms of epistemic fragility. If an entire field follows the same fashionable problem, uses the same dataset, and shares the same horizon of

value, it can become highly productive while remaining blind to alternative objects and histories. Heterogeneous orientations preserve paths through which overlooked evidence or concepts can later re-enter inquiry.

Plurality also has limits. Unlimited diversification can fragment expertise and make cumulative work difficult. Orientation therefore involves composition: deciding which differences should be maintained, which infrastructures can be shared, where duplication is useful, and which forms of coordination enable heterogeneous work without forcing premature unification.

6.13.10 Orientation under Uncertain Future Value

Research orientation reaches its most difficult form when the future value of inquiry is uncertain. The future epistemic importance of a concept, dataset, archive, instrument, or theory can depend on developments that are currently unforeseeable. Even the criteria by which future communities evaluate research can change. Orientation therefore cannot always maximize a known future payoff.

Definition 6.215 (Uncertain future research value). *Uncertain future research value* is the condition in which the later epistemic, methodological, practical, historical, or generative contribution of a research orientation cannot be specified with sufficient confidence at the time when attention or resources must nevertheless be allocated.

This condition does not eliminate judgment. It changes the form of judgment. Present evidential grounding still matters. So do generative promise, neglectedness, preservation costs, reversibility of commitment, complementarity with other work, potential harms, and the capacity of a project to generate reusable knowledge or infrastructure. A high-uncertainty orientation can sometimes justify a staged commitment: enough support to preserve and explore the possibility, followed by later review as evidence accumulates.

The problem becomes sharper when systems can cheaply generate many candidate hypotheses, analyses, or questions. Abundance of candidates increases the relative importance of orientation because human and institutional capacities for validation, interpretation, sustained attention, and responsible commitment remain limited. The dedicated discussion of AI-assisted research later in this chapter will examine those conditions more directly. At the present stage, the point is structural: reduction in the cost of candidate generation does not remove the scarcity of orientation.

Proposition 6.216 (Orientation under uncertain future value). *When future research value is materially uncertain, a defensible orientation combines explicit present grounds for significance with staged or revisable commitment, preservation of provenance, attention to generated capabilities and foreclosed alternatives, and sufficient plurality to avoid making one uncertain forecast govern the whole research field.*

This proposition completes the movement from judgment to orientation. Research praxis must select before it can investigate exhaustively; form problems before it can pose determinate questions; allocate attention and resources before future value is fully known; and preserve plural orientations when uncertainty is irreducible. Orientation therefore establishes the practical field within which methods are subse-

quently chosen. Section 147 turns to that next problem. Once a question has acquired sufficient orientation to justify inquiry, methodological pluralism concerns how different modes of epistemic access can be selected, combined, compared, and allowed to correct one another without assuming that one method possesses universal priority.

6.14 Methodological Pluralism

Section 6.13 established that research orientation organizes which problems and questions receive sustained attention before the future value of inquiry is fully known. The present section turns from orientation to the methodological constitution of inquiry. Its role is to explain why Generative Relational Theory requires methodological plurality while preserving standards of evidential warrant, conceptual precision, and mutual criticism. The objective is to distinguish plural epistemic access from unrestricted methodological permissiveness. The discussion proceeds through plural modes of access, partial irreducibility, question-first and object-sensitive method selection, historical and relational sensitivity, complementarity, productive methodological tension, and the limits of methodological unification. The method is comparative and relational: methods are evaluated by the kinds of objects, relations, histories, manifestations, and inferential tasks they can render accessible, together with the characteristic remainders they leave. This prepares Section 148, where the principal inquiry modes used throughout the book are differentiated more concretely.

6.14.1 Plural Modes of Epistemic Access

A research object can become epistemically accessible through several different relations. Archival records can disclose historical sequences. Interviews can disclose situated interpretations and remembered relations. Ethnographic observation can disclose interactional organization that remains weakly represented in official documents. Quantitative data can disclose distributions, covariation, heterogeneity, or change across populations and periods. Formal models can make assumptions and structural consequences inspectable. Network representations can disclose patterned relational configurations. Legal and institutional materials can disclose formally recognized rights, obligations, classifications, and procedures. None of these forms of access is simply identical with the object itself.

This plurality follows from the epistemology developed in Chapter 5. Manifestations and traces are mediated, observation is partial, and relational reconstruction depends on boundary, scale, representation, and historical conditions. Different methods therefore enter the evidential field through different trace-production processes. A method can increase visibility along one dimension while leaving another weakly accessible. The possibility of several modes of access does not imply that each mode is equally informative for every claim.

Definition 6.217 (Methodological pluralism). *Methodological pluralism* is the disciplined use and preservation of multiple modes of epistemic access when the research

object, question, or evidential field contains properties that cannot be adequately reconstructed through one methodological relation alone.

The definition places the justification for plurality in the relation among object, question, evidence, and method. Pluralism is therefore stronger than the practice of merely adding several techniques to a project. A study can use interviews, regressions, archival documents, and simulations while still imposing one interpretive logic on all of them. Conversely, a project can remain methodologically plural even when one method is dominant if it preserves the possibility that another mode of access can reveal a remainder, counterevidence, or alternative reconstruction that the dominant method cannot absorb.

Longino's account of scientific objectivity is relevant because it locates epistemic strength partly in critical interaction among differently situated perspectives rather than in insulation from such plurality (Longino 1990). GRE extends this intuition to methodological relations: heterogeneous access can become a source of correction when the differences among methods remain visible.

Proposition 6.218 (Plural access condition). *Methodological plurality is epistemically warranted when materially relevant properties of the research target are differentially accessible through distinct evidential or representational relations and when those differences can alter the warranted form, scope, or confidence of the resulting claim.*

This condition keeps plurality connected to research need. It also opens the question of whether the distinct modes can be fully translated into one another.

6.14.2 Partial Irreducibility of Methods

Methodological plurality becomes theoretically important when methods are only partially reducible to one another. Reduction is possible in some cases. Narrative material can sometimes be coded into variables; qualitative categories can sometimes be operationalized for measurement; a historical sequence can sometimes be represented through a state-transition model. Yet these translations can alter what is retained, what is backgrounded, and what counts as evidence. Section 151 will examine those translation problems directly. The present concern is prior: whether different methods can remain epistemically non-equivalent even when translation is technically possible.

Historical inquiry, for example, can reconstruct sequence, contingency, and category transformation in ways that a cross-sectional statistical representation may not preserve. Statistical inquiry can reveal population-level regularities that local interpretive work may not establish. Ethnographic inquiry can disclose tacit coordination and practical meaning that administrative datasets do not record. Formalization can expose logical dependencies and hidden assumptions that remain diffuse in prose, while formal exactness does not by itself establish that the represented relations correspond adequately to the historical world.

Definition 6.219 (Partial methodological irreducibility). *Partial methodological irreducibility* is the condition in which two methods can overlap in evidential target or representational content while retaining epistemically relevant capacities, distinctions, or remainders that cannot be transferred between them without material loss

or transformation.

The term *partial* matters. It resists two symmetrical exaggerations. One would assume complete commensurability, as though every valid historical, interpretive, formal, and empirical claim could ultimately be restated in one universal methodological language. The other would treat methods as isolated worlds lacking grounds for comparison or mutual criticism. GRE adopts neither position. Methods can share objects, evidence, and inferential questions while preserving differences that remain analytically consequential.

Ricoeur's treatment of explanation and understanding provides one precedent for resisting a simple opposition between methodological modes while preserving their distinct contributions (Ricoeur 1991). Anderson's argument that higher levels of organization can require concepts not exhausted by lower-level description offers a structurally analogous caution against premature reduction (Anderson 1972). GRE does not identify methodological levels with physical levels; the relevance lies in the general discipline of preserving analytically productive remainder.

Remark 6.220 (Irreducibility and comparison). Partial irreducibility limits complete translation. It does not eliminate comparison. Methods can still be compared with respect to the claims they support, the assumptions they require, the evidence they preserve, and the failure modes to which they are exposed.

This makes the choice among methods a problem of fit rather than allegiance.

6.14.3 Research Questions before Method Preference

Research communities often inherit favored techniques. Training pathways, journals, software, datasets, laboratories, and disciplinary evaluation can make some procedures easier to imagine, execute, and publish than others. Such inheritances can generate accumulated expertise, but they can also reverse the order of inquiry: a method is selected first and a question is subsequently formulated in a form that the preferred method can answer.

Section 6.13.3 treated question formation as the articulation of an epistemic target within a broader problem. Method selection should normally follow that articulation closely enough that the method can be evaluated against the target rather than merely against disciplinary convention. A question about historical category formation differs from a question about current prevalence. A question about lived interpretation differs from a question about causal contribution. A question about structural possibility differs from a question about predictive performance. Each can require different evidence and different standards of adequacy.

Definition 6.221 (Question–method fit). *Question–method fit* is the degree to which a method's observational, representational, and inferential capacities correspond to the epistemic target specified by a research question, including its relevant boundary, scale, temporal horizon, and uncertainty.

Question-first selection does not mean that questions are formed in methodological innocence. Available methods can generate new questions, as Section 6.13.3 already noted. A telescope, archive, database, simulation environment, or new statistical estimator can make previously inaccessible questions researchable. The relation is there-

fore recursive: questions orient methods, while methods can expand the question space. The discipline lies in preventing available technique from silently defining significance.

Dewey's account of inquiry is relevant because methods arise within the transformation of a problematic situation rather than functioning as detached procedures applied independently of the problem (Dewey 1910). Kuhn's historical account provides a complementary warning: mature research traditions can organize puzzle selection around inherited exemplars and accepted procedures (Kuhn 1962). Such organization can support cumulative inquiry while also narrowing which questions appear methodologically legitimate.

Proposition 6.222 (Question-priority principle). *Where a research question has been sufficiently specified, methodological justification should proceed primarily from the epistemic demands of that question and its object, while methodological availability, expertise, cost, and institutional feasibility remain explicit practical constraints rather than hidden substitutes for epistemic fit.*

The principle is intentionally qualified. Feasibility matters. A theoretically ideal method that cannot be executed safely, ethically, or reliably is not automatically preferable. This leads from the question to the properties of the object itself.

6.14.4 Object-Sensitive Method Selection

The same question form can require different methods when the object changes. A relation may be observable directly in one domain and only through indirect traces in another. Some relations are institutionally documented; others are tacit or strategically concealed. Some processes occur rapidly enough for prospective observation; others unfold over generations. Some systems permit intervention; others make experimental manipulation ethically unacceptable or practically impossible. Method selection therefore depends on how the target relation becomes manifest and how research access is organized.

Definition 6.223 (Object-sensitive method selection). *Object-sensitive method selection* is the choice or composition of methods in response to the target object's relational structure, manifestation processes, temporal organization, accessibility, scale, historical constitution, and ethically permissible forms of inquiry.

Object sensitivity also protects inquiry against reifying method-generated objects. A dataset can make entities appear naturally discrete because rows require units. A network model can foreground edges and nodes. A legal archive can privilege formally recognized subjects and categories. An interview protocol can organize experience through the concepts built into its questions. These representations can be useful while still contributing to the apparent form of the object.

Bourdieu and Wacquant's methodological relationalism provides a relevant precedent for resisting substantialist treatment of social objects and for reconstructing positions through relations within fields (Bourdieu and Wacquant 1992). Hacking's historical work similarly demonstrates that classificatory objects and styles of reasoning can have histories that matter for how they become available to investigation (Hacking 2002). GRE draws from these lineages without requiring every object to be

reconstructed through one sociological or historical vocabulary.

Proposition 6.224 (Object–method reciprocity). *A method is adequate only relative to a provisional account of how the target object can be accessed and represented; because the method can in turn revise that account, object specification and method selection should remain reciprocally revisable during inquiry.*

This reciprocity prevents object sensitivity from becoming static. A method may reveal that the object initially specified was too narrow, that a relation assumed to be local crosses scales, or that the relevant category changed historically. Historical sensitivity is therefore a specific requirement within object-sensitive selection.

6.14.5 Historical Sensitivity

Methods encounter objects at particular historical moments, but many research targets carry trajectories longer than the observational window. Categories, institutions, measurement systems, technologies, and social practices can change while retaining names that suggest continuity. A method that treats the present representation of an object as timeless can therefore generate precise estimates of a historically unstable category.

Historical sensitivity concerns more than adding contextual background to an otherwise unchanged design. It asks whether the object, variable, relation, or evidential rule itself has transformed. The meaning of an administrative category can change after legal reform. The composition of a population can change after migration, institutional restructuring, or technological adoption. A measure can preserve its numerical definition while the process generating the measured data changes. Historical inquiry can therefore correct assumptions embedded in contemporary measurement.

Definition 6.225 (Historical methodological sensitivity). *Historical methodological sensitivity* is the capacity of a research design to identify and respond to changes in the categories, relations, institutions, evidence-production processes, and temporal dependencies through which its object becomes researchable.

Sewell's account of structural transformation through consequential events provides a useful precedent for treating historical sequence as potentially constitutive rather than decorative (Sewell 1996). Hacking's historical ontology likewise illustrates how categories and objects of knowledge can emerge within historically specific practices (Hacking 2002). These perspectives support an important methodological caution: apparent longitudinal comparability can fail when the underlying category or manifestation relation has changed.

Historical sensitivity also constrains causal interpretation. A relation observed repeatedly across periods may be generated by different mechanisms in each period. Conversely, a mechanism may persist while its manifestations change. Methodological pluralism therefore preserves space for historical reconstruction alongside contemporary measurement and formal analysis.

Remark 6.226 (Temporal portability). The portability of a method or measure across periods should be treated as an empirical and interpretive question whenever the object, category, institution, or evidence-production process is historically variable.

The same logic extends from history to relational position.

6.14.6 Relational Sensitivity

A method can be historically sensitive while still treating its units as analytically isolated. GRE requires an additional discipline: attention to whether properties attributed to entities are partly generated through relations, positions, fields, institutions, or cross-scale configurations. This does not imply that every research question must become a network analysis. It means that method selection should test whether the target property can be adequately investigated without reconstructing the relations through which it emerges or changes.

A survey can estimate attitudes while missing the institutional relations that formed the available options. An experiment can identify a local response while bracketing the longer relational history that made the treatment meaningful. Ethnography can disclose interactional mechanisms while providing limited grounds for population-level prevalence. A formal model can represent interdependence elegantly while omitting historically specific relations that determine which interactions are feasible. Relational sensitivity therefore concerns both inclusion and omission.

Definition 6.227 (Relational methodological sensitivity). *Relational methodological sensitivity* is the capacity of a research design to detect when the target property, event, or process depends materially on relations, positions, configurations, boundaries, or cross-scale organization and to select methods capable of preserving those dependencies at the required level of warrant.

The requirement is compatible with methodological economy. Some questions genuinely permit a local or entity-centered design. The burden is to justify the boundary. Section 119 established that boundary and scale are epistemically consequential. Here that principle becomes practical: a design should be able to explain why omitted relations are provisionally treated as background rather than constitutive components of the target claim.

Bourdieu and Wacquant's insistence on thinking relationally again provides one relevant methodological lineage (Bourdieu and Wacquant 1992). Giddens's structuration theory offers another, emphasizing recursive relations among practices, rules, and resources (Giddens 1984). GRE uses these lineages as resources rather than as compulsory templates. Relational sensitivity can be realized through historical comparison, process tracing, network analysis, qualitative reconstruction, formal models, institutional analysis, or combinations of methods depending on the object.

Proposition 6.228 (Relational adequacy condition). *When the warranted form of a claim depends materially on relations or positions omitted by the principal method, methodological adequacy requires either incorporating a mode capable of reconstructing those relations or explicitly restricting the claim to the narrower object that the existing method can support.*

This condition gives methodological complementarity a specific function.

6.14.7 Methodological Complementarity

Complementarity arises when methods contribute different but jointly relevant access to a research problem. The concept is stronger than accumulation. Two meth-

ods are complementary when the contribution of one changes how the evidence or limitations of the other can be interpreted. Historical reconstruction can clarify why a variable changed meaning. Ethnographic observation can reveal a mechanism behind an aggregate pattern. Quantitative comparison can test how widely a locally reconstructed relation appears. Formalization can expose whether an interpretive explanation contains mutually inconsistent assumptions. Interpretive work can reveal that formally identical categories carry different meanings across contexts.

Definition 6.229 (Methodological complementarity). *Methodological complementarity* is a relation among methods in which their distinct epistemic capacities jointly improve the reconstruction, discrimination, scope, or revisability of a claim while the differences among their evidential and representational bases remain explicit.

Complementarity does not require convergence on one result. Agreement can strengthen a claim when methods carry sufficiently independent vulnerabilities, but disagreement can be equally informative. If archival evidence suggests one trajectory while administrative data suggest another, the discrepancy can reveal category change, missing records, selection effects, or a mistaken historical interpretation. Complementarity therefore includes the capacity to generate productive friction.

Longino's emphasis on transformative criticism within epistemic communities supports this orientation toward heterogeneity and critical interaction (Longino 1990). Gadamer's account of understanding through historically situated horizons provides a different lineage for thinking about how distinct standpoints can enter a relation without presuming complete assimilation (Gadamer 2004). GRE does not merge these traditions; it uses their shared resistance to epistemic isolation as a methodological resource.

Proposition 6.230 (Complementarity without collapse). *Methods can contribute to one research claim without being reduced to one representational language, provided the design specifies what each method evidences, where translation occurs, and which disagreements remain unresolved.*

This proposition anticipates Sections 150 and 151. Mutual correction requires preserving enough methodological difference for tension to remain diagnostically useful.

6.14.8 Methodological Tension as Productive Resource

Methodological tension appears when different modes of inquiry support different descriptions, boundaries, mechanisms, scales, or confidence profiles. Research practice often treats such disagreement as a problem to be eliminated by selecting the supposedly superior method. Some disagreements do require adjudication. Others reveal that the object has been incompletely specified or that methods are accessing different manifestations of a relational process.

A historical account can emphasize contingency where a formal model emphasizes structural regularity. An ethnographic account can disclose heterogeneous meanings beneath a statistically stable category. A quantitative analysis can reveal prevalence patterns that challenge a compelling local narrative. A legal analysis can identify formally binding categories that diverge from lived practices. These tensions can

generate new questions when their sources are reconstructed rather than averaged away.

Definition 6.231 (Productive methodological tension). *Productive methodological tension* is a documented disagreement or non-alignment among methods that generates epistemically useful pressure to reconsider the object, boundary, scale, category, mechanism, evidence-production process, or scope of a research claim.

Productivity is not automatic. Tension becomes useful only when the participating methods are sufficiently warranted for the disagreement to deserve explanation. A poorly executed analysis does not acquire value merely because it conflicts with stronger evidence. Likewise, unresolved disagreement should not be romanticized. Some tensions can be adjudicated through additional data, better measurement, clearer concepts, or more appropriate modeling.

Proposition 6.232 (Tension-preservation principle). *When a disagreement among adequately executed methods cannot yet be explained by identifiable error, preserving the disagreement with its provenance can be epistemically preferable to forcing premature convergence, because the unresolved tension may identify a missing relation, unstable category, scale difference, or historical discontinuity.*

This principle connects methodological pluralism to the preservation and re-epistemization commitments developed in Chapter 5. It also sets a limit on the aspiration to unify methods.

6.14.9 Limits of Methodological Unification

Methodological unification can be valuable. Shared standards can improve comparability, replication, cumulative evidence, and communication. Common data structures can support collaboration. Formal frameworks can reveal connections across cases. Standardized measures can make large-scale comparison possible. GRE therefore has no general commitment against methodological integration.

The problem arises when integration requires erasing distinctions that are constitutive of the research object or the evidence. A common metric can suppress heterogeneous value. A universal category can obscure historical transformation. A single causal representation can background interpretation and meaning. A standardized observational unit can fragment relations whose significance lies in configuration. A unified formal language can retain structural equivalence while losing the domain-specific semantics that made the represented relation intelligible.

Definition 6.233 (Methodological unification limit). A *methodological unification limit* is reached when further integration of methods would require suppressing epistemically relevant differences in object constitution, evidence production, representation, scale, temporality, meaning, or standards of warrant that remain material to the research claim.

The limit is claim-relative. The same methods can be unified for one purpose and remain irreducible for another. A shared coding scheme may be adequate for estimating prevalence while remaining insufficient for reconstructing the historical emergence of the coded categories. A formal state representation may support simulation while leaving interpretive questions about the meaning of transitions unresolved.

Proposition 6.234 (Pluralism with disciplined limits). *Methodological pluralism is strongest when it permits integration where relevant information and inferential commitments can be preserved, preserves irreducibility where integration would create material epistemic loss, and keeps both choices open to later revision as the object and research purpose change.*

Methodological pluralism therefore does not culminate in a catalogue of equally valid methods. It establishes a research discipline in which methods are selected in relation to questions and objects, remain historically and relationally sensitive, enter complementary or critical relations where useful, and resist premature unification when epistemically relevant remainder persists. The next section develops the principal inquiry modes more concretely. Formal, quantitative empirical, qualitative empirical, historical, genealogical, interpretive, hermeneutic, ethnographic, legal and institutional, and computational inquiry can then be examined as differentiated research practices whose capacities overlap without becoming interchangeable.

6.15 Formal, Empirical, Historical, and Interpretive Inquiry

Section 6.14 established methodological pluralism as a disciplined response to differentiated epistemic access, partial methodological irreducibility, and the possibility of mutual correction among methods. The present section gives that argument a more concrete research-practice form by distinguishing several inquiry modes that recur across Generative Relational Theory and Generative Relational Economics. Its objective is to specify what each mode principally makes accessible, the kinds of claims it can support, and the characteristic remainders that should remain visible when modes are combined. The discussion proceeds through formal, quantitative empirical, qualitative empirical, historical, genealogical, interpretive, hermeneutic, ethnographic, legal and institutional, and computational inquiry before returning to their partial irreducibility. The method is comparative rather than hierarchical. Each mode is treated as an organized relation among research question, object, evidence, representation, and inferential practice. The resulting distinctions prepare the next section, where formal and quantitative models are examined more narrowly as epistemic instruments with several different functions.

Definition 6.235 (Inquiry mode). *An inquiry mode is a relatively coherent organization of research objects, evidential access, representational practices, inferential operations, and standards of warrant through which a class of research questions becomes tractable.*

The definition does not treat inquiry modes as closed disciplinary territories. A single project can move among several modes, and one method can serve different modes depending on its role. An interview, for example, can contribute to qualitative empirical description, interpretive reconstruction, ethnographic analysis, or historical inquiry. A simulation can function as formal exploration, computational experimentation, or comparison among theoretical mechanisms. What matters is the epistemic role that the research practice performs in relation to the claim.

6.15.1 Formal Inquiry

Formal inquiry examines the consequences of explicitly specified structures, relations, assumptions, or transformation rules. Its principal strength lies in making dependence visible. Once premises, state variables, relations, constraints, or rules are rendered sufficiently explicit, a formal representation can disclose implications that are difficult to inspect in ordinary prose. Formal inquiry can therefore clarify whether a proposed mechanism is internally coherent, whether two assumptions are jointly compatible, whether a result follows from a specified structure, or which conditions are necessary for a modeled transition.

This function should be distinguished from empirical confirmation. A mathematically valid implication can remain empirically inadequate when the representation omits relations that matter in the target domain. Conversely, empirical irregularity does not by itself show that a formal derivation is internally defective. Van Fraassen's account of scientific representation is useful here because it keeps the relation between model and world analytically distinct from the internal structure of the model itself (Fraassen 1980). GRE retains that separation while adding the requirement that representational choices remain historically and relationally inspectable.

Definition 6.236 (Formal inquiry). *Formal inquiry* is inquiry in which explicit symbolic, logical, mathematical, computational, or structural representations are used primarily to examine relations among assumptions, constraints, transformations, and consequences.

Formal inquiry can be highly generative because it may reveal unexplored cases, inconsistencies, invariants, or possible mechanisms. Its generativity does not convert formal consequence into ontological necessity. Within GRE, formalization remains an epistemic operation under ontological suspension. The next section will therefore treat formal models as instruments whose function must be specified relative to a research task.

6.15.2 Quantitative Empirical Inquiry

Quantitative empirical inquiry organizes observed or recorded variation through explicit measurement and numerical comparison. Its characteristic objects include distributions, frequencies, differences, associations, transitions, heterogeneous effects, temporal patterns, and estimated dependencies. It can make visible regularities or contrasts that remain difficult to establish from a small number of cases and can provide disciplined estimates of uncertainty when the measurement and inferential design are adequate.

The numerical form of a result does not remove the relational conditions of its production. Variables depend on classification; samples depend on access and inclusion; measurements depend on instruments and institutional procedures; missingness can be structured; and causal estimates depend on assumptions about comparison, assignment, temporal order, and alternative pathways. Contemporary causal-inference work makes these design dependencies explicit rather than treating numerical association as sufficient evidence of causation (Gangl 2010; Woodward 2003).

Definition 6.237 (Quantitative empirical inquiry). *Quantitative empirical inquiry* is

inquiry that represents empirically recorded variation numerically in order to estimate, compare, or test distributions, relations, changes, or dependencies under an explicit measurement and inferential design.

GRE therefore treats quantitative evidence as powerful but situated. A coefficient, estimated effect, or network statistic can support a claim within a specified boundary, scale, temporal horizon, and data-generating process. Its evidential strength is increased by clarity about how the measured object relates to the relational object of interest and by sensitivity to historically changing categories or measurement regimes.

6.15.3 Qualitative Empirical Inquiry

Qualitative empirical inquiry reconstructs properties of social and relational reality that require contextual differentiation, situated description, process tracing, or close attention to categories that cannot yet be responsibly compressed into a fixed numerical representation. Its materials can include interviews, observations, documents, correspondence, fieldnotes, institutional records, material artifacts, and naturally occurring interaction. The defining feature is not the absence of numbers but the preservation of contextual and categorical structure during empirical reconstruction.

Qualitative inquiry can identify relations that standardized instruments fail to register, recover distinctions that would otherwise be collapsed into one variable, and disclose how actors interpret or reproduce institutional categories. Bourdieu's practice-oriented work illustrates how dispositions, fields, and practical relations can require empirical reconstruction at a level that is difficult to recover from formal categories alone (Bourdieu 1977). Longino's emphasis on critical interaction among differently situated perspectives further supports the epistemic value of preserving heterogeneous access rather than forcing premature representational uniformity (Longino 1990).

Definition 6.238 (Qualitative empirical inquiry). *Qualitative empirical inquiry* is inquiry that reconstructs empirically grounded relations, processes, categories, meanings, or differences while preserving contextual information judged material to the research claim.

Its limits include local dependence, selective access, interpretive mediation, and difficulty establishing prevalence beyond the observed field. These limits call for explicit scope rather than a downgrade in epistemic status. Qualitative evidence can be decisive for a claim about process, category formation, mechanism, or situated relation even when it is insufficient for a population-level frequency claim.

6.15.4 Historical Inquiry

Historical inquiry reconstructs change through time. It is especially important when the identity, meaning, effect, or accessibility of a relation depends on sequence. Historical inquiry can establish how an institution emerged, when a category changed, which alternatives were available at a given moment, how a relation persisted through transformation, or why a later configuration cannot be inferred from a cross-sectional snapshot.

GRE's concern with generative relations makes temporal ordering more than contextual background. Path-dependent processes can make early events consequential through later reinforcement, while structural transformation can alter the very categories through which earlier evidence is interpreted (David 1985; Pierson 2000; Sewell 1992; Sewell 1996). Historical inquiry therefore contributes not only chronology but reconstruction of changing conditions of possibility.

Definition 6.239 (Historical inquiry). *Historical inquiry* is inquiry that reconstructs temporally ordered relations, events, categories, institutions, and generative conditions in order to establish how a research object formed, persisted, changed, or became intelligible through time.

Historical warrant depends on provenance, temporal specificity, category sensitivity, and disciplined handling of gaps in the record. Later knowledge can support re-epistemization of an earlier sequence, yet retrospective interpretation should remain distinct from retrospective determinism. A historical reconstruction can show that a later outcome became possible through a sequence without claiming that it was already necessary at the sequence's beginning.

6.15.5 Genealogical Inquiry

Genealogical inquiry shares historical materials with historical inquiry while placing particular emphasis on the formation of categories, practices, subject positions, standards, and regimes of intelligibility. Its central question is often less the continuous history of a stable object than the historical conditions through which something came to be constituted as an object, problem, identity, norm, or field of intervention.

This orientation is compatible with ontological suspension because genealogy can investigate the historical production of classifications without requiring that the classification exhaust the underlying reality. Hacking's work on historical ontology shows how categories and possibilities of description can emerge historically and then participate in the constitution of objects and persons (Hacking 2002). Foucault's analyses of power and subject formation likewise emphasize relations through which subjects and domains of knowledge are historically constituted (Foucault 1982).

Definition 6.240 (Genealogical inquiry). *Genealogical inquiry* reconstructs the historically contingent formation, stabilization, transformation, and effects of categories, norms, subject positions, problems, or regimes of intelligibility.

Genealogy should not be reduced to a search for a single hidden origin. Its value often lies in disclosing discontinuities, competing lineages, forgotten alternatives, and the relations through which a present category acquired authority. Within GRE, this makes genealogy especially useful for studying economic categories whose apparent naturalness may depend on institutional, legal, administrative, or epistemic histories.

6.15.6 Interpretive Inquiry

Interpretive inquiry addresses meanings, reasons, symbols, narratives, classifications, and practical understandings through which relations become intelligible to participants and observers. Economic and institutional action is rarely exhausted by externally observable behavior. The same transfer, contract, refusal, gift, debt,

or administrative act can carry different meanings across relational and historical contexts, and those meanings can themselves alter subsequent action.

Interpretive inquiry therefore treats meaning as part of the evidential target rather than as noise surrounding an otherwise complete behavioral record. It can reconstruct how actors understand obligations, how institutions narrate their purposes, how categories acquire normative force, or how apparently similar practices differ because they inhabit different symbolic relations. Ricoeur's movement from text toward action provides one important account of how interpretation can extend beyond literary objects toward meaningful social action (Ricoeur 1991).

Definition 6.241 (Interpretive inquiry). *Interpretive inquiry* is inquiry directed toward the meanings, reasons, symbolic relations, narratives, and practical understandings through which an object, action, or relation becomes intelligible within a situated field.

Interpretation remains evidentially constrained. Participant accounts can conflict; meanings can be strategic or retrospective; and an interpretation that is coherent to the researcher can still be weakly supported by the field. Interpretive warrant therefore depends on textual, observational, historical, and relational evidence together with explicit treatment of alternative readings.

6.15.7 Hermeneutic Inquiry

Hermeneutic inquiry develops interpretation through the relation between part and whole, present and history, question and text, and interpreter and tradition. It is especially relevant when the meaning of a document, concept, institution, or practice cannot be fixed by isolated propositions. Legal texts, philosophical concepts, policy documents, archival materials, and institutional vocabularies often acquire meaning through larger interpretive horizons that change over time.

Gadamer's account of historically effected understanding emphasizes that interpretation proceeds from a situated horizon rather than from a view outside history (Gadamer 2004). Ricoeur similarly develops a hermeneutics in which interpretation is mediated by texts, symbols, and action rather than reducible to recovery of an author's private intention (Ricoeur 1991). For GRE, these insights support reflexive interpretation without requiring that all interpretations be equally warranted.

Definition 6.242 (Hermeneutic inquiry). *Hermeneutic inquiry* is interpretive inquiry that reconstructs meaning through historically situated relations among parts, wholes, contexts, traditions, questions, and interpreters.

Hermeneutic inquiry is therefore particularly valuable when concepts travel across periods or domains. It can disclose that a familiar term has shifted in meaning, that a legal category is intelligible only through a doctrinal history, or that a theoretical concept acquires different implications when inserted into a new problem field. Such reconstruction should preserve the distance between historical meaning and present analytical use.

6.15.8 Ethnographic Inquiry

Ethnographic inquiry studies relations through sustained engagement with situated practices. Its distinctive contribution lies in observing how categories, norms, skills, routines, infrastructures, and tacit forms of coordination are enacted in settings where formal descriptions may only partially capture what participants actually do. Ethnography can therefore reveal discrepancies between official procedure and practical conduct, between stated rule and negotiated practice, or between institutional category and lived relation.

The strength of ethnographic inquiry depends on relational presence rather than mere physical proximity. Access, trust, role, language, duration, and the researcher's changing position affect what can be observed and how observed conduct is interpreted. Hutchins' study of distributed cognition illustrates how close analysis of practice can disclose cognitive organization distributed across persons, artifacts, and procedures that would be difficult to reconstruct by isolating individual actors (Hutchins 1995). Bourdieu's account of practice likewise supports attention to practical regularities that actors may not formulate explicitly (Bourdieu 1977).

Definition 6.243 (Ethnographic inquiry). *Ethnographic inquiry* is sustained, situated empirical inquiry into practices and relations through observation, participation, interaction, and contextual interpretation within a field of activity.

Ethnographic evidence is powerful for reconstructing mechanism, practice, meaning, and relational organization, while usually requiring caution in population-level generalization. Its local density is a feature rather than a defect when the research claim concerns how a process is enacted. Wider inference requires additional justification or complementary evidence.

6.15.9 Legal and Institutional Inquiry

Legal and institutional inquiry reconstructs rule-governed orders, formal classifications, rights, obligations, procedures, organizational arrangements, enforcement relations, and the practical operation of institutions. It is indispensable when the research object is partly constituted through legal or institutional facts rather than merely influenced by them. Property, corporate personhood, contractual obligation, administrative eligibility, organizational authority, and many economic categories depend on rule systems whose content cannot be inferred from behavior alone.

Hart's analysis of law clarifies the importance of rule structures and institutional recognition for understanding legal orders (Hart 2012). North and Ostrom, from different institutional traditions, likewise emphasize that institutions organize incentives, constraints, and patterned interaction while their operation depends on historically and contextually specific arrangements (North 1990; Ostrom 2005). GRE extends this institutional sensitivity by distinguishing formal rule, institutional manifestation, practical enactment, and downstream relational effects.

Definition 6.244 (Legal and institutional inquiry). *Legal and institutional inquiry* is inquiry directed toward the constitution, interpretation, operation, interaction, and transformation of formal or informally stabilized rules, categories, organizations, rights, obligations, procedures, and institutional relations.

Such inquiry can combine doctrinal interpretation, archival reconstruction, organizational analysis, interviews, administrative records, and comparative institutional evidence. A formally valid rule may be weakly implemented; an informal rule may be strongly stabilizing; and institutional effects can exceed the intentions of rule designers. The method therefore requires attention both to constitutive rules and to relational realization.

6.15.10 Computational Inquiry

Computational inquiry uses algorithmic procedures to represent, explore, reconstruct, or generate patterns that would be difficult to examine through unaided analytical reasoning. It includes simulation, agent-based modeling, network computation, large-scale data processing, optimization, machine learning, and computational experiments. Its distinctive contribution lies in executable representation: assumptions and transition rules can be iterated, complex interactions can be explored across many configurations, and consequences can be compared under controlled alterations of the computational system.

Agent-based computational economics exemplifies one use of computation to investigate how macro-level patterns can emerge from specified heterogeneous agents and interactions (Tesfatsion 2006; Epstein and Axtell 1996). Simulation studies also show that computational models can function as epistemic instruments whose results depend on model construction, implementation, parameterization, and interpretation rather than functioning as transparent deductions from theory (Winsberg 2010).

Definition 6.245 (Computational inquiry). *Computational inquiry* is inquiry in which executable algorithmic procedures are used to represent, process, simulate, compare, infer, or explore relations and transformations relevant to a research question.

Computational power can expand the tractable search space without dissolving epistemic uncertainty. Simulated agents remain representations; inferred patterns depend on data and objective functions; and high-dimensional results can conceal rather than eliminate assumptions. Computational inquiry is therefore strongest when implementation choices, data provenance, representational scope, and the relation between computational output and substantive claim remain inspectable.

6.15.11 Partial Irreducibility among Inquiry Modes

The preceding modes overlap extensively. Historical inquiry can be quantitative; ethnography can be interpretive and empirical; legal inquiry can be hermeneutic; computational inquiry can instantiate formal theory; qualitative evidence can support causal-process reconstruction; and genealogical work can draw on institutional records. The purpose of distinguishing modes is therefore not to create disciplinary borders. It is to prevent overlap from being mistaken for equivalence.

Each mode foregrounds a different epistemic relation. Formal inquiry clarifies structural consequence. Quantitative empirical inquiry estimates patterned variation. Qualitative empirical inquiry preserves contextual difference and process. Historical inquiry reconstructs sequence and transformation. Genealogical inquiry reconstructs the formation of categories and regimes of intelligibility. Interpretive and

hermeneutic inquiry reconstruct meaning. Ethnography reconstructs situated practice. Legal and institutional inquiry reconstructs rule-governed orders. Computational inquiry expands executable exploration and algorithmic inference. A project can move among these functions, yet information may be lost when one is translated wholly into another.

Proposition 6.246 (Differentiated inquiry principle). *When a research claim depends on properties that are differentially accessible through formal structure, empirical variation, historical sequence, situated practice, meaning, institutional constitution, or computational exploration, adequate inquiry should preserve the evidential contribution and characteristic remainder of each materially relevant mode rather than assuming complete interchangeability.*

Partial irreducibility does not protect a mode from criticism. Historical narratives can be contradicted by quantitative evidence; formal elegance can fail empirically; ethnographic interpretations can be challenged by documentary records; computational results can reveal sensitivities that undermine a verbal mechanism; and legal analysis can show that a category presumed by empirical work has been misidentified. The possibility of correction depends precisely on retaining enough difference for one mode to disclose what another has missed.

Proposition 6.247 (Mode-specific warrant). *The warrant supplied by an inquiry mode should be stated in terms of the property it renders accessible, the evidence or representation through which access is achieved, the inferential operation performed, and the boundary beyond which the resulting claim requires additional support.*

This formulation keeps methodological pluralism operational. Researchers need neither choose one privileged mode for the entire project nor combine every available method. They need to establish which inquiry relation is appropriate to the claim, where another mode can provide correction or complementary access, and where translation would suppress a material remainder. The next section narrows this discussion to formal and quantitative models. Rather than treating models as one homogeneous method, it distinguishes their roles in representation, reconstruction, explanation, comparison, prediction, counterfactual exploration, theory critique, theory generation, and practical decision support.

6.16 Formal and Quantitative Models as Epistemic Instruments

This section specifies the epistemic functions that formal and quantitative models can perform within research praxis. Its role is to prevent the term *model* from naming a single undifferentiated activity and to clarify why representational adequacy, reconstruction, explanation, comparison, prediction, counterfactual exploration, and theory development require different forms of warrant. The discussion proceeds function by function and then reconnects model use to the distinction between research-dominant and application-dominant praxis developed earlier in this chapter. The method is analytical rather than taxonomic: the same model can serve several functions, yet the evidential burden appropriate to one function does not automatically transfer to another. This functional differentiation is particularly important for GRE

because formalization is useful for relational structure, generative dynamics, and cross-scale comparison while remaining subject to ontological suspension, historical sensitivity, representational remainder, and methodological pluralism.

Definition 6.248 (Epistemic model). An *epistemic model* is a deliberately constructed representation whose variables, relations, parameters, rules, states, or other formal elements are used to make selected properties of a target object or process accessible for a specified research or practical purpose.

The definition treats model use as purposive and target-relative. Giere's account of scientific representation is useful here because it treats scientists as using models to represent selected aspects of reality for particular purposes rather than requiring model and target to stand in a relation of complete similarity (Giere 2004). Models therefore achieve epistemic usefulness partly through selection. The same selectivity that makes a model tractable also generates a remainder: relations, histories, meanings, scales, or contingencies outside the representation can remain materially relevant.

6.16.1 Models as Representations

Representation is the most basic model function considered here. A formal or quantitative model specifies a structured representational domain in which selected features of a target are rendered through variables, categories, state spaces, parameters, equations, distributions, graphs, algorithms, or rules. Such a model can clarify what is being claimed about a target because it requires some assumptions and relational commitments to become explicit. It can also conceal assumptions by embedding them in apparently technical choices whose substantive meaning receives insufficient attention.

The epistemic question is therefore not whether a model is literally identical to its target. It concerns which target properties the representation is intended to preserve, which transformations are licensed, which differences are treated as negligible, and what inferential work the representation is expected to support. Under ontological suspension, a formal relation in a model is not automatically an ontological relation in the world. A state variable can represent a historically formed category without implying that the category is a timeless natural kind. A network edge can represent an observed or inferred relation without exhausting the meaning or institutional structure of that relation.

Definition 6.249 (Model representation claim). A *model representation claim* specifies the target of a model, the properties intended to be represented, the representational correspondence being asserted, the purposes for which that correspondence is treated as adequate, and the material remainders left outside the representation.

This formulation makes representation inspectable. A model can be useful for one purpose and inadequate for another without contradiction. A simplified mobility model may represent aggregate flows adequately while remaining weak for reconstructing lived reasons for movement. A legal-economic model may preserve entitlement structure while suppressing informal practice. A generative model may clarify how local interaction rules can produce aggregate patterns while remaining silent about the historical formation of the rules themselves.

6.16.2 Models as Instruments of Reconstruction

Models also function as instruments of reconstruction. Here the task is not merely to represent an already known object but to infer relational structure, latent states, parameters, trajectories, or mechanisms from incomplete manifestations and traces. Statistical estimation, network inference, latent-variable models, state-space reconstruction, inverse problems, and many computational procedures operate in this mode. The model mediates a movement from observed evidence toward an analytically specified relational object.

Reconstruction carries a stronger burden than descriptive representation because multiple underlying structures may be compatible with the same observed manifestations. The identification problem therefore matters. Manski's work on identification is especially relevant because it distinguishes what can be learned from available data under weak assumptions from what becomes identifiable only after additional assumptions are imposed (Manski 2008). Within GRE, this implies that a reconstructed relation should retain information about the assumptions that made the reconstruction possible.

Definition 6.250 (Model-based reconstruction). *Model-based reconstruction* is an inferential use of a model in which observed manifestations, traces, or measurements are used to estimate or delimit unobserved relational structures, states, parameters, or processes under explicitly stated assumptions.

A point estimate can therefore be less epistemically informative than a wider reconstruction set when the latter more accurately preserves underdetermination. Model complexity does not itself solve non-identifiability. Additional parameters can increase representational flexibility while leaving several relational explanations compatible with the evidence. Reconstruction is strongest when the relation between evidence, assumptions, inferred object, and residual alternatives remains explicit.

6.16.3 Models as Instruments of Explanation

Models can contribute to explanation by identifying structural dependencies, causal relations, generative mechanisms, invariances, or process organizations that make an observed pattern intelligible. This function differs from reconstruction. Reconstructing a stable association or latent configuration does not yet explain why it arises or how it would respond to relevant changes.

Woodward's interventionist account clarifies one important form of explanatory modeling: causal explanation can concern how changes in one variable would produce changes in another under suitable interventions and invariance conditions (Woodward 2003). For GRE, however, explanation can also require historical sequence, institutional constitution, interpretation, and distributed generative organization. A formal model may isolate one mechanism while other inquiry modes establish whether that mechanism exists, how it became operative, and what boundaries constrain its explanatory relevance.

Proposition 6.251 (Explanatory burden of models). *A model supports an explanatory claim only to the extent that the modeled dependencies, mechanisms, or generative structures are adequately linked to the target process and competing explanations are*

addressed at the level required by the claim.

This principle separates internal derivability from external explanation. A conclusion can follow rigorously from model assumptions while the assumptions remain weakly connected to the target. Formal validity is an achievement inside the representational system; explanatory warrant additionally requires a justified world-link.

6.16.4 Models as Instruments of Comparison

Models provide comparison by placing different cases, periods, configurations, or scenarios within a common representational frame. Quantitative normalization, common indicators, standardized parameters, typologies, relational measures, and simulation environments can reveal contrasts that are difficult to see through unstructured description. Comparison is particularly useful when a research question concerns variation across institutional arrangements, relational topologies, historical trajectories, or intervention designs.

The common frame that enables comparison can also distort it. Commensuration may suppress qualitative differences, historically specific meanings, or non-equivalent categories. A comparison therefore needs an account of what is held common and what remains case-specific. Porter documents how quantitative and standardized forms of objectivity can acquire institutional authority precisely because they facilitate impersonal comparison and coordination (Porter 1995). The gain in comparability can be real while still carrying representational costs.

Definition 6.252 (Model-mediated comparison). *Model-mediated comparison* is the use of a common formal or quantitative representation to examine differences or similarities among targets while specifying the dimensions treated as comparable and the case-specific properties that remain outside or resist the common frame.

Comparison thus becomes an explicit analytical achievement rather than an assumed property of the cases. A model can make two objects comparable in one dimension while preserving their non-equivalence in others.

6.16.5 Models as Instruments of Prediction

Prediction concerns the use of a model to estimate future, unobserved, or held-out manifestations under specified conditions. Predictive performance can provide important information about whether a model captures stable regularities relevant to its forecasting task. It is especially valuable when claims must survive contact with data not used in model construction.

Predictive success nevertheless has a bounded epistemic meaning. A model can predict well through stable correlation while offering a weak account of mechanism. A structurally informative model can explain an important process while predicting poorly because the system is exposed to unmodeled shocks, measurement limitations, strategic adaptation, or genuine openness. Prediction and explanation can reinforce one another, but neither function subsumes the other.

Manski's distinction between identification, prediction, and decision is useful because it makes visible the assumptions needed to move from observed data toward statements about outcomes and practical choices (Manski 2008). GRE extends this cau-

tion to historically changing relational systems: predictive validity can decay when institutions, categories, behavior, technologies, or the relations being modeled change.

Proposition 6.253 (Predictive scope principle). *The epistemic significance of predictive performance is indexed to the population, boundary, scale, temporal horizon, data-generating conditions, and decision context under which the prediction is evaluated.*

Prediction should therefore carry a scope statement rather than appearing as a context-free property of the model.

6.16.6 Models as Instruments of Counterfactual Exploration

Models enable counterfactual exploration by examining how represented outcomes change when specified conditions, parameters, relations, rules, or interventions differ. This function can reveal dependency structure, test the robustness of explanations, explore unrealized alternatives, and support practical deliberation. Counterfactual modeling is especially useful when direct experimentation is impossible, unethical, historically unavailable, or institutionally infeasible.

A counterfactual result remains conditional on the model's representational and structural assumptions. Woodward's interventionist framework shows why causal counterfactuals require disciplined specification of interventions and invariances rather than arbitrary alteration of variables (Woodward 2003). Historical and institutional counterfactuals require an additional constraint: alternatives should remain compatible with what was materially, institutionally, and epistemically feasible in the relevant period.

Definition 6.254 (Model-based counterfactual exploration). *Model-based counterfactual exploration* is the disciplined alteration of specified model conditions in order to examine conditional changes in represented outcomes, while preserving explicit assumptions about feasibility, invariance, boundary, and the relation between the modeled alteration and the target process.

This definition separates counterfactual exploration from fantasy scenario generation. Models can widen the space of considered alternatives, but substantive feasibility remains a distinct empirical, historical, institutional, and normative question.

6.16.7 Models as Instruments of Theory Critique

Formalization can expose weaknesses in theory by requiring verbal claims to be made structurally explicit. Internal inconsistency, missing mechanisms, hidden closure assumptions, non-identification, sensitivity to parameter choices, unstable equilibria, or dependence on restrictive boundary conditions can become visible once a theory is represented formally. Quantitative models can also reveal that an apparently general theoretical claim survives only within a narrow empirical range.

Computer simulation provides a particularly useful example. Winsberg emphasizes that simulation is a scientific practice involving theory, modeling, approximation, implementation, and evidence rather than a transparent execution of prior theory (Winsberg 2010). When simulation behavior diverges from theoretical expectation, the discrepancy can direct attention toward assumptions, implementation choices, omitted processes, or genuinely new dynamics.

Proposition 6.255 (Model-enabled theory critique). *A model functions as an instrument of theory critique when its explicit structure reveals consequences, incompatibilities, sensitivities, absences, or empirical failures that materially challenge the scope or organization of the theory from which the model was derived.*

Critique does not require immediate rejection. A failure can localize where revision is needed and can thereby become generative for theory development.

6.16.8 Models as Instruments of Theory Generation

Models can generate theoretical possibilities rather than merely implement pre-existing theory. Exploratory formalization may reveal a previously unnoticed dependency. Simulation can display aggregate patterns arising from local rules that were not anticipated verbally. Network or statistical models can disclose regularities that demand new concepts. A model can therefore function as a conjecture-producing environment.

Agent-based approaches make this generative function particularly visible. Epstein and Axtell construct artificial societies in which macro-patterns arise from repeated interactions among heterogeneous agents (Epstein and Axtell 1996). Tesfatsion similarly presents agent-based computational economics as a constructive approach in which decentralized interactions, learning, organizations, and institutions can be studied through computationally realized systems (Tsfatsion 2006). Such models do not establish that the represented mechanism operates in the empirical world merely because it can generate a pattern. They can, however, enlarge the space of plausible mechanisms and direct subsequent empirical, historical, or interpretive inquiry.

Definition 6.256 (Theory-generative model use). *Theory-generative model use occurs when formal or quantitative exploration produces new candidate concepts, mechanisms, relations, hypotheses, or explanatory structures that were not fully specified before the modeling process.*

The resulting theoretical proposal remains provisional until it acquires warrant beyond the generative model environment.

6.16.9 Models as Instruments of Theory Transformation

Theory generation becomes theory transformation when model-based inquiry reorganizes an existing theoretical system rather than adding a local hypothesis. Repeated sensitivity failures may alter the theory's account of stability. Model comparison can show that a familiar category aggregates several processes that need separation. A simulation may reveal that interactions treated as residual are structurally central. Empirical modeling may make a historical discontinuity visible that requires a new state space or identity criterion.

Theory transformation is therefore recursive. Theory guides model construction; model behavior reveals consequences and limits; empirical and historical inquiry evaluate those consequences; and the resulting findings can change the concepts from which later models are built. This recursion echoes the broader account of research-dominant praxis developed in Section 6.4: inquiry can transform the

epistemic-theoretical system through which subsequent inquiry proceeds.

Proposition 6.257 (Recursive model-theory transformation). *When model construction or model-based evidence reveals a persistent mismatch that is traceable to the conceptual organization of a theory, warranted revision can extend beyond parameter adjustment to the theory's categories, relational architecture, mechanisms, boundary conditions, or criteria of identity.*

This proposition guards against treating every failure as a tuning problem. Some failures concern the representational architecture itself.

6.16.10 Use of Models within Application-Dominant Praxis

Within application-dominant praxis, models can support forecasting, resource allocation, risk assessment, scenario exploration, monitoring, prioritization, and intervention design. Their practical relevance increases the need to separate epistemic output from decision authority. A model can estimate consequences under assumptions; it does not by itself determine which consequences should be valued, which risks are acceptable, whose losses count, or how uncertainty should be distributed.

The distinction becomes especially important when model outputs are operationalized through institutional procedures. Once a score, forecast, ranking, optimization rule, or simulation result changes access, incentives, expectations, or behavior, the model becomes part of the relational system under study. MacKenzie's analysis of financial models illustrates how models can become incorporated into market practices and contribute to reshaping the processes they represent (MacKenzie 2006). Model evaluation in application-dominant praxis can therefore require post-deployment monitoring of performative and reflexive effects.

Definition 6.258 (Application-oriented model use). *Application-oriented model use* is the incorporation of model outputs into practical judgment, intervention design, allocation, monitoring, or institutional action under an explicit account of uncertainty, value conflict, reversibility, affected relations, and possible model-induced transformation of the target system.

This definition preserves human and institutional responsibility. Practical closure can draw on models without delegating the entire decision problem to them.

6.16.11 Model Function and Praxis Orientation

The same formal object can perform different epistemic functions in different phases of praxis. A network model can first represent a relation structure, later reconstruct missing ties, then compare institutional configurations, and finally support an intervention scenario. A simulation can serve exploratory theory generation in research-dominant praxis and later become a decision-support instrument in application-dominant praxis. The epistemic requirements change with the function.

Definition 6.259 (Model function profile). *A model function profile* records the target of a model, its current epistemic or practical function, the assumptions and evidence supporting that function, the form of validation or criticism appropriate to it, the relevant uncertainty, and the praxis orientation within which the model is being used.

The function profile prevents warrant from migrating silently across uses. Good predictive performance does not automatically establish causal explanation. A useful counterfactual tool does not automatically establish historical truth. An elegant formal representation does not automatically justify practical intervention. A model that is adequate for exploratory research may require substantially stronger validation, monitoring, and accountability before it becomes part of consequential application.

Proposition 6.260 (Non-substitution among model functions). *Evidence supporting one model function should not be treated as sufficient support for another function unless the inferential bridge between them is independently justified.*

This principle makes model use compatible with the methodological pluralism developed in Section 6.14. Models are powerful because they can perform several tasks, and epistemically disciplined because those tasks remain distinguishable.

6.16.12 Limits of Model-Centered Inquiry

Model-centered inquiry becomes inadequate when tractability is mistaken for relevance, formal precision for substantive warrant, predictive performance for explanation, or model availability for completeness of the research object. Some materially important properties are weakly represented by available variables; some relations acquire meaning through history, law, language, interpretation, or situated practice; some boundaries change during inquiry; and some forms of uncertainty arise from categories or possible futures that have not yet been adequately articulated.

The limitation is especially serious when model outputs acquire institutional authority. Representation can feed back into classification, behavior, resource allocation, and future data. In such cases the model can partly produce the conditions under which it later appears empirically successful. Reflexive monitoring therefore belongs to model criticism whenever outputs enter the relational system they describe.

Models also create opportunity costs. Building, calibrating, validating, maintaining, and interpreting a sophisticated model consumes intellectual and institutional resources. A project should therefore be able to explain why formal or quantitative modeling provides epistemic access that simpler comparison, historical reconstruction, field observation, qualitative evidence, or interpretive analysis cannot supply as effectively for the target claim.

Proposition 6.261 (Disciplined model-use principle). *Formal and quantitative models are epistemically strongest when their function, target, representational commitments, assumptions, evidence, validation standard, uncertainty, praxis orientation, and material remainder are explicit, and when claims exceeding those supports remain available to correction from other inquiry modes.*

The principle places models within research praxis rather than above it. Formal and quantitative instruments can sharpen representation, reconstruct hidden structure, explain dependencies, compare cases, predict outcomes, explore counterfactuals, criticize and generate theory, and support practical judgment. Their contribution remains strongest when their partiality is preserved. The next section develops the reciprocal side of methodological pluralism by examining how different methods can

correct one another when their evidential and representational outputs diverge.

6.17 Mutual Correction among Methods

The methodological pluralism developed in Section 6.14 becomes epistemically consequential only when different modes of inquiry can do more than coexist. This section develops the corrective relation among methods. Its role is to specify how historical, formal, quantitative, qualitative, interpretive, and field-based inquiry can expose limits in one another without being reduced to a single methodological standard. The objective is therefore narrower than methodological integration: the section asks how one mode of inquiry can identify assumptions, omissions, category failures, scope conditions, or representational distortions in another. The discussion proceeds through eight recurrent forms of correction before formulating recursive methodological revision as a general research practice.

Mutual correction differs from simple agreement among methods. Convergence can increase confidence when independently generated evidence supports compatible claims, yet agreement can also arise because several methods share the same categories, data infrastructure, institutional blind spots, or background assumptions. Conversely, disagreement need not imply that one method has failed. It can indicate that the methods access different scales, historical periods, relational positions, or manifestations of the object. Longino's account of scientific objectivity emphasizes the epistemic importance of criticism directed toward background assumptions rather than the mere accumulation of observations (Longino 1990). GRE extends this insight methodologically: a method becomes especially valuable when it can reveal where another method's warrant ceases to travel.

Definition 6.262 (Methodological correction). *Methodological correction* is a warranted revision of a research claim, category, representation, scope condition, inferential bridge, or method choice generated when evidence or reasoning from one inquiry mode exposes a materially relevant limitation in another.

Correction therefore concerns the research configuration rather than victory of one method over another. A formal model may survive historical correction after its scope is narrowed. A quantitative regularity may remain useful after interpretation changes its meaning. An ethnographic category may become stronger after measurement reveals its distribution. The relevant question is what must be revised so that the combined research configuration better fits the object and the claim.

6.17.1 Formal Models Corrected by History

Formal models often obtain analytical power by stabilizing categories, rules, relations, parameters, and state spaces long enough to examine their consequences. Historical inquiry tests whether those stabilizations remain valid across the period to which the model is applied. The corrective function of history is therefore directed less toward the internal mathematics of a model than toward the historical persistence of its represented objects and assumptions.

A formal model may treat an institution as a stable rule set even though the le-

gal meaning of the institution changed. It may represent agents as choosing from a fixed opportunity set even though political transformation altered which actions were conceivable or permitted. It may use one category across several decades while the practices classified under that category changed substantially. Hacking's historical ontology is relevant here because categories and objects of knowledge can acquire their apparent stability through historically specific practices of classification and reasoning (Hacking 2002). A model that ignores such transformations can remain internally coherent while representing several historically different objects as though they were one.

Historical correction can take several forms. It can restrict the temporal scope of a model, split a variable or state into historically distinct forms, introduce regime change, alter the identity criterion of an entity, or show that a parameter assumed to be exogenous was itself produced by an earlier institutional sequence. Pierson's analysis of increasing returns and path dependence demonstrates why timing and sequence can materially condition political development (Pierson 2000). In such settings, a model that represents only contemporaneous covariation can miss the historically generated constraints that make the present configuration possible.

Proposition 6.263 (Historical correction of formal scope). *When historical evidence shows that a model's entities, rules, boundaries, or opportunity structures changed materially within the modeled period, the model's scope or structure should be revised before its results are generalized across that period.*

The proposition does not privilege historical narrative over formal analysis. Formalization can make historical claims more explicit by forcing assumptions about continuity, sequence, and identity into inspectable form. The corrective relation is reciprocal even when this subsection emphasizes one direction.

6.17.2 Quantitative Findings Corrected by Interpretation

Quantitative inquiry can establish distributions, associations, differences, temporal patterns, and estimated effects with a degree of explicitness that interpretive inquiry often does not seek. Yet numerical results remain dependent on what the variables mean, how categories were constructed, what practices generated the observations, and whether apparently identical measurements carry the same significance across groups or contexts. Interpretation corrects quantitative findings when it shows that a numerical relation has been assigned a meaning that the evidence does not support.

The problem is particularly visible when administrative or survey categories travel across relational contexts. A variable labeled "employment," "household," "participation," or "trust" can aggregate substantially different practices. A statistically stable association can then coexist with heterogeneity in what the measured category denotes. Porter's history of quantitative objectivity shows how standardized measurement gains institutional strength partly by suppressing local judgment and making comparison portable (Porter 1995). That portability is valuable, but it can also conceal the interpretive work through which heterogeneous situations become commensurable.

Interpretive correction can therefore identify category mismatch, contextual heterogeneity, shifts in respondent meaning, or institutional production of the measured

variable. Ricoeur's treatment of explanation and understanding is useful because it resists treating these operations as mutually exclusive (Ricoeur 1991). A quantitative result can be explanatorily informative while still requiring interpretation of the actions, texts, rules, and meanings through which the measured pattern was generated.

Definition 6.264 (Interpretive correction of quantitative meaning). *Interpretive correction of quantitative meaning* occurs when contextual, linguistic, institutional, or practice-based evidence revises the substantive interpretation assigned to a quantitative pattern without requiring that the numerical pattern itself be discarded.

The distinction is important. Correction can change the claim attached to a coefficient while leaving the coefficient unchanged. It can also reveal that separate estimates are needed because the original variable pooled non-equivalent relations. Interpretation therefore enters quantitative inquiry at the level of meaning and category adequacy, not only after statistical analysis is complete.

6.17.3 Qualitative Categories Corrected by Measurement

Qualitative inquiry often develops categories from close engagement with practices, narratives, institutions, and situated differences. Such categories can achieve high contextual adequacy while remaining uncertain in distribution, prevalence, comparative reach, or temporal stability. Measurement can correct qualitative categories when it reveals that a distinction treated as central is rare, that a supposedly marginal form is widespread, that several field-defined types overlap empirically, or that variation within a category is greater than the qualitative account initially suggested.

This corrective function should not be understood as quantitative validation of qualitative truth. Measurement works through operationalization, and operationalization can itself distort the category under examination. The relevant contribution is more specific: explicit measurement can test the extension, distribution, boundary, and repeatability of a qualitative distinction. It can also make counterexamples visible at a scale that local observation cannot easily access.

For example, a field study may identify a meaningful distinction between two organizational practices. A subsequent survey or administrative reconstruction may show that the distinction predicts only a small part of observed variation, or that a third pattern appears frequently outside the original sites. The qualitative category need not be abandoned. It may instead be revised into a conditional type, decomposed into several dimensions, or limited to a particular institutional context. Longino's emphasis on critical interaction is again relevant: objectivity is strengthened when assumptions and classifications are exposed to perspectives capable of challenging them (Longino 1990).

Proposition 6.265 (Measurement-based category correction). *When a qualitative category carries claims about prevalence, distribution, comparative scope, or empirical boundaries, appropriately constructed measurement can correct those claims by testing where the category travels, where it overlaps with alternatives, and where its internal variation becomes materially significant.*

Measurement therefore supplies one kind of resistance to overextension. The qualitative category, in turn, supplies the interpretive content needed to determine what

is being measured. Mutual correction is strongest when both operations remain visible.

6.17.4 Historical Claims Corrected by Comparative Evidence

Historical inquiry reconstructs sequences, contingencies, institutional transformations, and context-specific mechanisms. Its strength can become a limitation when a mechanism inferred from one trajectory is treated as broadly general without comparison to alternative sequences. Comparative evidence corrects historical claims by showing whether an apparently distinctive process recurs elsewhere, whether similar outcomes arise through different mechanisms, or whether comparable initial conditions generate divergent trajectories.

Comparison is especially useful for testing narratives of necessity. A single historical sequence can appear internally coherent because later events make earlier steps seem preparatory. Comparative cases can reveal branches that were feasible but unrealized, institutions that responded differently to similar pressures, or similar outcomes produced without the mechanism emphasized in the focal account. Sewell's analysis of events and structural transformation emphasizes that consequential historical events can reorganize schemas and resources rather than simply instantiate pre-existing structures (Sewell 1996). Comparative inquiry can test whether the inferred transformation depends on features specific to one event or reflects a broader relational pattern.

Comparative correction also works against false uniqueness. Researchers can overstate the singularity of an institutional form because the evidential archive is organized nationally or disciplinarily. Cross-case comparison may reveal homologous processes under different names, or it may show that surface similarity conceals distinct legal, political, or cultural relations.

Definition 6.266 (Comparative correction of historical inference). *Comparative correction of historical inference* is the revision of a historical claim after evidence from additional cases, trajectories, or periods alters the inferred necessity, uniqueness, portability, or mechanism of the focal sequence.

Comparison does not eliminate historical specificity. It identifies more precisely which parts of a historical explanation can travel and which depend on a particular sequence, boundary, or institutional configuration.

6.17.5 Models Corrected by Field Observation

Models can organize relations that are difficult to perceive directly, yet their tractability often depends on simplifying how actors interpret rules, how institutions are enacted, how informal practices modify formal structures, and how exceptional situations are handled. Field observation corrects models when situated practice reveals relations, distinctions, feedbacks, or constraints omitted from the model's representation.

The correction is particularly important for models built from administrative data or formally specified institutions. What appears in the data as a rule can be implemented selectively. What appears as a binary organizational boundary can be tra-

versed through informal coordination. A resource recorded as available may be practically inaccessible to particular actors. Bourdieu and Wacquant's methodological relationalism emphasizes that positions and practices acquire meaning within fields of relations rather than in isolation (Bourdieu and Wacquant 1992). Field observation can therefore disclose how modeled positions are actually inhabited and negotiated.

A field-based discrepancy can have several implications. It may indicate measurement error, an omitted variable, an omitted relation, a misspecified behavioral rule, an unrepresented institutional layer, or a boundary problem. The appropriate response is not automatically to enrich the model. Sometimes the field observation shows that the model should be used only for a narrower target. In other cases it motivates a new state, relation type, or mechanism.

Proposition 6.267 (Field correction of modeled relations). *When field evidence reveals recurrent practices or relations that materially alter the mechanism or target represented by a model, the discrepancy should be treated as information about model scope or structure rather than absorbed as unexplained residual variation by default.*

Field observation thus supplies contact with forms of relational organization that standardized representations can weakly preserve. The model can subsequently test whether those observations matter beyond the local site.

6.17.6 Interpretation Corrected by Counterevidence

Interpretation is indispensable when research concerns meaning, intention, legal reasoning, symbolic practice, institutional language, or historically situated categories. Yet interpretive coherence can become self-reinforcing if evidence is selected primarily for compatibility with an established reading. Counterevidence corrects interpretation by requiring plausible readings to confront passages, actions, cases, or outcomes that the interpretation predicts poorly or cannot readily accommodate.

Counterevidence need not be decisive falsification. Interpretive claims often concern layered, contested, and context-dependent objects for which several readings retain partial support. The corrective requirement is that resistant evidence remains inside the interpretive field rather than being dismissed solely because it complicates the preferred account. Ricoeur's effort to articulate explanation together with understanding provides one model for maintaining interpretive openness while subjecting interpretation to structured constraints (Ricoeur 1991).

A resistant case can lead to several revisions. The interpretation may be narrowed to a subset of contexts; an additional actor perspective may be incorporated; the meaning of a category may be differentiated historically; or the original interpretation may be replaced. Counterevidence can also reveal that the apparent contradiction arises because the research object itself contains competing normative or symbolic orders.

Definition 6.268 (Interpretive counterevidence). *Interpretive counterevidence* is evidence that remains materially difficult to accommodate under a proposed interpretation and therefore creates a reason to revise the interpretation's scope, internal differentiation, contextual assumptions, or substantive content.

The concept protects interpretive inquiry from both extremes: it avoids treating

interpretation as unconstrained, while also avoiding the assumption that a single discrepant observation mechanically decides among complex meanings.

6.17.7 Formal Elegance Corrected by Empirical Inadequacy

Formal elegance can make a model intellectually compelling because compression, symmetry, tractability, or structural economy can reveal relations that are difficult to see in ordinary prose. Section 6.12 nevertheless separated aesthetic judgment from epistemic warrant. Mutual correction makes that separation operational: empirical inadequacy can override the attraction of an elegant formal structure when the structure fails at the target for which empirical adequacy is required.

McAllister's historical analysis of aesthetic evaluation in science shows that standards of beauty and elegance can guide theory preference while changing across scientific history (McAllister 1996). Such criteria can be generative because they orient attention toward coherent and fertile theoretical forms. Their epistemic role remains defeasible. An elegant model that persistently misrepresents observed relations, omits decisive historical conditions, or fails under relevant comparison should not be insulated by its formal appeal.

Empirical correction need not imply abandonment. A model can remain valuable as an exploratory structure, limiting case, comparative benchmark, or theory-generating instrument after losing status as an empirically adequate explanation. The model-function profile developed in Section 6.16 makes this repositioning explicit.

Proposition 6.269 (Aesthetic non-immunity of formal models). *Formal elegance can support attention, tractability, and theory generation, but it does not immunize a model against empirical, historical, interpretive, or relational evidence that materially undermines the function for which the model is being used.*

Correction therefore need not destroy an elegant model. It can reclassify its epistemic function and preserve what remains generative without overstating its warrant.

6.17.8 Empirical Regularity Corrected by Historical Discontinuity

Empirical regularity can be compelling because repeated association suggests stability. Historical discontinuity places a boundary around that inference. A relation estimated across one institutional regime, technological environment, legal order, or classificatory system may weaken or reverse after the underlying conditions change. Regularity therefore requires a continuity assumption that historical inquiry can test.

This issue is especially important in economic and institutional research because the production of data is itself historically organized. The same variable name can persist while the process generating it changes. Policy reforms can alter incentives and reporting. New technologies can change available actions. Political events can reorganize institutions. Sewell's account of structural transformation highlights how events can alter schemas and resources in ways that change the conditions of subsequent action (Sewell 1992; Sewell 1996). When those transformations occur, pooling observations across the discontinuity can manufacture apparent stability or conceal

genuine change.

Historical correction asks whether the relation has the same identity on both sides of the break. If the answer is uncertain, researchers may need regime-specific estimates, interaction terms, segmented comparisons, revised categories, or a different model of continuity. The correction can also run in the other direction: a purported historical rupture may prove less consequential when empirical evidence shows continuity in behavior or outcomes.

Definition 6.270 (Historical discontinuity correction). *Historical discontinuity correction* is the revision of an empirical regularity claim when historically evidenced changes in institutions, categories, technologies, relations, or opportunity structures undermine the assumption that observations before and after the change are generated by a sufficiently continuous process.

The concept ties empirical scope to historical identity. A regularity can be robust within a regime and still fail as a transhistorical claim.

6.17.9 Recursive Methodological Revision

The preceding cases show that correction among methods is rarely a one-step procedure. Historical evidence may force a formal model to change; the revised model may suggest a new comparison; comparison may reveal a measurement problem; revised measurement may generate a quantitative anomaly; field observation may then reveal an omitted practice; and the resulting interpretation may require another round of model revision. Methodological pluralism therefore becomes recursive when correction alters the subsequent organization of inquiry itself.

Definition 6.271 (Recursive methodological revision). *Recursive methodological revision* is the repeated reorganization of methods, categories, representations, evidence, and inferential relations in response to corrections generated within and across inquiry modes over successive research cycles.

The object of revision can be local or architectural. A local revision changes an estimate, category, coding rule, model term, or interpretation. An architectural revision changes which methods are used, which method has priority for a particular claim, how evidence is translated across representations, or what the research object itself is taken to be. Dewey's account of inquiry as transformation of an indeterminate situation is useful here because inquiry proceeds through repeated reconstruction rather than a fixed sequence of neutral operations (Dewey 1910). GRE adds that such reconstruction occurs across heterogeneous methods whose corrective relations can themselves evolve.

Recursive revision also requires preservation. If prior categories, model versions, coding decisions, field notes, alternative interpretations, and rejected mechanisms disappear, later researchers cannot reconstruct why a methodological change occurred or whether the change improved warrant. Methodological revision should therefore leave an inspectable history when the stakes and resources justify it.

Proposition 6.272 (Mutual-correction principle). *In methodologically plural inquiry, disagreement among adequately executed methods should be examined for differences in object definition, representation, boundary, scale, historical period, evidential access,*

and inferential assumptions before it is reduced to error or averaged into consensus.

Proposition 6.273 (Recursive correction principle). *When a methodological correction materially changes the research object, category system, evidential interpretation, or inferential bridge, the methods that depend on the revised element should themselves be reconsidered rather than treated as unchanged downstream procedures.*

These principles give methodological pluralism a dynamic form. Methods remain distinct enough to resist one another and connected enough to learn from the resistance. Mutual correction does not promise final methodological convergence. It creates a disciplined process through which the research configuration can become more adequate while preserving the remainders that one method cannot absorb into another. The next section examines this problem at the representational interface by analyzing how claims are translated across narrative, variable, relational, legal, qualitative, and formal forms.

6.18 Translation across Methodological Representations

The preceding sections established methodological plurality and mutual correction. Those commitments create a further problem: methods rarely remain epistemically isolated. A historical narrative may be coded into variables, field observations may be summarized as categories, social relations may be represented as edges, legal statuses may become analytical groupings, and formal results may later be expressed in interpretive prose. This section examines such movements as *translations across methodological representations*. Its role is to specify what can be preserved, transformed, omitted, or newly introduced when an object passes from one representational form into another. The discussion proceeds through recurrent translation interfaces and then develops criteria for information loss, non-equivalence, and reversibility. The objective is methodological discipline rather than representational purity: GRE can move among heterogeneous representations while keeping the epistemic consequences of those movements visible.

Definition 6.274 (Methodological representation translation). *A methodological representation translation is a rule-governed transformation through which an object, relation, event, category, experience, or result expressed in one methodological representation is re-expressed in another representation for a specified research purpose.*

Translation therefore includes a source representation, a target representation, a purpose, a set of transformation rules, and a remainder. The remainder matters because methodological representations select different properties of an object. Giere's purposive account of scientific representation is useful here: models represent selected aspects of targets for particular purposes rather than reproducing targets in their entirety (Giere 2004). Translation across representations consequently changes the selection through which the object becomes epistemically available.

6.18.1 From Narrative to Variable

Narrative representations preserve sequence, actor perspective, institutional context, contingency, ambiguity, and relations among events in forms that can remain open to reinterpretation. Quantitative inquiry often requires a different structure. Events and descriptions must be mapped into variables whose values can be compared across observations. The translation creates analytical portability, but it also requires decisions about what counts as an instance, which distinctions are retained, and which narrative features are treated as irrelevant to the target claim.

Consider a historical narrative describing repeated episodes of insecure employment. The narrative may distinguish contract status, bargaining relations, household responsibilities, employer practices, legal protections, expectations of continuity, and the person's interpretation of risk. Translating the narrative into a variable such as "employment insecurity" requires an operational rule. The rule might use contract duration, hours variability, probability of dismissal, or a composite index. Each choice makes a different part of the narrative analytically portable.

Porter's history of quantitative objectivity shows how standardized categories and measures gain strength through comparability and impersonal portability (Porter 1995). Desrosières likewise demonstrates that statistical reasoning depends on historically constructed practices of classification, coding, equivalence, and aggregation (Desrosières 1998). A variable is therefore an epistemic achievement rather than a transparent extraction from narrative material.

Definition 6.275 (Narrative-to-variable translation). A *narrative-to-variable translation* is the transformation of contextually organized descriptions into a coding or measurement scheme that preserves selected properties in a form permitting systematic comparison across observations.

The strength of the translation depends on fit between the retained properties and the claim for which the variable is used. A variable can be well suited to estimating prevalence while remaining poorly suited to reconstructing sequence, meaning, or institutional mediation. The source narrative should remain recoverable where later reinterpretation could materially change the variable's meaning or boundary.

6.18.2 From Relation to Edge

Relational inquiry often translates a substantive relation into an edge within a network representation. The operation is powerful because edges make relational structure mathematically tractable. Degree, centrality, clustering, paths, communities, temporal ordering, and multilayer structure can then be examined explicitly. Network science provides a mature vocabulary for these structural properties (Newman 2003), while temporal and multilayer approaches show how timing and relation type can be incorporated rather than collapsed into one static graph (Holme and Saramäki 2012; Kivelä et al. 2014).

Yet a substantive relation and an edge are not interchangeable objects. A relation can include direction, intensity, obligation, meaning, legal status, temporal depth, multiplexity, contested interpretation, and third-party dependence. An edge representation retains only those properties encoded in its definition and attributes. Even

a weighted, directed, temporal edge may omit features that remain important to the relation under investigation.

Definition 6.276 (Relational edge translation). A *relational edge translation* is the representation of a substantively specified relation through a graph or network element whose existence and attributes are determined by an explicit edge-definition rule.

The edge-definition rule is therefore part of the evidence. A coauthorship edge, for example, indicates a documented joint publication under a particular counting rule; it does not by itself establish intellectual influence, trust, friendship, equal contribution, or continuing collaboration. Likewise, a transaction edge can record exchange while leaving bargaining power and legal dependence outside the representation.

Higher-order interactions create an additional limit. Some relations involve groups whose interaction cannot be reconstructed adequately from pairwise links alone. Higher-order network research makes this distinction explicit by representing interactions among three or more units through structures beyond ordinary pairwise edges (Battiston et al. 2020). Translation from relation to edge is therefore strongest when the edge structure preserves the relational property relevant to the research claim and when omitted higher-order structure is explicitly considered.

6.18.3 From Historical Category to State Variable

Historical categories are situated within institutions, languages, classificatory practices, and trajectories of change. Formal or computational inquiry may translate such a category into a state variable that can assume specified values across time. This translation makes transitions, persistence, and comparative dynamics easier to analyze, but it requires an identity criterion that determines when historical variation counts as change within one state space and when the category itself has transformed.

A category such as “firm,” “household,” “worker,” or “citizen” can retain the same lexical label across periods while its legal constitution, institutional boundary, resource access, and practical meaning change substantially. Hacking’s historical ontology emphasizes that categories and objects of knowledge can emerge and change through historically specific styles of reasoning and classificatory practices (Hacking 2002). Treating a historical category as a stable state variable can therefore conceal transformations in the category that makes the variable possible.

Definition 6.277 (Historical state-variable translation). A *historical state-variable translation* is the representation of a historically situated category through a defined state space whose values permit comparison or dynamic analysis across specified periods.

Such a translation requires at least three explicit judgments: the historical identity criterion for the category, the coding rule that assigns observations to states, and the temporal interval over which the state space is treated as sufficiently stable. If any of these conditions changes materially, apparent state transitions may partly reflect category transformation rather than change within a stable category.

The distinction is especially important for long-run modelling. A model can represent a sequence of states with formal precision while silently treating historically non-equivalent categories as commensurable. Historical correction, developed in

Section 6.17, then becomes a test of whether the state-variable translation remains warranted across the period under study.

6.18.4 From Field Experience to Formal Structure

Field experience contains observations, conversations, embodied routines, spatial arrangements, tacit expectations, anomalies, and practical sequences that often exceed immediate formal expression. Formalization can nevertheless disclose structure that is difficult to see within the density of experience. Recurrent dependencies can become graphs, sequences can become transition structures, constraints can become admissible-state conditions, and differentiated positions can become model parameters or relational roles.

The translation begins with abstraction. Some properties of field experience are selected because they appear recurrent or analytically consequential. Those properties are then assigned formal counterparts. The formal structure can clarify assumptions and expose implications that were only implicit in field description. It can also generate new questions that return the inquiry to the field.

Bourdieu and Wacquant's reflexive methodology is relevant because the analytical construction of the object is itself part of social-scientific practice rather than a passive transcription of experience (Bourdieu and Wacquant 1992). Formalization intensifies this constructive moment by requiring explicit boundaries, relation types, state definitions, or functional dependencies.

Proposition 6.278 (Field-to-formal traceability). *When field experience is translated into a formal structure, the analytical pathway from observed or interpreted field material to formal objects should remain sufficiently traceable to identify which empirical distinctions support the formalization and which experiential properties remain outside it.*

Traceability allows formal results to return to their evidential basis. Without it, the formal structure can acquire autonomy from the field and make later correction difficult. With it, formalization can function as a disciplined compression that remains open to revision when additional field evidence exposes omitted relations or alternative structures.

6.18.5 From Legal Category to Analytical Object

Legal categories are particularly consequential methodological representations because they are simultaneously classificatory and institutionally operative. Terms such as corporation, employee, property, beneficiary, contract, creditor, or household member can allocate rights, duties, liabilities, standing, and access to remedies. Research often translates these categories into analytical objects for comparison, measurement, modelling, or causal analysis.

The translation must distinguish legal definition from analytical purpose. Organizational law, for example, can constitute entities and separate asset pools in ways that have material economic consequences (Hansmann and Kraakman 2000). An analytical category labelled “firm” may nevertheless require a different boundary when the research target concerns productive coordination, ownership, control, consolidated

reporting, or network dependence. Similarly, reporting frameworks can define an economic reporting entity whose boundary does not simply coincide with one legal entity (IFRS Foundation 2018).

Definition 6.279 (Legal-to-analytical translation). A *legal-to-analytical translation* is the transformation of a legally constituted category, status, relation, or boundary into an analytical object specified for a research question while preserving the legal properties materially relevant to that question.

The preservation clause matters. An analytical simplification that removes legal relations can become misleading when those relations are causally or institutionally active. At the same time, legal categories should not automatically determine the full analytical ontology. Research can distinguish legal ownership from effective control, formal employment from practical dependence, or juridical organization from economic coordination when the evidence supports those distinctions.

Legal categories thus enter methodological translation in a dual role: they are representations produced by institutions and relations that can help constitute the object being studied. Their analytical translation must preserve this performative dimension where it matters.

6.18.6 From Qualitative Difference to Quantitative Measure

Qualitative inquiry often encounters differences before their magnitude, prevalence, or distribution is known. Researchers may identify varieties of practice, contrasting meanings, institutional types, experiences of constraint, or degrees of relational dependence through interviews, observation, documents, or interpretive comparison. Translating those differences into quantitative measures can make distribution and comparison explicit, but it requires a metric or ordering structure that the qualitative material does not automatically supply.

A distinction can be nominal, ordinal, interval-like, multidimensional, or resistant to meaningful compression into one scale. Measurement therefore begins by specifying what form of difference is being asserted. Standardization is useful when observations can be made sufficiently commensurable, yet the history of quantification shows that commensurability is constructed through choices about categories, units, coding, and acceptable loss of local detail (Porter 1995; Desrosières 1998).

Definition 6.280 (Qualitative measurement translation). A *qualitative measurement translation* is the assignment of numerical, ordinal, categorical, or vector-valued representations to qualitatively identified differences according to an explicit measurement rule and a specified comparative purpose.

The definition allows several forms of measurement without presuming that every qualitative distinction belongs in one metric space. Some differences are better represented by multiple dimensions or mutually exclusive types. Others may support ranking while resisting meaningful interval comparisons. Measurement quality therefore includes fidelity to the topology of the qualitative distinction, not merely reliability of numerical coding.

Quantification can then feed back into qualitative inquiry. Unexpected distributions, clustering, or overlap can reveal that the original distinction was too coarse,

too context-specific, or internally heterogeneous. Translation can thus become a site of mutual correction rather than a one-way reduction of qualitative material to numbers.

6.18.7 From Formal Result to Interpretive Claim

Formal results acquire substantive meaning only through interpretation. A theorem establishes consequences within a formal system. A coefficient estimates a relation under a statistical specification. A simulation produces trajectories under programmed rules and parameter settings. A network metric summarizes a property of a defined graph. None of these results carries a complete interpretation of the empirical or historical world independently of the bridge connecting formal objects to substantive claims.

Ricoeur's treatment of explanation and understanding is helpful because it shows that formal explanation and interpretation can be connected without reducing one to the other (Ricoeur 1991). Giere similarly emphasizes that models represent selected aspects of reality through purposive representational claims (Giere 2004). The move from result to interpretation therefore adds propositions about what the formal object corresponds to, which assumptions travel with the result, and how the result bears on the substantive research question.

Definition 6.281 (Formal-to-interpretive translation). *A formal-to-interpretive translation is the inferential operation through which a result established within a formal, statistical, or computational representation is connected to a substantively meaningful claim about a specified research object.*

This translation should preserve function. A predictive result translated into explanatory prose requires an additional explanatory bridge. A simulated possibility translated into a claim of historical occurrence requires historical evidence. A network centrality score translated into power requires a theory and evidence connecting the metric to relevant forms of control, access, dependence, or influence. The model-function distinctions developed in Section 6.16 therefore constrain interpretation after formal analysis.

Proposition 6.282 (Interpretive bridge requirement). *A substantive claim derived from a formal result requires an explicit interpretive bridge specifying how the formal objects, assumptions, and result correspond to the properties of the research object invoked by the claim.*

The bridge does not weaken formal inquiry. It identifies the point at which formal validity becomes substantive inference and therefore makes that inference open to correction.

6.18.8 Information Loss in Translation

Translation is usually selective. A narrative coded into variables may lose sequence and ambiguity. A relation represented as an edge may lose meaning or higher-order context. A legal category transformed into an analytical grouping may lose doctrinal distinctions. Field experience compressed into a formal structure may lose tacit, embodied, or situational detail. These losses are not automatically methodological

defects; compression is often the condition that makes analysis possible. The epistemic problem arises when omitted information is material to the claim or when the loss becomes invisible.

Definition 6.283 (Translation remainder). A *translation remainder* is information, structure, meaning, uncertainty, or contextual dependence present in the source representation that is not preserved in the target representation under the chosen translation rule.

Definition 6.284 (Material translation loss). A *material translation loss* occurs when a translation remainder could reasonably alter the interpretation, scope, comparison, mechanism, attribution, or practical use of the claim for which the target representation is employed.

This distinction permits disciplined compression. Researchers need not preserve every detail from every representation. They should identify losses that matter for the intended inferential function. Longino's emphasis on critical scrutiny is relevant because what appears irrelevant from one methodological position may become consequential from another (Longino 1990). Mutual correction is partly a process of discovering previously invisible translation remainders.

A useful translation record can therefore state the source representation, target representation, translation rule, retained properties, known remainders, uncertain losses, and intended function. Such documentation becomes especially important when the target representation travels far from the context in which the translation was originally made.

6.18.9 Non-Equivalent Representations

Two methodological representations can concern the same research object without being equivalent. A historical narrative and a time series can overlap in temporal scope while preserving different properties. A legal category and a survey category can use similar labels while defining membership differently. A graph and an ethnographic account can describe the same organizational setting while representing distinct relational structures. Translating between them therefore requires comparison of preserved information rather than an assumption of identity.

Definition 6.285 (Representational non-equivalence). Two methodological representations are *non-equivalent* with respect to a research purpose when each preserves at least one property materially relevant to that purpose that cannot be recovered from the other representation under the available translation rules and auxiliary information.

Non-equivalence can be local rather than global. Two representations may be equivalent for estimating one quantity while diverging for historical explanation or normative interpretation. A legal and administrative classification may yield identical counts for one period while differing in the rights or exclusions attached to membership. A weighted network and a narrative may support the same claim about repeated interaction while differing on whether the interaction expresses cooperation, coercion, obligation, or strategic dependence.

The practical consequence is that methodological integration should not force all

representations into one master format. Some research claims are better supported by keeping multiple representations in parallel and specifying the relations among them. Partial irreducibility, introduced in Section 6.14, thus reappears at the level of representation itself.

Proposition 6.286 (Parallel-representation principle). *When methodologically non-equivalent representations preserve different properties that are materially relevant to the same research claim, the inquiry should retain those representations in parallel or explicitly preserve their irreducible remainders rather than treating translation into one format as epistemically complete.*

Parallel representation can be more cumbersome, but the additional complexity is warranted when a single representation would erase distinctions central to the research object.

6.18.10 Reversibility and Irreversibility of Translation

Some methodological translations are approximately reversible. A dataset generated from a fully documented coding scheme may allow reconstruction of the coded categories and source identifiers. A formal transformation can sometimes be inverted when the mapping is one-to-one and all necessary parameters are retained. Other translations are substantially irreversible. Aggregation can erase individual variation; anonymization can deliberately remove linkage information; summary statistics cannot reconstruct the original observations; and a binary edge representation cannot recreate meanings, negotiations, or temporal sequences that were never encoded.

Definition 6.287 (Representational reversibility). A methodological translation is *reversible relative to a specified property set* when the source representation's relevant properties can be reconstructed from the target representation and retained auxiliary information with an explicitly acceptable degree of uncertainty.

Definition 6.288 (Representational irreversibility). A methodological translation is *irreversible relative to a specified property set* when information necessary to reconstruct those properties has been discarded, merged, transformed beyond recoverability, or never encoded in the target representation and available auxiliary record.

Reversibility is therefore relative to what needs to be recovered. A transformation can be reversible for category membership and irreversible for narrative sequence. A legal record can preserve formal status while losing informal bargaining history. A quantitative dataset can permit reconstruction of measured responses while leaving the respondent's interpretive context unavailable.

The distinction has direct implications for research design. When translation is expected to be lossy and future reinterpretation is plausible, preservation of source material, provenance, coding rules, model versions, and translation metadata can protect later inquiry. Preservation remains subject to privacy, legal, ethical, security, and resource constraints. The aim is selective recoverability rather than indefinite retention of all material.

Proposition 6.289 (Translation traceability principle). *For methodologically consequential translations, research records should preserve enough provenance to iden-*

tify the source and target representations, the transformation rule, materially relevant losses, and the degree to which later reconstruction remains possible, subject to applicable ethical and institutional constraints.

Translation across methodological representations is thus a generative moment of research praxis. It enables comparison, formalization, measurement, modelling, and integration, while also producing new analytical objects and new possibilities for loss. Treating translation explicitly allows methodological plurality to remain connected without pretending that heterogeneous representations are interchangeable. The next section develops the recursive consequence of this insight by treating research as iterative reconstruction across observation, interpretation, formalization, empirical examination, and revision.

6.19 Research as Iterative Reconstruction

This section develops the recursive organization of research praxis after the methodological pluralism, mutual correction, and representational translation established in Sections 6.14–6.18. Its role is to explain how observation, interpretation, concept formation, formalization, empirical examination, and comparison can repeatedly reconstruct one another rather than form a single linear sequence. The objective is to specify the principal moments through which research objects, categories, models, theories, and methods are stabilized provisionally and then reopened when evidence, translation remainders, anomalies, or new relational configurations require revision. The discussion proceeds analytically through twelve moments of reconstruction and concludes by treating iteration across research cycles as a cumulative but non-identical process. The framework is methodological rather than ontological: it concerns how inquiry reorganizes its representations and inferential commitments while remaining answerable to evidence and to the relational realities under investigation.

Definition 6.290 (Iterative research reconstruction). *Iterative research reconstruction* is a research process in which observations, interpretations, concepts, formal representations, empirical examinations, comparisons, categories, theories, and methods are repeatedly revised in response to one another, with the provenance of consequential revisions kept sufficiently visible for later scrutiny.

Iteration therefore differs from repetition. Repetition may reproduce the same procedure under similar assumptions. Iterative reconstruction permits the object of inquiry, the questions asked of it, the representational system, and the standards of adequacy to change when warranted. Dewey's account of inquiry already treats problematic situations, conceptual operations, and experimental consequences as recursively connected rather than as isolated stages (Dewey 1910). Longino's emphasis on transformative criticism similarly makes scientific knowledge dependent on the possibility that claims and background assumptions can be altered through critical interaction (Longino 1990). GRE extends these insights by making relational change, methodological translation, and generative consequences explicit within the research cycle.

6.19.1 Observation

Observation is the first moment considered here because research reconstruction requires some relation through which features of the object become available to inquiry. Observation need not be temporally first in every project. Concepts, instruments, archives, or prior theories often precede a particular observation and condition what can be noticed. The analytical role of observation is therefore to supply or reorganize evidential contact rather than to provide an unmediated foundation.

Definition 6.291 (Reconstructive observation). *Reconstructive observation* is observation treated as revisable evidential access whose target, conditions, instruments, and interpretive relevance can be re-specified during inquiry.

An observation can change the research configuration in several ways. It can add a previously unavailable trace, challenge an existing category, disclose variation hidden by aggregation, reveal a relation that a model omitted, or weaken confidence in an earlier mechanism. Observations can also remain stable while their role changes. A record initially treated as background may become central after a new comparison; a recurrent field practice may acquire theoretical relevance only after a category is reformulated; an apparent anomaly may become expected once the relevant boundary or scale changes.

Observation should therefore preserve provenance. Researchers should be able to distinguish what was directly recorded, what was instrument-mediated, what was reconstructed from archival or administrative traces, and what entered the evidential record through later inference. Hacking's historical analyses of scientific objects and classifications illustrate how practices of observation and intervention can change the entities and regularities available to inquiry (Hacking 2002). For iterative reconstruction, such change is part of the evidential history rather than an inconvenience to be erased.

6.19.2 Interpretation

Interpretation organizes observations into provisional meanings, relations, and explanatory possibilities. It connects a trace to a context and determines which distinctions become analytically relevant. Interpretation is required even when data appear highly standardized because the meaning of variables, categories, absences, changes, and comparisons depends on assumptions concerning the research object and its relational setting.

Definition 6.292 (Reconstructive interpretation). *Reconstructive interpretation* is an interpretation whose assumptions, contextual relations, and evidential consequences remain open to revision when subsequent observation, comparison, formalization, or counterevidence changes the warranted reading of the material.

Interpretation can revise observation without denying the observation's occurrence. A recorded decline can remain numerically unchanged while being reinterpreted as category migration rather than behavioral change. A repeated interaction can remain documented while its meaning shifts from cooperation to dependency after additional institutional evidence. A silence in an archive can move from apparent absence of activity to evidence of a recording regime that excluded certain

relations. In each case, the reconstruction changes what the observation supports.

Interpretive revision benefits from preserving competing readings when more than one remains materially plausible. This practice supports the revisability developed in Section 6.17: later methods may supply evidence that discriminates among interpretations that could not initially be resolved. Interpretive plurality is therefore productive when it is disciplined by evidence, provenance, and explicit inferential conditions rather than used to suspend evaluation indefinitely.

6.19.3 Concept Formation

Concept formation gives research a vocabulary for distinguishing objects, relations, mechanisms, trajectories, and evaluative dimensions. Concepts permit observations to become comparable and arguments to become cumulative. They also create selective boundaries around what counts as a case, a relation, a transformation, or an effect. Concept formation is consequently both enabling and risky.

Definition 6.293 (Reconstructive concept). A *reconstructive concept* is a research concept whose extension, internal distinctions, relational dependencies, and evidential indicators can be revised when the existing formulation no longer adequately organizes the phenomena for which it is used.

Conceptual revision may occur through differentiation, aggregation, redefinition, or relocation. A single category may divide when previously hidden heterogeneity becomes consequential. Several categories may be grouped when their differences prove irrelevant to the target claim. A concept may retain its name while changing its operational criteria, or it may move from being treated as an attribute of actors to being understood as a relation among them.

The history of science contains many cases in which changing concepts reorganized observation and explanation. Kuhn's account of scientific development emphasizes that changes in disciplinary matrices can alter the questions, classifications, and standards through which phenomena are rendered intelligible (Kuhn 1962). Iterative reconstruction does not require adopting a universal theory of paradigms. It draws the more limited methodological lesson that concept formation participates in the production of the research object and therefore requires its own revision history.

6.19.4 Formalization

Formalization converts selected concepts and relations into explicit structures whose implications can be inspected more precisely. As developed in Sections 6.16 and 6.18, formalization can clarify assumptions, expose inconsistencies, support comparison, and generate new questions. It can also conceal translation loss when the relationship between the formal object and its source representation becomes opaque.

Definition 6.294 (Reconstructive formalization). *Reconstructive formalization* is a formal representation designed so that its assumptions, translation rules, target properties, and material remainders can be revised when empirical, historical, interpretive, or comparative inquiry reveals a mismatch between the formal structure and the research object.

Formalization can reconstruct earlier stages of inquiry by forcing implicit assumptions into explicit form. A model may reveal that a verbal explanation presupposes independence where field evidence suggests dependence, or that a proposed mechanism requires a temporal ordering unsupported by the record. Conversely, an apparently poor formal fit can identify the need to revise categories, boundaries, or scale rather than simply to add parameters.

This is why formalization should remain function-specific. A formal structure developed for comparison need not become an explanatory model, and an exploratory model need not be interpreted as a literal description of the underlying ontology. Reconstruction occurs when formal work returns to the concepts, evidence, and translations from which it was built and helps reorganize them.

6.19.5 Empirical Examination

Empirical examination tests how provisional concepts, interpretations, and formal structures relate to observed material. The term is used broadly here to include quantitative, qualitative, historical, ethnographic, legal-institutional, and computational evidence where the inquiry makes contact with records, practices, measurements, traces, or events capable of constraining a claim.

Definition 6.295 (Reconstructive empirical examination). *Reconstructive empirical examination* is the use of evidence to assess and potentially reorganize the concepts, representations, mechanisms, and scope conditions through which a research claim has been formulated.

Empirical examination therefore does more than confirm or reject a finished theory. It can show that the wrong object was measured, that the relevant relation operates at another scale, that the sampling frame excludes a crucial population, or that an apparent regularity is specific to a historical configuration. Popper's tradition of exposing theories to potential criticism remains an important precedent for maintaining empirical vulnerability (Popper 2002). Iterative reconstruction broadens the location of possible revision: criticism may alter the proposition under test, but it may also alter the categories, measurement architecture, boundary, comparison class, or method through which the proposition became testable.

Evidence can consequently be theory-relevant without being reducible to a binary test. The appropriate response to a mismatch depends on diagnosis. Some findings weaken a theory; others reveal a measurement failure; still others disclose a new object that the existing theory did not attempt to explain.

6.19.6 Comparison

Comparison makes differences and commonalities visible across cases, periods, scales, representations, models, or methodological results. Its reconstructive role is to challenge the assumption that categories and mechanisms travel unchanged. A claim that appears adequate within one case may require revision when a second case reveals a hidden boundary condition.

Definition 6.296 (Reconstructive comparison). *Reconstructive comparison* is comparison used to identify which properties of a research object, concept, mechanism, or

representation remain stable across specified differences and which require revision of scope, category, or explanation.

Comparison can operate within a method or across methods. Historical comparison may test whether a category retains meaning across periods. Cross-institutional comparison may distinguish a local rule from a more general mechanism. Comparison between a model and field material may identify where formal structure preserves or loses relevant relations. Comparison among competing interpretations can locate the observations on which disagreement turns.

The value of comparison therefore depends on explicit comparability. Similar labels, measurements, or legal categories do not guarantee equivalent objects. Section 6.18 showed that translation across representations can create material remainders. Reconstructive comparison carries that lesson forward by requiring the basis of comparability itself to remain revisable.

6.19.7 Reinterpretation

Reinterpretation occurs when later evidence, concepts, comparisons, or models change the warranted meaning of earlier material. It is more than replacing one opinion with another. Reinterpretation should identify what changed in the evidential or conceptual configuration and why the revised reading better fits the available material.

Definition 6.297 (Reinterpretive update). A *reinterpretive update* is a documented change in the warranted interpretation of existing evidence produced by a change in relevant context, concepts, comparisons, auxiliary evidence, or representational relations.

The same historical document can support a different inference after previously inaccessible archives become available. The same interview passage can acquire different relevance after a category distinction is refined. A statistical association can be reinterpreted after qualitative inquiry shows that a variable combines relations with different meanings. Reinterpretation is therefore a normal consequence of cumulative inquiry rather than an embarrassment to be minimized.

A disciplined reinterpretation preserves the earlier reading and the reasons it once appeared plausible. This creates a visible epistemic history and prevents later knowledge from being projected backward as if it had always been available. Such preservation also supports future re-epistemization: later researchers can reconstruct how evidence, concepts, and interpretations co-evolved rather than seeing only the latest stabilized result.

6.19.8 Model Revision

Model revision changes the structure, parameters, assumptions, target, or function of a model when the current representation becomes inadequate for its intended epistemic role. Revision can be local, such as recalibrating a parameter, or structural, such as changing the relations represented or abandoning an earlier state space.

Definition 6.298 (Model revision). *Model revision* is a documented change to a model's structure, assumptions, parameters, target, scope, or epistemic function

undertaken because new evidence, comparison, theory, or methodological criticism changes the conditions under which the model is warranted.

Model revision should preserve the distinction among model functions developed in Section 6.16. A revision that improves prediction may leave explanatory inadequacy unresolved. A model that becomes less parsimonious may become more historically faithful. A formal representation abandoned for estimation may remain useful as a conceptual comparison device. Revision therefore concerns fit between model and function rather than movement toward a single ideal model.

Versioned model records are especially useful where models participate in application-dominant praxis. When model outputs inform classification, allocation, or intervention, later changes can alter both the representation and the system being represented. Preserving earlier versions helps distinguish a change in the world from a change in the model's assumptions or data architecture.

6.19.9 Category Revision

Categories organize observation, measurement, comparison, administration, and interpretation. Their revision can therefore have consequences across an entire research configuration. A category that once appeared useful may become too broad, historically obsolete, normatively problematic, or empirically heterogeneous.

Definition 6.299 (Category revision). *Category revision* is a change in the definition, boundaries, internal differentiation, membership rule, or analytical role of a research category undertaken because the existing category no longer adequately supports the claims for which it is used.

Category revision can require retrospective work. Earlier datasets may need recoding; historical comparisons may need qualification; models may need rebuilding; and apparent trends may change when the classification system changes. Hacking's work on historical kinds and classification practices is relevant because categories can have histories and can participate in reorganizing the phenomena to which they are applied (Hacking 2002).

The reconstructive principle is therefore consequentiality. A category should not be revised merely because an alternative vocabulary is available. Revision becomes methodologically important when the existing category produces material misrepresentation, obscures a relevant relation, collapses heterogeneous cases, or impedes comparison. Once revised, dependent analyses should be reassessed rather than allowed to inherit the earlier category silently.

6.19.10 Theory Revision

Theory revision reorganizes claims about relations, mechanisms, structures, trajectories, or generative processes when accumulated research changes what can be adequately explained. Theories provide continuity across individual studies, but that continuity is productive only when theories remain vulnerable to reconstruction.

Definition 6.300 (Theory revision). *Theory revision* is a change in a theory's propositions, mechanisms, scope conditions, conceptual architecture, or relations among

explanatory elements undertaken in response to evidence, comparison, conceptual criticism, or methodological development.

Theory revision may narrow scope, differentiate mechanisms, add historical conditions, reorganize causal priority, or replace an explanatory architecture. It may also preserve a theory's central insight while revising the vocabulary through which that insight is expressed. Kuhn's account of conceptual change and Longino's account of critical interaction both show that theory development occurs within communities whose standards and background assumptions can themselves change (Kuhn 1962; Longino 1990).

For GRE, theory revision should leave a trace of the relations among versions. A revised theory need not present its predecessor as wholly mistaken. Earlier formulations may remain locally useful, may describe a narrower domain, or may contain distinctions that later synthesis risks losing. Iterative reconstruction therefore favors versioned theoretical development over retrospective narratives of seamless progress.

6.19.11 Method Revision

Method revision occurs when the procedures through which evidence is produced or analyzed become inadequate to the evolving research object. This can involve modifying sampling, measurement, field practice, archival strategy, computational procedure, comparison design, or the relation among several methods.

Definition 6.301 (Method revision). *Method revision* is a change in the procedures, instruments, evidential pathways, or methodological composition of an inquiry prompted by evidence that the existing research design insufficiently accesses, represents, or tests a materially relevant property of the research object.

Method revision follows from methodological pluralism rather than contradicting it. A method can be appropriate for one claim and inadequate for another. A new object may require additional access; a category revision may invalidate an earlier measurement; an unexpected historical discontinuity may require archival reconstruction alongside statistical analysis. Section 6.17 treated mutual correction among methods as a source of such redesign.

Method revision should also preserve comparability where possible. Changing an instrument or coding scheme can improve adequacy while disrupting longitudinal continuity. The research record should therefore state what changed, why it changed, which earlier observations remain comparable, and which require qualification. This makes methodological improvement compatible with cumulative knowledge rather than allowing each redesign to erase the evidential history that motivated it.

6.19.12 Iteration across Research Cycles

The preceding moments become a research cycle when they are connected through revision. Observation can reshape interpretation; interpretation can reshape concepts; concepts can reshape formalization and measurement; empirical examination and comparison can reshape models, categories, theories, and methods; revised

methods then produce new forms of observation. The sequence is not fixed, and several moments can operate simultaneously.

Definition 6.302 (Research reconstruction cycle). *A research reconstruction cycle is a temporally organized configuration in which at least one component of inquiry is revised in response to evidence or criticism and the consequences of that revision are propagated to other dependent components of the research configuration where materially relevant.*

Proposition 6.303 (Dependency-sensitive revision principle). *When a consequential revision changes a concept, category, model, evidential interpretation, or method on which other research claims materially depend, those dependent claims should be reassessed rather than presumed to survive the revision unchanged.*

This principle turns iteration into reconstruction rather than incremental accumulation alone. A research programme can grow by adding evidence, but it can also deepen by revising the structures through which earlier evidence was understood. The result is cumulative without requiring identity across cycles. Later inquiry inherits archives, concepts, methods, models, critiques, and unresolved alternatives from earlier work while potentially reorganizing their relations.

Proposition 6.304 (Cumulative reconstruction principle). *Research becomes cumulatively reconstructive when successive cycles preserve enough provenance to identify what was retained, revised, abandoned, or reinterpreted, while permitting new evidence and methods to alter the organization of the inherited epistemic structure.*

This form of cumulation differs from a simple stockpiling model of knowledge. What accumulates includes evidence and results, but also revision histories, failed representations, rejected categories, methodological corrections, and records of translation loss. Peirce's fallibilist account of inquiry and Dewey's recursive treatment of investigation both provide important precedents for knowledge that advances through corrigible reconstruction rather than final closure (Peirce 1877; Dewey 1910).

Iterative reconstruction also prepares the reflexive problem that follows. Research cycles do not occur outside the relational systems they study. Observation, classification, representation, measurement, and publication can themselves enter those systems and modify later evidence. The next section therefore examines reflexivity in research: the conditions under which inquiry becomes part of the causal and relational field that subsequent inquiry must reconstruct.

6.20 Reflexivity in Research

This section develops reflexivity as a practical requirement of research praxis after the iterative reconstruction established in Section 6.19. Its role is to examine circumstances in which inquiry enters the relational field that it studies and thereby modifies later observations, classifications, representations, measurements, institutional responses, or public understandings. The objective is to make those feedback pathways inspectable without converting reflexivity into a universal claim that every research act substantially transforms its object. The discussion proceeds through observational, classificatory, representational, measurement, and publication inter-

ventions before turning to research feedback, documentation, revision, and the limits of reflexive analysis. The argument is relational and methodological: reflexivity concerns identifiable pathways between research operations and subsequent states of the research field.

Definition 6.305 (Research reflexivity). *Research reflexivity* is the disciplined analysis of pathways through which research practices, representations, classifications, measurements, communications, or institutional arrangements can alter the evidential field, relational configuration, or practical behavior relevant to later inquiry.

Research reflexivity therefore extends the relational account of research developed in Sections 6.7–6.8. The researcher is situated within institutions, languages, infrastructures, and relations of access, but situatedness alone does not establish a material feedback effect. Reflexive analysis becomes especially important when a research operation changes what can subsequently be observed or when actors orient themselves to the categories, measures, or representations produced by inquiry. Bourdieu and Wacquant place reflexivity at the center of sociological practice by requiring inquiry to examine the social and intellectual conditions of its own production (Bourdieu and Wacquant 1992). GRE retains that requirement while giving particular attention to generative feedback: research can become one relation among those that help produce the subsequent state of the system.

6.20.1 Observational Intervention

Observation can alter the field from which later evidence is drawn. The effect may arise because participants become aware of observation, because instruments change the conditions under which activity occurs, because access arrangements reorganize interaction, or because repeated observation stabilizes a new routine. The relevant epistemic question concerns whether an observational relation contributes materially to a later state rather than whether observation is philosophically pure.

Definition 6.306 (Observational intervention). An *observational intervention* occurs when the establishment or maintenance of an observational relation contributes to a change in behavior, relations, material conditions, institutional routines, or evidential availability that is relevant to the target inquiry.

The definition is intentionally conditional. A satellite sensor can record an event with negligible influence on the event itself, while a researcher embedded in a small organization can alter communication simply through presence, questioning, or requests for documentation. Laboratory instruments may physically disturb the systems they measure, whereas archival observation may leave the historical event unchanged while still altering present preservation, classification, or interpretation. Reflexive inquiry therefore requires a claim about a pathway, magnitude, and target rather than an assumption that observation is invariably transformative.

Observational intervention also has temporal structure. An effect can be immediate, such as altered participant behavior during observation, or delayed, such as a new reporting routine created to satisfy a study and retained afterward. The resulting evidence may then partly reflect the observational arrangement that helped generate it. This does not automatically invalidate the evidence. It changes what the evidence is evidence of and requires the observational relation to enter the reconstruction.

Proposition 6.307 (Pathway requirement for observational reflexivity). *A claim that observation materially altered a research field should identify a plausible pathway connecting the observational arrangement to the relevant change, together with the temporal, relational, and institutional conditions under which the pathway operates.*

6.20.2 Classificatory Intervention

Classification is a particularly important reflexive interface because categories can organize both knowledge and conduct. A research category can begin as an analytical convenience and later become a label used by participants, institutions, regulators, funders, or automated systems. Once incorporated into practice, the category can influence eligibility, identity, resource allocation, comparison, or strategic behavior.

Hacking's historical work emphasizes that classifications and the people or practices classified can develop in relation to one another (Hacking 2002). For research praxis, the methodological lesson is that category use should be followed beyond the moment of coding. The question is whether a category remains an internal representational device or enters the relations through which the object subsequently develops.

Definition 6.308 (Classificatory intervention). *A classificatory intervention occurs when a research classification becomes consequential within the field by affecting recognition, treatment, self-description, institutional procedure, comparison, access, or resource distribution.*

Classificatory reflexivity requires attention to circulation. A category confined to a private analytic notebook has a different intervention profile from one published in an influential report, embedded in a survey instrument, adopted by an institution, or converted into an administrative eligibility rule. The category's performative capacity therefore depends on relations of authority, dissemination, uptake, and implementation.

The possibility of intervention does not imply that researchers should avoid classification. Inquiry requires distinctions. Reflexivity instead asks that consequential categories retain a visible genealogy: how they were constructed, what differences they compress, who can contest them, and what changes follow when they enter practice. Such documentation becomes especially important when category effects later appear in the data used to validate the classification itself.

6.20.3 Representational Intervention

Research representations can travel beyond the settings in which they were produced. Narratives, diagrams, models, maps, indices, causal accounts, and typologies can reshape expectations and reorganize relations when actors begin to orient themselves to them. Representation then has a dual role: it remains an epistemic object while also becoming a possible element of the system represented.

MacKenzie's analysis of financial models provides a clear case in which models can become incorporated into market practice and contribute to reshaping the processes they describe (MacKenzie 2006). GRE treats this as one form of a broader representational feedback problem. A representation can alter coordination, legitimacy, strate-

gic imagination, institutional design, or the perceived space of feasible action even when it was initially produced for descriptive or explanatory purposes.

Definition 6.309 (Representational intervention). A *representational intervention* occurs when a research representation enters subsequent practice in a way that materially alters expectations, relations, institutional arrangements, decision rules, or the possibilities actors treat as available.

Representational intervention should remain separate from representational adequacy. An inaccurate representation can become highly consequential if institutions adopt it, while a highly accurate representation can remain practically inert if it does not circulate or lacks authority. Reflexive analysis therefore tracks at least two questions separately: how well the representation is warranted as knowledge and how strongly it participates in later relational generation.

This distinction also matters for correction. When a consequential representation is revised, the earlier representation may already have generated effects that persist. Correcting the text does not automatically reverse the institutional arrangements, investments, reputational consequences, or categories that developed under the earlier representation. Reflexive revision may consequently require tracing residual effects rather than assuming that epistemic correction restores the prior field.

6.20.4 Measurement Intervention

Measurement can intervene when measured actors or institutions orient conduct toward the measure itself. Rankings, performance indicators, benchmarks, targets, audit scores, and evaluation metrics can become practical objects around which strategies are reorganized. Espeland and Sauder show how public rankings can generate reactivity through mechanisms including commensuration and self-fulfilling processes (Espeland and Sauder 2007). The measured system can therefore change in response to the representation used to assess it.

Definition 6.310 (Measurement intervention). A *measurement intervention* occurs when the production, disclosure, or institutional use of a measure contributes to changes in the behavior, organization, or relational environment of the measured system.

Measurement intervention can occur through several pathways. Actors may optimize directly for a metric, redirect resources toward visible dimensions, change documentation practices, reorganize categories to improve measured performance, or withdraw activity from domains that are weakly represented by the metric. The resulting improvement in the measure can then have several interpretations. It may indicate genuine improvement in the underlying target, adaptation to the measurement regime, or some combination of both.

Reflexive measurement therefore requires a distinction between target change and measure-oriented adaptation. Longitudinal analysis becomes especially difficult when the measure itself changes the practices that generate later observations. A time series may remain numerically comparable while the relation between indicator and target shifts because actors have learned to respond strategically or institutionally to the indicator.

Proposition 6.311 (Measurement-reactivity condition). *When a measure becomes consequential for actors or institutions, later observations of that measure should be interpreted with attention to the possibility that the measurement regime has altered the process generating the measured values.*

6.20.5 Publication Intervention

Publication extends research reflexivity beyond data collection and analysis. A finding can enter public discourse, institutional decision processes, professional practice, litigation, policy design, investment, advocacy, education, or organizational self-understanding. Publication is therefore part of the causal history of some research objects rather than merely the final communication of knowledge about them.

Definition 6.312 (Publication intervention). *A publication intervention occurs when dissemination of a research claim, category, representation, or finding contributes materially to subsequent relations, decisions, expectations, institutional arrangements, or evidential conditions within the relevant field.*

The intervention profile of publication depends on audience, authority, accessibility, timing, framing, and institutional uptake. A technical article with limited circulation may produce little immediate field effect while later becoming foundational to a regulatory framework. A widely publicized preliminary finding can have large immediate consequences despite substantial uncertainty. Reflexive publication therefore concerns both anticipated and emergent pathways of circulation.

Publication can also alter the future evidence base. Once participants know a hypothesis or classification, their subsequent behavior may reflect knowledge of the research. Institutions may begin recording variables that previously went undocumented, or they may change categories in response to critique. Archives, administrative records, and later datasets can consequently contain traces of earlier research dissemination. Historical reconstruction should preserve this possibility when research claims become part of the field's own history.

Publication reflexivity does not require suppressing consequential findings. It requires attention to foreseeable harms, uncertainty communication, provenance, and the difference between communicating a warranted claim and projecting a level of certainty or practical authority beyond the evidence. Where publication is likely to alter the field substantially, dissemination strategy itself becomes part of research praxis.

6.20.6 Research Feedback

The preceding intervention forms can combine into feedback structures. Observation generates a classification; the classification is formalized into a measure; the measure is published; institutions reorganize behavior around the measure; and the reorganized behavior becomes the next round of evidence. Research then participates in a recursive process in which its products condition the phenomena from which later research draws.

Definition 6.313 (Research feedback loop). *A research feedback loop is a recurrent pathway in which a research operation or output alters the relational field and the*

altered field subsequently contributes new evidence, categories, behaviors, or institutional conditions to later inquiry.

Research feedback can amplify, dampen, redirect, or stabilize patterns. A public measure may intensify competition; a new category may stabilize recognition of a previously weakly legible relation; a corrective representation may weaken a harmful institutional routine; repeated evaluation may normalize a practice that initially existed only provisionally. The direction and desirability of feedback are therefore empirical and normative questions rather than consequences of reflexivity alone.

Feedback also complicates causal attribution. If an observed regularity strengthened after a theory, measure, or classification was institutionalized, later evidence cannot simply be treated as independent confirmation of the original claim. The research product may be one contributor to the regularity. This is closely related to the institutionally generated confirmation problem developed in Section 6.6: theories and representations can help produce the conditions under which they later appear descriptively successful.

Proposition 6.314 (Reflexive evidential dependence). *When prior research outputs materially contribute to the production of later evidence, evaluation of the later evidence should include the research-mediated pathway rather than treating the observations as independent of the earlier inquiry.*

6.20.7 Reflexive Documentation

Reflexivity becomes methodologically useful when possible research effects can be reconstructed rather than merely acknowledged. Reflexive documentation extends ordinary provenance by recording how research activity may have entered the field. It is especially important when the same project, institution, or research community returns repeatedly to a site or when research products are likely to circulate among participants.

Definition 6.315 (Reflexive documentation). *Reflexive documentation* is the preservation of information needed to reconstruct materially relevant pathways through which research presence, categories, instruments, measurements, representations, publications, or institutional arrangements may have altered the research field or later evidential conditions.

Useful documentation can include changes in access arrangements, participant awareness of research aims, dissemination events, category adoption, metric uptake, institutional responses, changes in recording practices, and observable shifts following publication. The relevant record depends on the target inquiry; exhaustive self-documentation is neither possible nor desirable. The objective is to preserve evidence for plausible pathways that could materially affect later inference.

Reflexive documentation should also preserve uncertainty. Researchers often cannot know at the moment of fieldwork whether a conversation, category, report, or measurement will become consequential. Recording plausible intervention pathways without prematurely declaring their effects supports later re-epistemization. This follows the provenance-preserving logic developed in Section 6.19: future inquiry should be able to distinguish a stable empirical pattern from one partly

generated by changing research relations.

Documentation itself remains ethically constrained. Recording participant reactions, institutional adaptations, or confidential communications can create privacy, security, and power risks. Reflexive completeness therefore cannot be pursued without regard to consent, confidentiality, data minimization, and the potential consequences of preserving sensitive material.

6.20.8 Reflexive Revision

Reflexive information matters when it can change the research configuration. If inquiry has altered the field, later interpretation may need to revise the object definition, temporal boundary, causal model, comparison strategy, measurement assumptions, or practical conclusions. Reflexivity thereby becomes a source of methodological reconstruction rather than an appended statement of positionality.

Definition 6.316 (Reflexive revision). *Reflexive revision* is a research revision undertaken because evidence indicates that inquiry itself has materially altered the relational field, evidential conditions, or interpretation relevant to the target claim.

Reflexive revision can take several forms. Researchers may distinguish pre-exposure and post-exposure periods, model research dissemination as part of a causal pathway, revise a category after observing classification effects, separate target improvement from metric adaptation, or change an intervention when publication creates unanticipated harms. In longitudinal work, a research project may also become part of the historical sequence it later seeks to explain.

Longino's account of critical interaction supports a wider view of objectivity in which assumptions and standards remain open to transformation through criticism (Longino 1990). Reflexive revision adds a further requirement: criticism can concern the research relation itself. If the conditions of observation have changed partly because of inquiry, the revised account should incorporate that change rather than preserve a fictional separation between research process and research object.

Proposition 6.317 (Reflexive revision principle). *When a materially supported research-feedback pathway changes the evidential field or target relation, dependent claims, models, categories, and practical recommendations should be reassessed to the extent that their warrant relied on the earlier configuration.*

Reflexive revision is compatible with strong claims. A finding can remain well warranted after research effects are incorporated. The objective is calibration: identify what changed, which claims depend on the change, and which conclusions remain robust across the reconstructed field.

6.20.9 Limits of Reflexivity

Reflexivity has practical and epistemic limits. Research cannot reconstruct every consequence of its own existence, and infinite regress would make inquiry impossible. A researcher examining the effect of a measure can also affect responses to that measure; documenting that effect can itself become another intervention. Methodological reflexivity therefore requires a stopping rule.

Definition 6.318 (Reflexive relevance threshold). A *reflexive relevance threshold* is the point at which a plausible research-mediated pathway becomes sufficiently material to the target claim, evidential interpretation, ethical responsibility, or practical consequence that explicit reflexive analysis is warranted.

The threshold is target-relative. Reflexive analysis should become more demanding when research outputs are authoritative, publicly visible, institutionally consequential, repeated over time, closely coupled to participant behavior, or used directly in allocation and governance. It can remain lighter when plausible research-mediated effects are weak relative to the target process and would not materially change interpretation.

Several constraints follow. First, reflexivity should not attribute every change to researcher presence. That would replace methodological naivety with researcher-centered overreach. Second, reflexive claims themselves require evidence; plausible influence should remain distinct from demonstrated influence. Third, some research effects will remain unknowable because data are unavailable, feedback is distributed, or future consequences have not yet emerged. Such uncertainty should be recorded rather than filled with speculative narratives.

Proposition 6.319 (Proportional reflexivity). *The depth of reflexive analysis should be proportionate to the plausibility, materiality, and consequence of research-mediated pathways for the claim or practical decision under investigation.*

Reflexivity therefore functions as a disciplined enlargement of research praxis. It asks inquiry to include itself among the relations that may matter when evidence supports doing so, while preserving the possibility that some observations remain only weakly affected by the act of study. This balance keeps research answerable both to its own generative consequences and to relational realities that exceed the researcher. The historical transformation of research methods introduces a further source of reconstruction: methods themselves change through time, altering what later inquiry can observe, compare, and warrant.

6.21 Historical Evolution of Methods

This section extends the reflexive account of research developed in Section 6.20 by treating methods themselves as historically evolving components of research praxis. Its role is to examine how methods become possible, authoritative, limited, displaced, renewed, or reinterpreted under changing material, institutional, technological, conceptual, and evidential conditions. The objective is to preserve methodological learning across time without treating current practice as the natural endpoint of a linear history. The discussion proceeds from methods as historical formations through their material, institutional, technological, and conceptual conditions, then considers changing standards of evidence, methodological obsolescence, emergence of new methods, and re-evaluation of earlier methods. The approach is reconstructive: a method is examined together with the relations and infrastructures that make its use, validation, and circulation possible.

Definition 6.320 (Historical formation of a method). The *historical formation of a method* is the temporally situated configuration of concepts, instruments, materials,

skills, institutions, standards, and research problems through which a procedure becomes available and intelligible as a method of inquiry.

This definition gives the history of methods an epistemic role. A method cannot be understood only through an abstract description of its procedure, because the same formal procedure can have different research functions under different evidential infrastructures, technologies, categories, and institutional expectations. Kuhn's account of scientific practice emphasizes that accepted problems, exemplars, standards, and forms of puzzle solving are historically organized within research traditions (Kuhn 1962). Hacking similarly draws attention to historically developing styles of reasoning, classifications, and objects of inquiry (Hacking 2002). GRE uses these insights without assuming that every methodological change is a paradigm replacement. Method histories can involve gradual adaptation, recombination, extension, institutional diffusion, technical refinement, rediscovery, or selective abandonment.

A historical account also modifies how methodological pluralism is understood. The pluralism developed in Sections 6.14–6.18 concerns partially irreducible modes of access in a present research configuration. Historical analysis adds that the available repertoire itself changes. What appears to be a stable menu of methods at one time may be the temporary result of earlier investments, exclusions, technical possibilities, conceptual innovations, and institutional settlements. Method selection therefore takes place within an inherited but revisable methodological field.

6.21.1 Methods as Historical Formations

A method is learned, taught, standardized, criticized, modified, and transmitted. These processes give it a history that is partly distinct from the history of the phenomena it is used to investigate. A statistical procedure, archival practice, interpretive tradition, laboratory technique, legal method, ethnographic practice, or computational routine can persist across changes in its objects and can also be transformed when new objects strain its inherited assumptions.

Definition 6.321 (Methodological lineage). A *methodological lineage* is a historically reconstructible sequence through which a method, family of methods, or methodological principle is transmitted, modified, recombined, contested, or repurposed across research settings.

Lineage does not imply continuity of identity in every respect. A procedure can retain its name while its instrumentation, data structure, interpretation, or evidential role changes substantially. Conversely, a new label can describe a recombination of older operations. Historical reconstruction should therefore attend to the components that persist and those that transform rather than infer methodological identity from terminology alone.

Methods can also acquire authority historically. Repetition, successful application, professional training, journal conventions, regulatory recognition, software implementation, and institutional investment can stabilize a procedure as an expected way of producing evidence. Such stabilization can be epistemically productive because it supports comparability, training, replication, and shared criticism. It can also make alternative forms of evidence harder to recognize when the dominant method defines what counts as an admissible research object or credible result.

The historical formation of methods therefore enters present evaluation. A current method may be technically sophisticated while carrying categories or assumptions inherited from earlier contexts. A historically older method may remain useful because the relation it captures persists, or because it preserves a form of access that newer infrastructures neglect. Historical status alone supplies neither authority nor disqualification.

6.21.2 Material Conditions of Method

Methods depend on material conditions. Archives require preservation media and storage; fieldwork requires mobility, time, safety, and access; laboratory techniques require equipment and consumables; surveys require communication infrastructures and sampling frames; computational inquiry requires hardware, data storage, energy, and software environments. These conditions affect which methods can be practiced, at what scale, by whom, and with what continuity.

Definition 6.322 (Material condition of method). A *material condition of method* is a resource, infrastructure, embodied capability, spatial arrangement, or physical support whose availability materially affects whether a methodological operation can be performed, repeated, extended, or preserved.

Material conditions can shape methodological possibility without determining research conclusions. The existence of high-resolution sensors can make previously inaccessible variation observable, yet interpretation still requires conceptual and evidential work. The absence of stable archives can narrow historical reconstruction, yet alternative traces may remain available through oral testimony, material culture, institutional records, or later copies. The relevant point is that methodological feasibility is relationally produced through material arrangements.

Material asymmetry can also generate epistemic asymmetry. Research communities with durable infrastructures can accumulate longitudinal datasets, standardized instruments, and reusable computational pipelines, while communities with fewer resources may rely on intermittent observation or locally maintained records. Apparent differences in methodological preference can therefore partly reflect differences in feasible access. This extends the analysis of the researcher's material position in Section 6.8: method repertoires are themselves conditioned by the material environments in which inquiry occurs.

Material dependence also matters for preservation. A method may remain conceptually intelligible while becoming difficult to reproduce because instruments, calibration standards, software versions, materials, or tacit craft knowledge have disappeared. Historical method reconstruction can consequently require attention to laboratories, field sites, libraries, data formats, and embodied skills in addition to published descriptions.

6.21.3 Institutional Conditions of Method

Institutions organize methodological development through training, funding, publication, credentialing, ethics review, professional standards, and access to research sites. These arrangements help coordinate inquiry, but they also distribute method-

ological visibility and legitimacy unevenly. A method can become dominant partly because it fits available infrastructures and evaluation systems, while a potentially valuable alternative remains marginal because it is expensive, slow, difficult to standardize, or poorly aligned with established publication formats.

Definition 6.323 (Institutional condition of method). An *institutional condition of method* is an organizational rule, incentive, access arrangement, training structure, evaluation practice, or authority relation that materially shapes the development, use, circulation, or recognition of a method.

Porter's historical analysis of quantification shows how standardized numerical procedures can acquire authority in settings where impersonal and publicly defensible forms of judgment are institutionally valuable (Porter 1995). This does not reduce quantitative method to bureaucracy. It illustrates how methodological forms can answer institutional demands as well as epistemic questions. A similar analysis can be applied to other methods: intensive fieldwork may depend on institutions willing to support long-duration presence; archival work depends on regimes of preservation and access; collaborative research depends on structures that recognize distributed contribution.

Institutionalization can generate both capacity and path dependence. Once curricula, journals, software, review standards, funding categories, and career structures accumulate around a method, later researchers inherit a substantial methodological infrastructure. This can lower the cost of high-quality work within the established approach while raising the cost of experimentation outside it. Institutional conditions should therefore enter explanations of methodological persistence alongside demonstrated empirical success.

Proposition 6.324 (Institutional stabilization of method). *When training, evaluation, infrastructure, and access are organized repeatedly around a method, the resulting institutional support can stabilize its use beyond the evidential force of any single application and can shape which alternative methods remain practically available.*

The proposition does not imply that institutionalized methods are epistemically weak. It requires a distinction between evidential warrant and institutional reproduction. A method can be strongly warranted and institutionally stabilized at the same time; historical reconstruction should identify both relations where they matter.

6.21.4 Technological Conditions of Method

Technological change can alter the scale, granularity, speed, and kinds of evidence accessible to inquiry. Recording devices extend memory; imaging technologies expose previously inaccessible structures; digital archives change search and retrieval; networked communication changes collaboration; computational systems permit simulation, large-scale estimation, automated classification, and new forms of pattern detection. Technological conditions can therefore transform methods rather than merely accelerate established procedures.

Definition 6.325 (Technological extension of method). A *technological extension of method* occurs when a technological system materially expands, reorganizes,

or changes the operations through which a method observes, records, compares, reconstructs, models, or communicates its object.

Extension can generate new evidence while introducing new mediation. A digital corpus makes large-scale textual comparison feasible but depends on digitization, metadata, search architecture, and preprocessing. Machine learning can reveal patterns across high-dimensional data while adding model dependence, opacity, training-data constraints, and classification assumptions. Remote sensing can widen spatial access while narrowing other forms of contextual contact. Technological expansion therefore changes both capability and the structure of methodological remainder.

Technologies also create new forms of methodological dependency. Proprietary platforms, inaccessible source code, discontinued software, changing file formats, or vendor-controlled data can reduce reproducibility even when computation appears highly standardized. Conversely, open tools and documented formats can support cumulative research across institutions. The epistemic consequences depend on provenance, accessibility, maintainability, and the relation between technological representation and the target object.

Historical comparison of methods should therefore avoid treating technological sophistication as a scalar measure of methodological superiority. New technologies can strengthen some kinds of access while weakening others. Their significance is target-relative and should be assessed through the claim–method relations developed in Section 6.14.

6.21.5 Conceptual Conditions of Method

Methods also depend on conceptual conditions. An instrument records only through a prior account of what counts as a signal; a variable requires decisions about categories and measurement; archival research depends on concepts that identify relevant traces; qualitative coding depends on distinctions that organize interpretation; formal models depend on specified entities, relations, states, and transformation rules. Changes in concepts can therefore make new methods possible or render established methods inadequate.

Hacking's historical work is useful here because it treats classifications and styles of reasoning as historically consequential components of what can be investigated and said (Hacking 2002). GRE adds a relational emphasis: concepts help configure the interface between research object and methodological operation. When a concept changes, the same technique can begin to address a different object.

Definition 6.326 (Conceptual condition of method). A *conceptual condition of method* is a category, distinction, object specification, relational assumption, or inferential concept required for a methodological operation to identify, organize, or interpret its evidential target.

Conceptual dependence is especially visible when new objects emerge. A phenomenon may have been observable in fragments before a concept allowed those traces to be assembled into a coherent research problem. Conversely, an inherited concept can compress distinctions that later become important, making an estab-

lished method systematically insensitive to variation within its categories.

This produces a recursive relation between concept and method. Concepts orient methodological access, while methodological encounters can generate pressure for conceptual revision. The iterative reconstruction developed in Section 6.19 therefore has a historical counterpart: over longer periods, methods and concepts can co-evolve as each reorganizes the possibilities of the other.

6.21.6 Changing Standards of Evidence

Historical change also affects what research communities treat as adequate evidence. Standards can shift regarding sample size, documentation, replication, transparency, statistical inference, qualitative saturation, archival provenance, measurement validity, causal identification, interpretive adequacy, or computational reproducibility. Such changes can strengthen inquiry, but they can also redistribute attention toward what existing standards can recognize and away from difficult-to-formalize or weakly institutionalized evidence.

Longino's account of science emphasizes the role of criticism and social interaction in transforming background assumptions and standards of inquiry (Longino 1990). From a GRE perspective, standards of evidence are themselves part of research praxis. They regulate which claims travel, which doubts become institutionally visible, and which forms of evidence receive durable recognition.

Definition 6.327 (Evidential standard regime). An *evidential standard regime* is a historically situated configuration of criteria through which a research community assesses the admissibility, adequacy, transparency, reproducibility, interpretability, and inferential force of evidence.

A change in standards can alter the apparent status of existing research without changing the historical evidence that researchers originally possessed. Earlier work may later appear under-documented, statistically underpowered, insufficiently reflexive, or weakly reproducible by contemporary criteria. Such retrospective assessment can be warranted, yet it should distinguish two questions: whether the earlier conclusion remains supportable now, and whether the earlier researchers followed the strongest standards realistically available within their context.

Proposition 6.328 (Historical indexing of evidential evaluation). *Evaluation of an earlier method should distinguish its adequacy relative to the evidential standards and feasible alternatives of its historical context from the adequacy of its resulting claims under later standards and later evidence.*

This distinction enables critical re-evaluation without either presentism or inherited deference. Later standards can reveal limitations while historical reconstruction preserves the conditions under which earlier methods were intelligible and useful.

6.21.7 Methodological Obsolescence

Methods can become obsolete, but obsolescence is rarely a single condition. A method may lose comparative advantage because a new technique provides greater accuracy, lower cost, wider coverage, better safety, or stronger reproducibility. It may also become inadequate because the research object has changed, the conceptual categories

on which it depends have been revised, or its material and technological infrastructure is no longer sustainable.

Definition 6.329 (Methodological obsolescence). *Methodological obsolescence* is a historically situated decline in the adequacy, feasibility, or comparative epistemic value of a method for a specified research function under changed evidential, conceptual, material, institutional, technological, or ethical conditions.

Obsolescence is therefore function-relative. A method can become inadequate for measurement while remaining valuable for historical comparison; unsuitable for causal attribution while remaining useful for exploration; inefficient for large-scale analysis while retaining distinctive sensitivity to local meaning. This follows the model-function distinction developed in Section 6.16: replacement should be assessed against the function a method is expected to perform.

Methods can also become institutionally obsolete before they become epistemically useless, or remain institutionally dominant after better alternatives appear. Historical analysis should therefore ask what exactly has changed: warrant, feasibility, cost, legitimacy, ethics, infrastructure, or disciplinary convention.

Methodological obsolescence creates preservation questions. If an older method generated long time series, archival conventions, or category systems, abrupt abandonment can break comparability. Transition strategies may need overlapping measurements, calibration studies, translation records, or parallel representations so that methodological improvement does not erase the historical relation between earlier and later evidence.

6.21.8 Emergence of New Methods

New methods can emerge when inherited methods encounter persistent limits, when new research objects become salient, when technological capacities expand, when conceptual innovations reorganize the object, or when institutional and social conditions make previously marginal forms of inquiry possible. Methodological novelty is therefore often relationally distributed rather than attributable to a single isolated invention.

Definition 6.330 (Methodological emergence). *Methodological emergence* is the formation of a sufficiently distinct research procedure or methodological configuration through the recombination, extension, or transformation of concepts, instruments, evidence practices, skills, infrastructures, and research problems.

This formulation allows degrees of novelty. A new method can involve a genuinely new instrument, a new combination of established techniques, a new inferential role for an existing representation, or a transfer across disciplinary settings. The important question is what new form of epistemic access or correction becomes possible.

Kuhn's analysis of scientific change is relevant because transformations in problems and standards can reorganize research practice (Kuhn 1962). Yet methodological emergence need not require a comprehensive disciplinary rupture. Many changes are cumulative or hybrid: historical inquiry incorporates computational search; qualitative research adopts digital recording and collaborative coding; formal models are linked to field experiments; archival practice integrates machine-assisted

transcription while retaining human interpretation.

Proposition 6.331 (Generative conditions of methodological emergence). *A new method becomes epistemically significant when changes in concepts, instruments, evidence, skills, or institutions jointly enable a form of access, comparison, correction, reconstruction, or inference that was previously unavailable or materially weaker for the target problem.*

Methodological emergence should therefore be evaluated through capabilities and remainders rather than novelty claims alone. New methods inherit assumptions, create new dependencies, and can make some phenomena less visible even as they illuminate others.

6.21.9 Re-Evaluation of Earlier Methods

Historical evolution makes earlier methods available for re-evaluation. Later evidence, concepts, technologies, and standards can reveal weaknesses that were previously difficult to see. They can also reveal neglected strengths. A method abandoned because it appeared inefficient under one research regime may later become valuable when a new problem makes its distinctive form of access relevant again.

Definition 6.332 (Historical methodological re-evaluation). *Historical methodological re-evaluation* is the reassessment of an earlier method through a reconstructed account of its original conditions together with later evidence, concepts, technologies, standards, and research questions.

Re-evaluation differs from simple ranking. The objective is to identify what the method could reveal, what it systematically missed, which assumptions supported its use, what alternatives were feasible, how later changes altered its comparative value, and whether some of its capacities remain recoverable. Porter's history of quantification, for example, shows that methods and ideals of objectivity can be understood partly through the institutional problems they were developed to address (Porter 1995). Such reconstruction helps explain both their historical power and their limits.

Re-evaluation can support methodological repair. Older data can be reinterpreted under revised categories; an earlier instrument can be recalibrated against new standards; historical qualitative material can be revisited with questions not available at the time of collection; discarded techniques can be combined with new technologies. The preservation of source material, procedural descriptions, code, instruments, and contextual records therefore increases the future possibility of re-epistemization.

Proposition 6.333 (Methodological re-epistemization). *When later evidence, concepts, or standards materially alter the interpretation of an earlier method, research should distinguish revision of the method's historical evaluation from revision of the claims originally produced through it, while preserving the provenance needed to reconstruct both.*

The historical evolution of methods therefore expands the recursive account of research praxis. Inquiry changes not only theories, categories, and representations but also the means through which later researchers can encounter and reconstruct reality. Present methods should consequently be treated as historically achieved and

revisable capacities rather than as final forms of access. This conclusion leads directly to a parallel problem: the standards by which research itself is evaluated also evolve historically, changing what counts as relevance, rigor, significance, and value.

6.22 Historical Evolution of Evaluation

This section extends the historical account of methods in Section 6.21 to the standards through which research is judged. Its role is to show that evaluation is itself a historically situated practice embedded in institutions, disciplinary traditions, infrastructures, productive conditions, and changing conceptions of what research is for. The objective is to distinguish the evolution of criteria of relevance, rigor, significance, and value from the changing metrics used to operationalize them, and then to examine how altered productive conditions can require renewed evaluation of both current and earlier research. The discussion proceeds through evaluation as historical practice, transformations in major evaluative criteria, revision of metrics, evaluation under changing productive conditions, re-epistemization of earlier work, and finally the evaluation of evaluation itself. The method is reconstructive and reflexive: evaluation is treated as part of research praxis whose own standards, effects, and limitations remain open to inquiry.

Definition 6.334 (Historical evaluation regime). A *historical evaluation regime* is a historically situated configuration of criteria, procedures, representations, institutions, and judgment practices through which research questions, methods, evidence, outputs, and contributions are assessed.

Evaluation regimes can support cumulative inquiry by stabilizing expectations, concentrating attention, enabling criticism, and coordinating scarce research resources. They can also privilege forms of contribution that are comparatively easy to recognize, count, compare, or institutionalize. Porter shows historically how ideals of impersonal quantitative objectivity became connected to institutional conditions of trust and standardized judgment (Porter 1995). Longino, from a different direction, emphasizes that standards of evidential relevance and criticism depend partly on background assumptions and organized critical interaction (Longino 1990). GRE therefore treats evaluation neither as external administration added after research nor as a timeless expression of epistemic quality. It is one of the relational practices through which research systems select, stabilize, revise, and sometimes distort what they recognize as valuable inquiry.

6.22.1 Evaluation as Historical Practice

Research evaluation occurs within historically specific communities and institutions. Peer judgment, examination, replication, citation, editorial selection, funding review, institutional audit, professional recognition, public accountability, and later historical reassessment can all function as evaluative practices. Their relative weight changes over time, as do the objects being evaluated. A research system may emphasize the soundness of an argument, the credibility of witnesses, experimental reproducibility, statistical identification, archival provenance, formal elegance, social usefulness, novelty, publication placement, public impact, data openness, or

some combination of these.

Definition 6.335 (Research evaluation practice). A *research evaluation practice* is an organized activity through which a research community, institution, or relevant public assigns provisional judgments concerning the adequacy, relevance, significance, value, credibility, priority, or consequences of research.

Such practices acquire authority relationally. An evaluative criterion becomes consequential when journals, funders, universities, professional communities, governments, infrastructures, or researchers orient decisions toward it. The history of science described by Kuhn shows that standards of legitimate problems, methods, and solutions can shift with broader transformations of research practice (Kuhn 1962). This does not imply that evaluative change is arbitrary. Changes may respond to accumulated counterevidence, new instruments, failures of earlier standards, altered social responsibilities, or new forms of research production. Historical reconstruction is therefore required to distinguish mere fashion from changes that improve the fit between evaluative practice and the epistemic or practical functions it is meant to support.

Evaluation also has a generative dimension. Criteria influence which questions receive time, which results become durable, which methods receive institutional investment, which researchers gain access to resources, and which forms of evidence become legible. An evaluation regime can consequently alter the future composition of the research field. This point connects evaluation with the reflexive pathways developed in Section 6.20: when researchers adapt behavior to evaluation, the evaluation regime becomes part of the process generating the later research record.

Proposition 6.336 (Generative effect of evaluation). *When evaluative criteria materially affect access to attention, publication, resources, recognition, infrastructure, or career continuity, the evaluation regime can contribute to generating the subsequent distribution of research topics, methods, outputs, and capacities.*

6.22.2 Changing Criteria of Relevance

Relevance concerns the relation between research and a problem, audience, body of knowledge, practical condition, or future possibility. What counts as relevant can change when historical problems change, when previously marginal relations become visible, when new evidence becomes available, or when institutions reorganize their priorities. Relevance is therefore indexed to an evaluative horizon rather than being an intrinsic property of a research object.

Definition 6.337 (Evaluative relevance). *Evaluative relevance* is the judged relation between a research contribution and a specified epistemic, theoretical, historical, practical, institutional, or public problem under a stated evaluative horizon.

A problem can gain relevance because historical conditions make its consequences newly visible. A previously local phenomenon can become relevant at another scale when infrastructures connect it to broader systems. Conversely, an issue that once organized a field may become less central when its underlying conditions change or when another contradiction becomes principal. This is consistent with the phase-sensitive analysis of praxis developed in Sections 6.3–6.6: evaluative relevance can

change when the practical and epistemic configuration changes.

Historical variability also creates a danger of retrospective dismissal. Earlier research can appear irrelevant from a later horizon even when it addressed urgent questions in its original context. The reverse can also occur: archival work, descriptive data, apparently minor anomalies, or speculative formal results can acquire substantial later relevance after new questions emerge. The concept of deferred significance developed in Section 6.10 therefore applies equally to evaluation. Relevance judgments should remain temporally indexed and sufficiently documented to permit later reassessment.

Proposition 6.338 (Historical indexing of relevance). *A judgment of research relevance should identify the problem, audience, scale, and temporal horizon relative to which relevance is attributed, especially when the judgment is used to allocate durable research opportunities or resources.*

6.22.3 Changing Criteria of Rigor

Rigor concerns disciplined adequacy of inquiry, but the practices through which rigor is recognized can change historically. Different periods and disciplines may emphasize formal proof, experimental control, statistical inference, transparent documentation, archival criticism, conceptual precision, interpretive accountability, replication, triangulation, computational reproducibility, or reflexive disclosure. Methodological pluralism therefore requires rigor to be assessed partly in relation to the epistemic function and object of a method rather than through one universal procedural template.

Definition 6.339 (Historically situated rigor). *Historically situated rigor* is the disciplined adequacy of a research practice relative to its target claim, method, evidence, available alternatives, and the strongest justified standards materially feasible in its historical setting.

This formulation has two consequences. First, historical situatedness does not immunize earlier research from later criticism. New evidence can reveal uncontrolled assumptions, weak measurement, inaccessible provenance, or inferential gaps. Second, later standards should not be projected backward without reconstructing what could realistically have been known or done. The distinction parallels the historical methodological evaluation developed in Section 6.21.

Rigor also changes when methods change. Computational research can increase the importance of code provenance, data lineage, model specification, robustness checks, and software environments. Large administrative datasets can expand statistical power while creating new concerns about category construction, missingness, selection, and institutional data-generating processes. Einav and Levin document the growing economic-research significance of large administrative and private-sector data and the opportunities created by more granular observation (Einav and Levin 2014). Such changes can raise some dimensions of rigor while creating new ones that earlier evaluative regimes did not need to emphasize.

Proposition 6.340 (Function-relative rigor). *Rigor should be evaluated against the epistemic function a method or representation is expected to perform, together with*

the inferential and provenance requirements generated by that function.

6.22.4 Changing Criteria of Significance

Significance concerns why a research contribution matters within a larger epistemic or practical configuration. Section 6.12 distinguished significance from salience, difficulty, elegance, and immediate attention. Historical evolution adds a further dimension: the criteria through which significance is recognized can themselves change.

Research may be judged significant because it resolves a long-standing problem, opens a new domain, changes a concept, exposes a hidden relation, produces a reusable method, reorganizes a theory, preserves evidence, changes practical possibilities, or enables later work whose form could not have been specified in advance. These dimensions are not reducible to one another. Their importance can also become visible at different times.

Definition 6.341 (Research significance profile). *A research significance profile is a multidimensional and temporally indexed account of the epistemic, theoretical, methodological, historical, practical, infrastructural, or generative ways in which a research contribution matters.*

The profile formulation avoids compressing significance into a single rank. A work can be theoretically modest while infrastructurally important because it preserves a dataset or establishes a measurement standard. Another can have limited immediate application while generating a conceptual distinction that later reorganizes several research programs. A third can be historically significant because it records a disappearing practice even if its contemporary citation rate remains low.

Evaluation systems can obscure this plurality when they equate significance with readily observable indicators. Espeland and Stevens analyze commensuration as the transformation of qualitative differences into a common metric, a process that can enable comparison while altering what is visible in the objects compared (Espeland and Stevens 1998). The methodological lesson is that any metric of significance should state which dimension it represents and which forms of significance remain outside its scope.

6.22.5 Changing Criteria of Value

Research value extends beyond significance because evaluation may include normative judgments about which forms of inquiry deserve support, protection, continuation, dissemination, or practical uptake. Such judgments can involve epistemic value, public value, educational value, cultural value, institutional value, ethical responsibility, long-horizon generativity, or contribution to capabilities and infrastructures. Their relative weighting is historically variable.

Dewey's theory of valuation treats valuing as connected to practical conditions, desires, consequences, and inquiry rather than as a detached assignment of fixed worth (Dewey 1939). GRE adopts a compatible practical orientation while preserving the distinctions developed earlier in this chapter: value judgments remain separable from evidential warrant, aesthetic attraction, and immediate utility. A research contribution can be well supported yet normatively troubling; socially valuable yet

epistemically weak; aesthetically compelling yet empirically unsupported; or valuable because it preserves future inquiry rather than because it produces immediate results.

Definition 6.342 (Research value configuration). A *research value configuration* is the historically situated arrangement of epistemic, normative, practical, institutional, cultural, educational, infrastructural, and generative considerations through which research worth is provisionally assessed.

The configuration concept makes evaluative plurality explicit. It also prevents one value dimension from silently substituting for another. The non-substitution principle developed for research judgment in Section 6.12 therefore extends to evaluation regimes. A high level of public visibility cannot establish epistemic adequacy. Strong formal rigor cannot by itself settle ethical acceptability. Immediate utility cannot exhaust long-horizon research value.

Historical evolution can alter the value configuration. Periods of crisis may increase emphasis on rapid applicability; periods of infrastructural expansion may reward standardization and data accumulation; intellectual transitions may increase the value of conceptual reconstruction; changing social relations may reveal the importance of voices or objects previously excluded from evaluation. These changes should become visible in evaluation rather than being disguised as timeless criteria.

6.22.6 Historical Revision of Metrics

Metrics translate selected dimensions of evaluation into standardized representations. Publication counts, citation measures, journal classifications, rankings, performance indicators, replication rates, grant success, data-sharing indicators, and other measures can support coordination across large research systems. Their usefulness depends on the relation between what is measured and what the evaluator intends to know.

Definition 6.343 (Evaluation metric). An *evaluation metric* is a standardized quantitative or categorical representation used to approximate one or more dimensions of research performance, contribution, quality, significance, value, or institutional functioning.

Metrics inherit the translation problems analyzed in Section 6.18. They select properties, impose comparability rules, and leave remainders. Desrosières' historical analysis of statistical reasoning emphasizes that categories and comparability are constructed through institutional and classificatory practices (Desrosières 1998). Porter similarly shows why quantified judgment can acquire authority under institutional conditions that value impersonal standards (Porter 1995). Metrics can therefore be historically intelligible and practically useful while remaining partial representations.

Historical revision becomes necessary when the relation between a metric and its intended evaluative target changes. A citation measure can be affected by field size, publication practices, database coverage, collaboration structure, or strategic citation. A ranking can become a target of institutional strategy and thereby change the behavior it was initially intended to measure. Espeland and Sauder show how

public rankings can generate organizational reactivity through commensuration and self-fulfilling processes (Espeland and Sauder 2007). Such feedback does not render measurement useless, but it changes the evidential meaning of the metric.

Proposition 6.344 (Metric revision requirement). *When changes in research practice, strategic behavior, data infrastructure, or institutional conditions materially alter the relation between an evaluation metric and its intended target, the metric should be recalibrated, supplemented, reinterpreted, or retired with its historical comparability explicitly documented.*

Revision should also preserve historical continuity where possible. Abrupt replacement can make longitudinal interpretation difficult. Overlapping measurement periods, transparent transformation rules, archived definitions, and parallel representations can help distinguish genuine change in research practice from change induced by the measurement system itself.

6.22.7 Evaluation under New Productive Conditions

Evaluation becomes especially important when the productive conditions of research change. New instruments, large-scale data, automation, computational infrastructures, collaborative platforms, and machine-assisted analysis can alter the cost, speed, volume, and distribution of research production. Under such conditions, evaluative criteria inherited from a scarcer-output environment may lose discriminating power or encourage behavior poorly matched to the new research ecology.

Definition 6.345 (Research productive condition). *A research productive condition is a material, technological, institutional, organizational, or cognitive arrangement that materially affects the rate, scale, cost, accessibility, or form through which research objects, analyses, representations, and outputs can be produced.*

The concept is broader than technology. Changes in collaboration, funding concentration, data access, publication infrastructure, or institutional labor can also transform productive conditions. When some forms of production become easier, evaluation may need to shift attention from mere output volume toward provenance, originality of problem formation, evidential quality, interpretive adequacy, reproducibility, long-horizon generativity, and the capacity to distinguish meaningful contribution from technically inexpensive repetition.

Machine-mediated research adds a further complication. Computational systems can increase analytical reach while introducing opacity concerning data transformations, model behavior, or inferential pathways. Burrell's analysis of machine-learning opacity distinguishes several sources of opacity, including secrecy, technical-literacy barriers, and characteristics of complex models (Burrell 2016). Evaluation under such conditions should therefore assess inspectability and provenance in addition to performance.

New productive conditions can also change the scarcity structure of research. When generating candidate hypotheses, simulations, formal transformations, summaries, or textual outputs becomes less costly, the scarce resource can shift toward judgment: selecting worthwhile questions, identifying meaningful anomalies, verifying evidence, interpreting results, preserving historical context, and deciding

which outputs deserve sustained attention. This connects evaluation directly to the encounter–salience–judgment–orientation sequence developed in Sections 6.10–6.13.

Proposition 6.346 (Productive-condition adjustment). *When research productive conditions materially change the relative scarcity of generation, verification, interpretation, judgment, preservation, or attention, evaluation criteria should be reconsidered so that institutional rewards remain aligned with the research functions that have become comparatively consequential.*

6.22.8 Re-Epistemization of Earlier Research

Changing evaluative regimes alter how earlier research is understood. A study judged rigorous in its own period can later appear methodologically limited; a neglected archive can become central after a new historical question emerges; a formally elegant model can lose explanatory status after new evidence; a low-status descriptive project can acquire major value because it preserved otherwise unavailable observations. Re-evaluation can therefore change the epistemic position of earlier research without changing the historical fact that it was produced under another evaluative regime.

Definition 6.347 (Evaluative re-epistemization). *Evaluative re-epistemization* is the historically informed reassessment of an earlier research contribution under later evidence, concepts, methods, evaluative criteria, and productive conditions while retaining the provenance necessary to reconstruct its original epistemic setting.

Re-epistemization should distinguish several layers. One concerns historical adequacy: whether the work met strong standards available in its own period. Another concerns present warrant: whether its claims remain supportable under later evidence. A third concerns present significance or value: whether later problems make the work newly useful, newly limited, or newly consequential. These judgments can diverge.

Kuhn's account of changing disciplinary problems and standards helps explain why earlier achievements can be reclassified under later research regimes (Kuhn 1962). Hacking's historical work similarly demonstrates the importance of reconstructing the historical conditions under which categories and styles of reasoning acquire their force (Hacking 2002). GRE adds a preservation requirement: re-epistemization is possible only to the extent that future researchers can recover the evidence, assumptions, methods, categories, alternative interpretations, and contextual conditions necessary for reassessment.

Proposition 6.348 (Layered re-evaluation of earlier research). *Historical reassessment of earlier research should distinguish its adequacy within the original evaluation regime, the present warrant of its claims, and its present significance or value under later research conditions.*

This distinction prepares the preservation problem of the next section. If research systems expect future evaluative revision, then the ability to reconstruct earlier inquiry becomes part of present research responsibility.

6.22.9 Evaluation of Evaluation

An evaluation regime should itself become an object of research. Criteria and metrics can stabilize quality, facilitate coordination, support accountability, and concentrate scarce resources. They can also generate blind spots, strategic adaptation, category compression, unequal burdens, or premature closure. Reflexive research praxis therefore requires periodic assessment of whether the system of evaluation remains adequate to the research ecology it helps govern.

Definition 6.349 (Meta-evaluation of research). *Meta-evaluation of research* is the systematic assessment of an evaluation regime's criteria, procedures, metrics, institutional effects, exclusions, feedback pathways, and fitness for the epistemic and practical functions it is intended to support.

Meta-evaluation should examine at least five dimensions. The first is *validity*: whether the evaluative criterion or metric tracks the property it claims to assess. The second is *coverage*: which forms of contribution remain weakly represented. The third is *behavioral effect*: how actors adapt to the evaluative system. The fourth is *historical fit*: whether the regime still corresponds to current methods, productive conditions, and research objects. The fifth is *revisability*: whether anomalies, alternative judgments, and excluded forms of evidence can trigger correction.

Longino's emphasis on effective critical interaction is relevant here because objectivity depends partly on conditions under which assumptions and standards can be challenged (Longino 1990). An evaluation system that rewards formal compliance while making its own criteria difficult to contest can weaken the critical processes that evaluation is meant to support. Conversely, unlimited criterion instability can undermine comparability and long-horizon coordination. The problem is therefore one of disciplined revisability.

Proposition 6.350 (Reflexive evaluation principle). *A research evaluation regime should be periodically reassessed in relation to the validity of its indicators, the plurality of contributions it recognizes, the behavior it generates, the historical conditions under which it operates, and the pathways through which its own standards can be revised.*

The historical evolution of evaluation completes the argument initiated in Section 6.21. Methods and standards develop together, and both can alter the research field they regulate. Research praxis therefore requires more than methodological revision; it requires the capacity to revise the judgments through which research is selected, rewarded, preserved, and transmitted. Such revision is only possible when the evidential and contextual materials needed for later reassessment survive. The next section turns to that infrastructural problem by examining evidence preservation for future re-epistemization.

6.23 Evidence Preservation for Future Re-Epistemization

Section 6.22 established that methods, evaluative criteria, and research productive conditions evolve historically. This section develops the infrastructural implication of that claim. Its role is to specify what present research praxis should preserve

if later researchers are to reassess earlier evidence, interpretations, models, categories, and conclusions under new questions and new epistemic conditions. The objective is neither indefinite retention of every research trace nor reconstruction of an imagined unmediated past. It is to preserve enough of the evidential and contextual architecture of inquiry that consequential claims can later be re-examined without being reduced to their published conclusions. The discussion proceeds through primary records, provenance, alternative interpretations, negative results, model assumptions, historical and methodological context, future reanalysis, and the costs and selectivity of preservation. The method is reconstructive and resource-sensitive: preservation is treated as a present design decision whose value depends partly on the future forms of re-epistemization it keeps possible.

Definition 6.351 (Re-epistemization infrastructure). A *re-epistemization infrastructure* is a preserved configuration of records, provenance, assumptions, contextual information, interpretive alternatives, methodological documentation, and access conditions that enables later inquiry to reassess the epistemic standing of earlier research.

Preservation therefore concerns more than durability of files. A dataset without its variables' historical meanings can survive physically while becoming difficult to interpret. A model without its assumptions can remain executable while losing explanatory transparency. A published conclusion can remain widely accessible while the negative results, rejected interpretations, or primary materials required to contest it disappear. The relevant object of preservation is thus relational: records must remain connected to enough of the conditions through which they acquired evidential meaning.

6.23.1 Preservation of Primary Records

Future reassessment often depends on materials closer to the original encounter than the final research representation. Fieldnotes, interview recordings or transcripts, archival images, survey instruments, laboratory records, administrative extracts, codebooks, legal documents, observational logs, sensor outputs, images, specimen descriptions, computational inputs, and contemporaneous annotations can all function as primary research records. Their value lies partly in the fact that later questions may require distinctions that the original analysis did not encode.

Definition 6.352 (Primary research record). A *primary research record* is a research trace produced, collected, copied, or preserved sufficiently close to an encounter, observation, source, measurement, or research operation that later inquiry can inspect it without relying exclusively on the final analytical representation derived from it.

Primary does not mean epistemically unmediated. A transcript depends on transcription conventions; a sensor output depends on an instrument; an archival document was produced for historically situated purposes; an administrative dataset reflects prior classification. Preservation should therefore retain both the record and, where materially relevant, information about the mediation through which it became available. This principle follows the representation discipline developed in Sections 6.15–6.18: the closer record does not eliminate interpretation, but it can leave later inquiry more room to reconstruct it.

Preserving source-level records can also protect against premature analytical closure. A project that stores only derived variables may make later recoding impossible. A project that keeps only selected quotations may prevent future interpretation of omitted context. A simulation archive containing only final plots can prevent examination of initialization choices or intermediate behavior. Primary-record preservation therefore expands future analytical option value.

That option value remains constrained by ethics, law, confidentiality, security, consent, physical feasibility, and the interests of people or communities represented in the record. Some records require restricted access, transformation, delayed release, controlled environments, or eventual deletion. Preservation is therefore not equivalent to unrestricted openness. Its epistemic purpose is to maintain legitimate future reconstructability where that purpose can be reconciled with other obligations.

Proposition 6.353 (Source-level preservation principle). *When later reanalysis could materially depend on distinctions omitted by a current analytical representation, research praxis should preserve the closest ethically and legally retainable source-level records together with documentation sufficient to interpret their mediation.*

6.23.2 Provenance

Records become progressively less useful for re-epistemization when their origin and transformation history are unknown. Provenance identifies how an evidential object came to have its present form. For a dataset, this can include collection procedures, inclusion rules, transformations, merges, missingness decisions, coding changes, versions, and responsible actors. For an archival corpus, provenance can include source repositories, selection paths, digitization procedures, cataloguing conventions, and known gaps. For a model, provenance can include data versions, software environments, parameter choices, calibration stages, and changes across iterations.

Definition 6.354 (Research provenance). *Research provenance* is the documented history of the origin, custody, selection, transformation, versioning, and use of a research record, representation, model, or evidential object insofar as that history is materially relevant to its interpretation or warrant.

The value of provenance is relational rather than ceremonial. It enables a later researcher to distinguish a property of the studied object from a property introduced by collection, cleaning, translation, aggregation, or institutional processing. Gebru and colleagues' proposal for datasheets for datasets makes a closely related case for documenting motivation, composition, collection processes, recommended uses, and related dataset history (Gebru et al. 2021). The same logic extends beyond datasets: evidence becomes more re-interpretable when its production history remains inspectable.

Versioning is particularly important under iterative reconstruction. Section 6.19 treated research as a sequence in which categories, models, interpretations, and methods can be revised. If each revision overwrites the preceding state, future researchers may know that a conclusion changed without being able to determine why. Preserving consequential versions, transformation rules, and reasons for change makes revision itself a research object.

Proposition 6.355 (Provenance-dependent reconstruction). *When an evidential claim materially depends on selection, transformation, aggregation, translation, or versioning, future reassessment requires preservation of enough provenance to distinguish source-level properties from properties introduced by the research process.*

Provenance also disciplines machine-mediated research. Computational systems can execute long transformation chains quickly, making the distance between source and final representation difficult to reconstruct retrospectively. Preserving machine-readable logs, human decisions, data versions, code or executable specifications where feasible, and interpretable descriptions of consequential transformations can reduce that opacity. The objective remains functional rather than exhaustive: document the transformations that future evaluators would need to inspect in order to understand how the evidential object was produced.

6.23.3 Preservation of Alternative Interpretations

A final publication usually presents a comparatively stabilized interpretation. Research praxis, however, often passes through competing explanations, category choices, causal stories, historical readings, and model specifications. Some alternatives are rejected because evidence strongly weighs against them; others remain underdetermined; still others disappear because of space, disciplinary convention, or later shifts in research orientation. Future re-epistemization becomes weaker when only the winning interpretation survives.

Definition 6.356 (Alternative-interpretation record). *An alternative-interpretation record is a preserved account of a materially plausible interpretation, explanation, categorization, or model considered during inquiry, together with its evidential basis, unresolved questions, and the reasons for its provisional retention or rejection.*

Longino's account of scientific objectivity emphasizes the role of critical interaction and the capacity for background assumptions to be challenged (Longino 1990). Preservation extends that critical possibility through time. A later conceptual framework may render a previously weak interpretation newly intelligible; newly available evidence may discriminate among alternatives that were once observationally equivalent; a historical category discarded as peripheral can become central when the research question changes.

Preservation of alternatives does not require equal epistemic weighting. A well-refuted explanation should remain identified as refuted under the evidence then available. A speculative hypothesis should remain marked as speculative. The objective is traceable disagreement rather than flattened pluralism. The preserved record should allow later researchers to reconstruct both the alternative and the grounds on which earlier inquiry assessed it.

This practice also protects against retrospective inevitability. Once one interpretation becomes dominant, the history of inquiry can appear more linear than it was. Preserving serious alternatives reveals which evidential and conceptual forks were available at the time and thereby supports historically responsible re-evaluation.

6.23.4 Preservation of Negative Results

Research preservation should include informative failures. A null association, unsuccessful replication, falsified prediction, failed intervention, unstable measurement, model breakdown, unproductive archival route, or method that repeatedly fails under specified conditions can constrain future inquiry even when it does not yield a positive finding. The epistemic value lies in narrowing plausible claims, exposing boundary conditions, identifying fragile assumptions, and reducing unnecessary repetition of already explored paths.

Definition 6.357 (Negative research result). A *negative research result* is a sufficiently documented research outcome in which an expected, hypothesized, targeted, or methodologically sought relation, effect, pattern, replication, performance, or practical result is absent, unstable, unsupported, or fails under specified conditions.

Negative is therefore a relation to an expectation or target, not a synonym for worthless research. Popper's emphasis on severe testing and the epistemic importance of failed predictions provides one classical precedent for treating counterevidence as substantive rather than disposable (Popper 2002). GRE broadens the point beyond falsification. A negative result can be informative even when it does not decisively reject a theory: it can expose a scale limit, temporal dependency, contextual condition, translation problem, or method–object mismatch.

Preservation quality matters. A statement that “the analysis did not work” offers little future value unless later researchers can determine what was attempted, on which records, under which assumptions, with which stopping rules, and with what observed failure. Negative results therefore inherit the provenance and methodological-context requirements developed throughout this section.

Preserving negative results also supports more accurate historical reconstruction of a research field. If only successful pathways remain visible, later observers can overestimate the reliability, inevitability, or efficiency of the route through which knowledge developed. An archive of well-documented failure preserves the contingency of inquiry without implying that every abandoned path deserves renewed investigation.

6.23.5 Preservation of Model Assumptions

Formal and quantitative models condense assumptions about entities, relations, parameters, boundaries, temporal structure, observation processes, and permissible transformations. Section 6.16 treated models as epistemic instruments whose functions can vary across representation, explanation, prediction, counterfactual exploration, theory development, and application. Future reanalysis requires more than the model's equations or code. It requires enough documentation to recover the assumptions that gave those formal objects their intended interpretation.

Definition 6.358 (Model assumption record). A *model assumption record* is a preserved specification of the substantive, formal, statistical, computational, boundary, scale, temporal, and evidential assumptions on which a model's construction, calibration, interpretation, or use materially depends.

Giere emphasizes that scientific models represent selected aspects of the world

from a perspective rather than reproducing reality without remainder (Giere 2006). Winsberg similarly shows that computer simulation depends on layered modelling practices, approximations, assumptions, and judgments that mediate relations among theory, computation, experiment, and evidence (Winsberg 2010). Preservation should therefore include assumptions that may be invisible in the final output: excluded mechanisms, fixed parameters, initialization rules, omitted populations, measurement models, convergence criteria, prior distributions where relevant, software dependencies, and intended domains of applicability.

Assumption preservation also enables later function reassignment. A model originally built for prediction can later be examined for explanatory structure, or a model once used for counterfactual exploration can be re-evaluated under new empirical evidence. Such reuse is defensible only when later users can distinguish the model's original function and evidential support from the function they now ask it to perform.

Proposition 6.359 (Assumption-preservation requirement). *When a model's conclusions depend materially on assumptions that are not recoverable from its outputs alone, preservation should retain those assumptions and their relation to the model's intended epistemic or practical function.*

6.23.6 Preservation of Historical Context

Evidence is produced within historical conditions. Categories, institutions, languages, technologies, legal arrangements, social meanings, disciplinary standards, and practical possibilities can change after a research record is created. Future researchers can therefore misread a well-preserved record if they interpret its terms through later meanings or assume that present-day alternatives were historically available.

Definition 6.360 (Historical research context record). *A historical research context record is preserved information concerning the contemporaneous categories, institutions, material conditions, technologies, linguistic conventions, evaluative standards, and feasible alternatives needed to interpret a research object or evidential claim in its historical setting.*

Hacking's historical ontology emphasizes that categories and objects of inquiry can acquire their forms through historically situated practices of classification and reasoning (Hacking 2002). Kuhn similarly demonstrates that scientific problems, standards, and intelligibility can shift across historical research configurations (Kuhn 1962). Preservation for re-epistemization should therefore retain enough historical context to prevent a later category from being projected uncritically backward.

Historical context includes absences and constraints as well as visible institutions. What data could not be collected? Which populations were administratively invisible? Which concepts did not yet exist in the relevant disciplinary vocabulary? Which technical capacities were unavailable? Which legal or political restrictions structured access? Which alternative interpretations were imaginable at the time? These conditions can materially affect the meaning of both evidence and omission.

Context preservation is necessarily selective. An archive cannot preserve an entire historical world. The practical criterion is dependency: preserve contextual information whose later loss would materially alter interpretation of the target records,

methods, categories, or claims.

6.23.7 Preservation of Methodological Context

Historical context describes the wider environment of inquiry; methodological context describes how researchers organized access to that environment. Future reanalysis requires knowledge of why a method was selected, how the sample or corpus was formed, which instruments and protocols were used, what transformations were applied, which exclusions occurred, and what alternatives were unavailable or rejected.

Definition 6.361 (Methodological context record). A *methodological context record* is preserved information concerning the selection, execution, limitations, alternatives, and consequential decisions of the methods through which research evidence was produced and interpreted.

This requirement complements the historical evolution of methods analyzed in Section 6.21. A method can be appropriate relative to the available tools and research question of one period while appearing limited under later capabilities. Re-evaluation becomes more disciplined when future researchers can identify whether an apparent limitation arose from the underlying object, the available instrument, institutional access, resource scarcity, or the researcher's methodological choice.

Methodological context should also preserve transformations between representations. Section 6.18 showed that translation from narrative to variable, field experience to formal structure, or qualitative distinction to quantitative measure can lose information. A later researcher needs access to the translation rules and, where feasible, the source representations in order to determine whether a finding depends on the chosen methodological representation.

Documentation can be structured without becoming exhaustive. Gebru and colleagues' dataset documentation framework illustrates how standardized prompts can preserve motivation, composition, collection process, and recommended uses in an inspectable form (Gebru et al. 2021). Analogous documentation can be adapted to interviews, archives, fieldwork, simulations, legal corpora, comparative cases, and mixed-method designs.

6.23.8 Future Reanalysis

Preservation becomes epistemically significant when it expands the possibility of later reanalysis. Future researchers may possess new questions, new concepts, new theoretical frameworks, improved instruments, expanded comparative cases, different ethical concerns, new computational capabilities, or access to evidence unavailable to the original inquiry. Reanalysis can therefore do more than verify whether an earlier calculation was executed correctly. It can reconstruct the research object itself.

Definition 6.362 (Future reanalysis). *Future reanalysis* is a later inquiry that re-examines preserved research records, representations, assumptions, or contexts under materially changed questions, evidence, methods, categories, theories, evaluative criteria, or historical conditions.

Future reanalysis is distinct from exact reproduction. Reproduction can be valuable when the objective is to determine whether a reported computational or analytical procedure can be repeated from the same materials. Reanalysis can intentionally ask a different question or employ a different representation. It may revisit an archive under a new historical interpretation, recode an older dataset using revised categories, compare a model with newly observed regimes, or re-evaluate a legal classification after institutional change.

This possibility gives preservation generative value. Preserved records do not merely retain past knowledge; they can become resources from which new relations, questions, interpretations, and methods emerge. The original research team cannot fully anticipate these later uses. Preservation therefore supports generativity under uncertainty by maintaining a bounded option for future reconstruction.

Proposition 6.363 (Reanalysis option principle). *The epistemic value of preservation includes the option it creates for future inquiry to reconstruct earlier evidence under questions, concepts, methods, or historical conditions that were unavailable or weakly developed at the time of original research.*

The option is neither unlimited nor automatically desirable. Consent, licensing, community interests, confidentiality, security, legal restrictions, and potential misuse can constrain later access. Preservation architecture should therefore distinguish retention from access: a record can be preserved under controlled conditions even when open reuse would be inappropriate.

6.23.9 Cost of Preservation

Preservation consumes resources. Storage is only one component. Records must be organized, documented, migrated across formats, protected against corruption, governed through access rules, reviewed for legal and ethical compliance, and made interpretable to future users. Sensitive records can require security infrastructures and continuing stewardship. Physical archives can require climate control and conservation. Computational environments can depend on obsolete software or hardware. Documentation itself demands researcher time and institutional attention.

Definition 6.364 (Preservation cost profile). *A preservation cost profile is the temporally extended configuration of financial, material, computational, organizational, documentary, legal, ethical, security, and attention costs required to retain a research object in a condition suitable for its intended future use.*

The inclusion of attention is important. Simon's analysis of information-rich environments emphasizes that abundance of information can create scarcity of attention (Simon 1971). A preservation system that retains enormous volumes without adequate indexing, provenance, or prioritization can shift scarcity from storage toward discoverability and interpretation. Preservation quality can therefore decline even as retained volume increases.

Costs can also be transferred. A research group can deposit poorly documented material and thereby shift future curation burdens to repositories or later researchers. Conversely, excessive documentation requirements can impose disproportionate burdens on small projects or communities with limited resources. A responsible

preservation design should therefore consider who bears the costs of storage, curation, access, interpretation, and risk over time.

Preservation cost also has an opportunity dimension. Resources devoted to indefinite retention of low-value or reproducible materials may reduce the capacity to preserve unique archives, vulnerable records, minority-language materials, or historically transient observations. Cost recognition is thus necessary for preservation justice as well as institutional sustainability.

6.23.10 Selective Preservation under Resource Constraints

Because preservation has costs and risks, research praxis requires selective preservation. The objective is to maintain future re-epistemic capacity under finite resources rather than to retain every possible trace. Selection should be explicit because unexamined selection already occurs through storage limits, institutional neglect, proprietary control, format decay, researcher departure, and differential visibility.

Definition 6.365 (Re-epistemic preservation priority). A *re-epistemic preservation priority* is a provisional judgment about the relative importance of retaining a research record or contextual element based on its uniqueness, irrecoverability, dependency relations, future reconstructive value, ethical significance, generative potential, preservation cost, and associated risks.

Several considerations can guide that judgment. *Uniqueness* concerns whether comparable evidence could later be regenerated. *Irrecoverability* concerns whether loss would be permanent, as with disappearing oral histories, transient ecological observations, or records from closed institutions. *Dependency* concerns whether many later claims rely on the item. *Reconstructive value* concerns whether future researchers could reinterpret earlier conclusions if the item survived. *Generative potential* concerns whether the material can support questions beyond the original study. *Ethical and legal risk* concerns whether retention itself can produce harm, breach duties, or create unacceptable exposure. *Cost* concerns the continuing resources required to preserve the material meaningfully rather than nominally.

Proposition 6.366 (Selective preservation principle). *Under finite resources, preservation priority should increase when a research record is difficult to regenerate, carries substantial dependencies for later claims, preserves otherwise vulnerable historical or relational information, or materially expands future possibilities for reanalysis, while the priority should be balanced against continuing ethical, legal, security, and stewardship burdens.*

Selection should preserve relationships among records where those relationships carry evidential meaning. Retaining a final dataset while deleting its codebook can destroy interpretability; retaining a model while deleting its data version can weaken validation; preserving a quotation while losing the surrounding interview can remove contextual meaning. Preservation decisions should therefore sometimes target a minimal reconstructive bundle rather than isolated files.

Definition 6.367 (Minimal reconstructive bundle). A *minimal reconstructive bundle* is the smallest ethically and practically retainable set of records, provenance, assumptions, contextual information, and methodological documentation sufficient to sup-

port the intended range of future reassessment of a consequential research claim.

The bundle is target-relative. Research intended only for short-horizon operational monitoring can require a different preservation horizon from a unique historical archive. A computational result based on public regenerable data can justify preserving code, versions, and transformation rules more strongly than duplicating every source file indefinitely. A confidential qualitative study can require controlled retention of contextual metadata while limiting access to source records. Selectivity becomes defensible when these choices are explicit, reasoned, and revisable.

Evidence preservation thus closes the loop opened by historical revision of methods and evaluation. If knowledge, categories, methods, and standards can change, research systems require enough memory to make later correction possible. Yet memory itself is selective, costly, and relationally governed. Preservation should therefore be designed as part of research praxis: sufficiently rich to sustain future re-epistemization, sufficiently documented to preserve interpretability, and sufficiently bounded to respect the ethical and material conditions under which evidence can responsibly endure. The following section turns from preservation of what can be retained to the complementary problem of conducting research when the available evidential field remains incomplete.

6.24 Research under Incomplete Evidence

Section 6.23 treated preservation as infrastructure for later re-epistemization. The present section turns to the complementary condition in which inquiry must proceed before the evidential field is complete. Its role is to specify how research-dominant praxis can remain rigorous when observation is partial, records are missing, evidence conflicts, and time or resources prevent indefinite investigation. The objective is to replace an implicit ideal of evidential completeness with a disciplined account of provisional inference, research decision, and research action under bounded evidential conditions. The discussion proceeds from incomplete observation and missing records through evidential conflict and provisional inference, then examines decisions and actions internal to research, temporal and resource constraints, explicit limits of conclusion, and the point at which practical closure begins to move inquiry toward application-dominant praxis. The method is reconstructive and constraint-sensitive: incomplete evidence is treated as a structured property of a research configuration whose location, consequences, and residual uncertainties should remain inspectable.

Definition 6.368 (Evidential incompleteness). *Evidential incompleteness* is a condition in which the evidence available to a research claim leaves one or more materially relevant observations, records, relations, temporal intervals, populations, mechanisms, comparisons, or alternative explanations insufficiently resolved relative to the intended scope of that claim.

Evidential incompleteness is therefore claim-relative. A dataset can be sufficient for one bounded descriptive question while remaining inadequate for a historical, relational, or generative claim requiring additional temporal or contextual informa-

tion. The relevant task is not to classify an entire project as complete or incomplete. It is to identify where the evidential architecture leaves consequential dependence on absence, assumption, extrapolation, or unresolved conflict.

This framing also prevents incomplete evidence from being converted too quickly into a single undifferentiated uncertainty value. Missing observations, inaccessible records, disagreement among sources, uncertain measurement, and unresolved causal alternatives create different inferential problems and require different responses. Manski's work on identification under weak assumptions illustrates the importance of distinguishing what is supported by available data from what becomes identified only after stronger assumptions are introduced (Manski 2008). GRE extends that discipline across heterogeneous evidential forms: the location and type of incompleteness should remain visible wherever they materially affect the conclusion.

6.24.1 Incomplete Observation

Incomplete observation arises when the target process, relation, or field is only partially accessible through the observation regime used in inquiry. Chapter 5 developed partial observation epistemologically; here the problem becomes practical. Researchers must decide whether to continue observing, alter the observation regime, narrow the claim, combine methods, or proceed provisionally with a documented remainder.

Definition 6.369 (Incomplete observation profile). An *incomplete observation profile* is a structured description of which relevant dimensions of a research target are observed, weakly observed, indirectly observed, temporally unobserved, inaccessible, or presently unknown under a specified observation regime.

The profile should distinguish several conditions. A relation can be visible only through one participant's position. A historical process can contain intervals for which surviving traces are sparse. A network can be observed through recorded transactions while informal dependencies remain weakly visible. A policy can be measured through immediate outcomes while delayed effects remain outside the study horizon. These forms of partiality differ because their inferential consequences differ.

Incomplete observation can sometimes be reduced by additional data collection, but extension of observation also has costs and can alter the object. Longer field presence can reveal temporal variation while changing researcher-participant relations. Additional measurement can increase coverage while producing measurement reactivity. Expanded administrative linkage can reveal cross-domain relations while increasing privacy and governance burdens. The practical response therefore requires judgment about whether increased observation materially improves the target inference relative to the costs and transformations it introduces.

Proposition 6.370 (Observation-completion proportionality). *The effort devoted to reducing incomplete observation should be proportionate to the expected effect of the missing observation on the target claim, the feasibility and consequences of obtaining additional evidence, and the availability of defensible scope restriction or alternative evidential access.*

This proposition keeps observation open without turning completeness into an unlimited research obligation. Some inquiries can advance through carefully bounded claims even when portions of the object remain unobserved.

6.24.2 Missing Records

Missing records create a different problem because the absent evidence may have once existed, may have been selectively preserved, may never have been produced, or may remain inaccessible. Each pathway has a different epistemic meaning. An archival silence generated by institutional exclusion differs from random file loss; a missing administrative category differs from an inaccessible confidential record; absence of documentation differs from evidence that an event did not occur.

Definition 6.371 (Missing-record condition). A *missing-record condition* is a research state in which a record materially relevant to a claim is unavailable and the pathway producing that unavailability is itself partly known, inferable, contested, or unknown.

The pathway matters because missingness can be relationally generated. Institutions decide what is recorded, which categories are administratively legible, which archives survive, who receives documentary recognition, and what is destroyed, privatized, or classified. Section 6.23 showed why preservation infrastructures matter; the present problem is what to do when those infrastructures have already failed or were never equally available.

A disciplined treatment therefore separates the empirical absence of a record from the substantive absence of the relation or event that the record might have represented. Where the record-production process is known, researchers can sometimes infer what kinds of cases are more likely to disappear. Where the pathway is uncertain, conclusions should remain correspondingly narrower. Historical and qualitative evidence can sometimes reconstruct missing institutional records indirectly, while quantitative designs can sometimes bound rather than point-identify quantities affected by incomplete data (Manski 2008). These responses remain claim-specific.

Proposition 6.372 (Missing-record interpretation principle). A *missing record should influence substantive inference through an explicit account of the record-production and loss process whenever that process is materially relevant and sufficiently reconstructable; where it remains unresolved, the conclusion should preserve the resulting inferential remainder.*

This principle also links evidential incompleteness to epistemic justice. Weakly recorded relations can become weakly represented in later research, especially when institutional visibility is itself unequally distributed. The following section develops that power dimension directly.

6.24.3 Conflicting Evidence

Incomplete evidence need not mean too little evidence. A research field can contain abundant evidence that points in different directions. Statistical patterns can diverge from interview accounts; administrative classifications can conflict with lived practice; historical sources can disagree about sequence or responsibility; different

models can fit overlapping evidence while implying different mechanisms. Conflict is therefore a distinct evidential condition rather than merely a temporary inconvenience before convergence.

Definition 6.373 (Evidential conflict). *Evidential conflict* is a condition in which two or more materially relevant evidence sources, representations, methods, or interpretations support conclusions that cannot be jointly accepted without qualification, reconstruction, scope differentiation, or revision of background assumptions.

Longino's contextual empiricism is relevant here because evidential relevance depends partly on background assumptions that can themselves become objects of criticism (Longino 1990). Apparent disagreement can arise because methods operationalize different constructs, observe different scales, sample different populations, or rely on different historical boundaries. Section 6.17 therefore treated disagreement as a trigger for methodological diagnosis rather than immediate averaging.

Research under conflicting evidence should preserve the conflict long enough to determine its source where feasible. One result may be adjudication: one source is less reliable for the target claim. Another may be differentiation: each source is adequate for a different property or scale. A third may be reconstruction: the conflict reveals that the original category combined phenomena requiring separation. A fourth may be durable underdetermination: available evidence does not support a defensible resolution.

Proposition 6.374 (Conflict-preservation principle). *When materially relevant evidence conflicts, research praxis should preserve the disagreement until the basis for adjudication, differentiation, reconstruction, or continued underdetermination has been made explicit enough for the target claim.*

Conflict preservation does not assign equal weight to every source. Evidence can differ substantially in provenance, measurement quality, inferential distance, historical fit, and vulnerability to bias. The requirement is that the route by which one source is privileged, combined, or bounded relative to another remain inspectable.

6.24.4 Provisional Inference

Research rarely waits for a final evidential state before inference begins. Concepts are formed from partial encounters, sampling decisions are revised from early observations, model families are compared before all mechanisms are known, and historical interpretations develop while archival gaps remain. Provisional inference is therefore a normal component of research praxis rather than an exceptional concession.

Definition 6.375 (Provisional inference). *A provisional inference* is an inference accepted for a specified research purpose and scope while its dependence on incomplete evidence, contestable assumptions, unresolved alternatives, or future revision remains explicitly recorded.

The central discipline is to separate what the evidence supports from what is contributed by assumptions. Manski's analysis of identification is again useful: weak assumptions can support bounded conclusions even when point identification is unavailable (Manski 2008). A parallel principle applies outside quantitative identifica-

tion. A historical study can state a range of plausible sequences; an ethnography can restrict its inference to the observed relational field; a legal analysis can distinguish doctrinal interpretation from empirical implementation; a computational model can report results conditional on specified assumptions rather than presenting them as direct observations.

Provisionality should be operational rather than ceremonial. Phrases such as “more research is needed” provide little discipline unless the unresolved component is specified. A stronger account identifies which observation is absent, which assumption carries the inference, which alternative remains live, and what new evidence would materially change the conclusion.

Proposition 6.376 (Structured provisionality). *A provisional inference should identify, to the extent material for the claim, its evidential basis, consequential assumptions, unresolved alternatives, scope of use, and plausible revision triggers.*

Provisional inference therefore supports research continuity without simulating closure. It allows inquiry to accumulate, compare, formalize, and publish while preserving a pathway for later correction.

6.24.5 Decision within Research

Incomplete evidence also enters decisions internal to research. Researchers decide which case to examine next, when to stop collecting data, which archive to prioritize, whether to merge categories, which model to estimate, which anomaly deserves follow-up, whether an interpretation is mature enough for publication, and whether a result should remain provisional. These decisions shape the evidential field that later appears to support the conclusion.

Definition 6.377 (Research decision under incomplete evidence). *A research decision under incomplete evidence is a choice among feasible inquiry paths made before the relevant evidential state is fully resolved, where the choice affects subsequent observation, representation, analysis, preservation, or communication.*

Such decisions are distinct from the external practical decisions emphasized in application-dominant praxis. Their immediate object is the conduct of inquiry. Yet they can still carry consequential path dependence. Choosing one archive can reduce time available for another. Fixing a codebook can stabilize later measurement. Publishing one classification can make it more likely to be reused. Selecting one model family can orient future data collection toward variables that model can represent.

Research decisions should therefore be treated as epistemically consequential actions within praxis. Dewey’s account of inquiry emphasizes the movement from problematic situations through observation and inference toward provisional resolution (Dewey 1910). In GRE, the decision problem includes the relational and historical effects of choosing a particular path through that movement.

Proposition 6.378 (Research-decision traceability). *When a research decision made under incomplete evidence materially shapes later evidence or interpretation, the decision, its principal alternatives, and the considerations supporting it should remain sufficiently traceable for later reconstruction.*

Traceability does not require an exhaustive diary of every minor choice. It applies

most strongly where the decision changes the object, sample, category system, model class, evidential access, stopping rule, or preservation architecture in ways that materially condition the conclusion.

6.24.6 Action within Research

Research decisions become research actions when they are implemented and thereby alter the inquiry configuration. Recruiting participants, opening a new field site, changing an instrument, recoding an archive, running a simulation, releasing a dataset, preregistering an analysis, publishing a classification, or constructing a new measurement infrastructure are actions internal to research praxis. Some act primarily on the research system; others can also act on the studied relational field.

Definition 6.379 (Research action under incomplete evidence). *A research action under incomplete evidence is an implemented change to the design, evidential access, representation, infrastructure, communication, or relational configuration of inquiry undertaken while relevant uncertainty remains unresolved.*

The distinction between decision and action matters because implementation can create new evidence and new path dependence. An additional interview can reveal an unanticipated category. A changed survey instrument can improve measurement while reducing comparability with earlier waves. Publication can generate uptake that makes a representation performative. Section 6.20 showed that these pathways can become reflexive when research activity alters later evidence.

Action within research can therefore function as disciplined exploration. A pilot study, alternative coding exercise, replication, model perturbation, or targeted archival search can be chosen partly because it is informative under uncertainty. Yet research action also has ethical and practical consequences. Additional observation can burden participants; expanded linkage can increase privacy risk; preservation can create stewardship obligations. The value of information supplied by an action should therefore be assessed together with its relational costs.

Proposition 6.380 (Informative research action). *A research action undertaken under incomplete evidence is epistemically preferable, other considerations being comparable, when it is expected to discriminate among materially different interpretations, reduce consequential uncertainty, or reveal the limits of a current representation while preserving acceptable ethical and relational conditions.*

This proposition does not convert all research into experimental intervention. Informative action can include observation, comparison, documentation, preservation, or representational revision. Its defining feature is that the action is selected partly for what it can teach about the unresolved research configuration.

6.24.7 Research under Time Constraints

Inquiry operates within time. Field access closes, archives impose schedules, grants end, policy windows shift, participants leave, ecological states change, computational resources are allocated for finite periods, and publication or coordination requires provisional stopping points. Time constraints can therefore create pressure for epistemic closure before evidence has reached the level that researchers would prefer

under an indefinite horizon.

Definition 6.381 (Time-bounded research closure). *Time-bounded research closure* is a provisional stopping point adopted because a specified research phase must conclude within a finite temporal horizon even though materially relevant evidential uncertainty remains.

Time-bounded closure can be responsible when the residual uncertainty is made explicit and the claim is scaled accordingly. It becomes more problematic when deadline pressure is converted into rhetorical certainty. The distinction is between ending a research phase and declaring the underlying epistemic problem settled.

Time scarcity also changes prioritization. Researchers may need to choose evidence with high discriminating value, preserve records for later work, narrow the claim, or defer secondary questions. These choices resemble attention allocation under information abundance discussed by Simon (Simon 1971). The relevant scarce resource is not only clock time but the capacity to process and compare evidence before a decision point.

Proposition 6.382 (Temporal closure discipline). *When research closes because of a time constraint, the resulting claim should distinguish evidential support achieved from questions deferred by the temporal boundary and should preserve, where feasible, the provenance needed for later continuation.*

This discipline turns deadline-induced incompleteness into an explicit property of the research design rather than a hidden weakness of the conclusion.

6.24.8 Research under Resource Constraints

Research is also materially bounded. Financial support, personnel, expertise, computing, laboratory access, language capacity, archival permissions, travel, security, and institutional infrastructure can all limit what evidence is feasible to obtain. Section 6.8 treated these conditions as part of researcher position; here they enter the design and interpretation of incomplete evidence.

Definition 6.383 (Resource-bounded research design). *A resource-bounded research design* is a design whose evidential reach and methodological configuration are materially shaped by finite financial, technical, infrastructural, linguistic, organizational, or human capacities.

Resource constraints need not invalidate a study, but they can change which claims are defensible. A small comparative study can be strong for mechanism reconstruction while weak for prevalence. A project without proprietary data can remain rigorous while observing a different portion of the relational field. A low-resource archive project can preserve unique evidence even if its digitization or metadata remain partial. The relevant question is whether the claim is aligned with the access and limitations of the design.

Resource constraints can also create systematic epistemic asymmetry. Well-funded institutions can purchase data, instruments, field access, computing, and preservation capacity unavailable to others. If these differences become invisible, methodological privilege can be misread as purely epistemic superiority. The following section examines these power relations directly.

Proposition 6.384 (Constraint-claim alignment). *A resource-bounded inquiry remains epistemically defensible when the scope and strength of its claims are aligned with the evidence its resource configuration can support and when materially consequential access limitations are disclosed rather than converted into implicit universality.*

This principle also protects methodological diversity. Research quality should not be equated with maximal expenditure where lower-resource methods provide appropriate access to the target question.

6.24.9 Explicit Limits of Conclusion

Incomplete evidence becomes most consequential at the point where findings are communicated. A research conclusion can remain useful while carrying explicit limits on population, scale, time, mechanism, representation, or inferential strength. The purpose of such limits is neither ritual modesty nor wholesale weakening of the claim. It is to specify the boundary within which the conclusion is warranted.

Definition 6.385 (Explicit inferential limit). An *explicit inferential limit* is a stated boundary on the interpretation, transport, strength, temporal horizon, scale, population, mechanism, or practical use of a research conclusion arising from the evidential and methodological conditions under which it was produced.

Limits should be informative enough to guide later use. “The sample is limited” is weaker than stating which relations or populations are weakly observed. “Causality cannot be established” is weaker than specifying whether temporal order, mechanism, counterfactual dependence, or alternative explanations remain unresolved. “Results may not generalize” is weaker than naming the boundary or scale across which transport has not been established.

Explicit limits also protect cumulative inquiry. Later researchers can decide whether new evidence addresses the missing dimension, whether a result can be combined with another study, or whether apparent contradiction reflects different scopes. Popper’s emphasis on exposing theories to criticism offers one historical precedent for keeping claims open to correction (Popper 2002); GRE extends this requirement to the specific relational and representational dependencies of the conclusion.

Proposition 6.386 (Limit-bearing conclusion). *A conclusion reached under incomplete evidence should carry the materially relevant limits that condition its warrant, especially where omission of those limits would invite transport, generalization, causal interpretation, or practical use beyond what the research design supports.*

The strength of a conclusion therefore depends partly on the precision of its boundary. A narrower but well-supported claim can contribute more reliably to cumulative research than a rhetorically expansive claim whose evidential dependencies remain hidden.

6.24.10 Transition toward Application-Dominant Praxis

Research under incomplete evidence creates a boundary problem because some research decisions have consequences beyond the organization of inquiry. A pilot intervention can alter a community relation; release of a classification can affect eligibility

or reputation; a forecasting system can guide institutional allocation; a published risk estimate can influence behavior; an experimental protocol can create lasting infrastructures. At such points, the principal contradiction can begin to shift from how to know under incomplete evidence toward how to act responsibly while knowledge remains incomplete.

Definition 6.387 (Praxis-orientation transition under incomplete evidence). A *praxis-orientation transition under incomplete evidence* occurs when the dominant burden of a research configuration shifts from producing or revising warranted knowledge toward selecting, implementing, or governing consequences in a practical-relational world while consequential uncertainty remains.

The transition is phase-dependent rather than institutional. A university research team can enter application-dominant praxis when it deploys a consequential classification or intervention. A public agency can remain in research-dominant praxis while reconstructing evidence before action. Hybrid configurations can carry both burdens simultaneously. Section 6.2 established this mode distinction; the present section identifies incomplete evidence as one of the conditions through which movement between modes becomes visible.

Three features are especially diagnostic. First, the relevant closure point becomes practical rather than primarily epistemic: an action, allocation, intervention, restriction, or deployment must be selected. Second, the consequences increasingly fall on relations beyond the research system. Third, uncertainty itself becomes part of the responsibility structure because waiting, acting, or choosing among reversible and irreversible options can each generate effects.

Proposition 6.388 (Transition under consequential closure). *When a choice made under incomplete evidence primarily determines consequential action in the practical-relational world rather than the next organization of inquiry, the praxis configuration should be evaluated increasingly through the responsibilities of application-dominant praxis, even if research activities continue within the same institutional setting.*

This transition does not imply that research-dominant inquiry ceases. Evidence collection, model revision, interpretation, and re-epistemization can continue after action begins. The change concerns which contradiction becomes principal in the active phase. Research under incomplete evidence therefore reveals both the limits and the generative capacity of research praxis: inquiry can advance through bounded provisionality, preserve unresolved alternatives, and organize further learning, yet some choices eventually acquire a practical burden that cannot be resolved by additional epistemic refinement alone. The following section returns to the research field itself and examines how the power to name, classify, measure, make visible, and allocate evidential authority shapes whose relations can become objects of knowledge.

6.25 Researcher Power and Epistemic Justice

The preceding section examined research under incomplete evidence and showed that limitations of access, time, resources, and records can shape what inquiry is able to support. The present section develops a closely related problem: those limitations are rarely distributed evenly. Research praxis includes capacities to name,

classify, measure, make visible, preserve, circulate, and authorize representations of persons, relations, institutions, and processes. These capacities can enlarge collective knowledge, yet they can also reorganize the epistemic field by determining which distinctions travel, whose evidence receives uptake, and which relations remain weakly legible. The role of this section is therefore to locate power within the ordinary operations of inquiry. Its objective is to specify how epistemic justice constrains research relations without replacing evidential warrant with automatic deference. The discussion proceeds from naming and classification through measurement, visibility, exclusion, evidential resources, representational authority, contestability, justice in research relations, and reflexive limitation. The method is relational and pathway-sensitive: power is attributed where identifiable research practices materially condition access, representation, uptake, or the future organization of inquiry.

Fricker's analysis of testimonial and hermeneutical injustice offers a philosophical precedent for examining unequal credibility and unequal participation in shared interpretive resources (Fricker 2007). Longino's account of socially organized criticism likewise emphasizes the epistemic importance of conditions under which criticism can enter inquiry and receive serious uptake (Longino 1990). GRE extends these concerns into a broader research-praxis architecture. Power can enter before an explicit credibility judgment is made: a relation may never be recorded, a category may be unavailable, a measurement infrastructure may be inaccessible, or a representation may circulate without a practicable route of contestation.

Definition 6.389 (Research epistemic power). *Research epistemic power* is the relationally distributed capacity to shape the conditions under which research objects are named, classified, measured, made visible, excluded, evidenced, represented, contested, preserved, or carried into subsequent inquiry and practice.

Definition 6.389 treats power as a property of research relations rather than a possession located only in individual researchers. Universities, funders, archives, statistical systems, journals, platforms, instruments, professional vocabularies, and data infrastructures can all participate in the organization of epistemic power. The relevant question is therefore which pathways materially shape the evidential and representational field, and with what consequences for the actors and relations under study.

6.25.1 Power to Name

Naming is one of the earliest operations through which an encountered phenomenon becomes portable within research. A name can stabilize attention, permit comparison, organize retrieval, support communication across institutions, and create a handle for cumulative inquiry. It can also foreground one interpretation while backgrounding others. The epistemic power of naming therefore lies partly in its capacity to establish which distinctions become repeatable in later research.

Names differ in their degree of stabilization. A provisional field term may remain close to participant language. A technical term may be embedded in a disciplinary lineage. An administrative label may carry eligibility rules or reporting consequences. A computational label may become a feature used repeatedly in automated classification. These forms should not be treated as equivalent merely because each assigns a

linguistic sign. Bourdieu's account of language and symbolic power is relevant here because linguistic forms can acquire differential authority through social and institutional conditions (Bourdieu 1991).

Definition 6.390 (Naming power in research). *Naming power in research* is the capacity to introduce, stabilize, circulate, or privilege a term through which a research object, relation, difference, or process becomes available for subsequent description, comparison, classification, or action.

A justice-sensitive use of naming makes the naming relation inspectable. Researchers should distinguish, where materially relevant, participant terms, inherited disciplinary terms, institutional terms, and newly introduced analytical vocabulary. The point is not to preserve every vocabulary indefinitely. It is to prevent a newly stabilized name from erasing the provenance of the distinctions from which it was constructed.

Proposition 6.391 (Provenance of consequential naming). *When a research name materially shapes later classification, measurement, attribution, or institutional uptake, its provenance and intended scope should remain sufficiently visible for later users to distinguish the introduced term from the phenomenon or relation it is used to represent.*

6.25.2 Power to Classify

Classification converts a field of differences into a structured set of categories, states, types, or partitions. This operation can make previously diffuse relations empirically tractable. It can also create boundaries whose consequences exceed the immediate research task. A classification may decide which cases are comparable, which observations enter a dataset, which histories count as instances of the same phenomenon, and which residual cases become coded as noise or exception.

The power of classification is especially visible when categories travel across settings. A category devised for one study can enter administrative practice, policy reporting, machine-learning datasets, or later scholarship. Once institutionalized, the category can influence what future systems observe. The classificatory effect can therefore become recursive: the research representation helps organize the world from which subsequent data are drawn. This possibility connects classification to the reflexive pathways developed in Section 6.20.

Definition 6.392 (Classificatory power in research). *Classificatory power in research* is the capacity to establish or stabilize distinctions that determine how cases, persons, relations, events, or observations are grouped, compared, included, excluded, or made available for subsequent inference.

Classification can be necessary without being ontologically final. Inquiry under ontological suspension in Section 6.9 already established that operational categories need not settle ultimate ontology. Justice adds a further requirement: where categories are consequential for represented actors or for the visibility of relations, researchers should examine whose distinctions are retained, whose are translated, and which alternatives become difficult to express within the adopted scheme.

Claim 6.393 (Contestable classification). *Consequential research classifications gain epistemic robustness when their criteria, residual cases, translation choices, and ma-*

terially relevant alternatives remain open to informed contestation rather than being treated as self-interpreting features of the data.

6.25.3 Power to Measure

Measurement adds another layer of epistemic power because it selects properties, establishes scales, and makes heterogeneous cases commensurable. Porter documents the institutional importance of quantitative objectivity and standardized procedures in modern public and scientific life (Porter 1995). Espeland and Stevens show that commensuration can have cognitive and political consequences because translating different entities into a common metric changes what becomes comparable and what distinctions recede (Espeland and Stevens 1998).

A measure can expand access to patterned evidence while remaining selective. The choice of construct, unit, denominator, coding rule, threshold, time window, or aggregation level can materially alter what becomes visible. Measurement power therefore concerns both the capacity to quantify and the authority to define the measurable form of the target.

Definition 6.394 (Measurement power in research). *Measurement power in research* is the capacity to define and operationalize properties through scales, indicators, coding rules, thresholds, or metrics that structure how observations become comparable and evidentially consequential.

Measurement power becomes justice-relevant where actors have unequal capacity to influence operationalization or to contest the resulting measure. A standardized index can travel farther than situated testimony because it fits existing institutional infrastructures. That portability can be useful, yet it may grant the metric greater authority than the construct validity or contextual fit warrants.

Proposition 6.395 (Measurement-authority discipline). *The authority granted to a research measure should remain proportionate to the evidential support for its construct, scope, and transport conditions, especially where the measure can redistribute visibility, credibility, eligibility, or institutional attention.*

This proposition preserves a distinction developed repeatedly in the chapter: methodological portability and epistemic warrant are related but different. A measure can be easy to circulate while remaining weakly suited to a particular relational context.

6.25.4 Power to Make Visible

Research can make previously weakly represented relations visible. Documentation can reveal hidden labor, dispersed harms, informal coordination, historical exclusion, ecological contribution, or institutional dependence. Visibility can therefore expand the evidential field and support recognition, criticism, and later inquiry. Yet visibility also redistributes informational power. Making a relation visible to researchers, institutions, or publics can expose participants to surveillance, reputational risk, strategic disadvantage, or new forms of intervention.

Definition 6.396 (Research visibility power). *Research visibility power* is the capacity to alter whether and how an actor, relation, practice, effect, or trace becomes observ-

able, recordable, comparable, circulable, or institutionally legible through research activity.

Visibility is therefore relationally indexed. A dataset can make a pattern visible to researchers while remaining inaccessible to the people represented within it. Publication can make a community visible to a wider public while reducing that community's control over contextual interpretation. Conversely, deliberate limits on visibility can protect confidentiality, bargaining position, cultural knowledge, or safety.

Proposition 6.397 (Purpose-sensitive visibility). *Research visibility should be assessed relative to epistemic purpose, consent and governance conditions, relational position, and foreseeable consequences for those made visible, rather than treated as an unqualified increase in epistemic justice.*

The proposition prevents a simple equation of transparency with justice. Visibility can support epistemic participation while also enabling new asymmetries of observation and control.

6.25.5 Power to Exclude

Every research configuration excludes something. Boundaries delimit populations; sampling frames omit cases; archives preserve some records and lose others; classification schemes generate residual categories; instruments detect only particular signals; publication compresses more material than it can retain. Exclusion is therefore partly unavoidable. The justice problem concerns patterned exclusion that materially narrows whose relations, evidence, interpretations, or consequences can enter inquiry and whose absence then becomes mistaken for insignificance.

Definition 6.398 (Epistemic exclusion in research praxis). *Epistemic exclusion in research praxis* is a relational condition in which actors, evidence, interpretations, categories, or relevant relations are systematically constrained from entering, influencing, contesting, or being preserved within a research process in ways that materially affect the resulting knowledge.

Fricker's account of hermeneutical injustice is especially relevant when unequal participation in interpretive resources makes some experiences harder to render intelligible within available categories (Fricker 2007). In research praxis, analogous exclusion can occur through inaccessible technical vocabularies, proprietary datasets, language barriers, credential requirements, institutional gatekeeping, or category systems that offer no adequate location for a relation participants regard as consequential.

Justice-sensitive inquiry should distinguish principled exclusion from unexamined exclusion. Ethical safeguards can properly restrict some data. A narrowly defined research question can properly exclude irrelevant cases. The issue is whether exclusion tracks the stated object and responsibilities of inquiry, or whether it silently reproduces asymmetries that distort the evidential field.

Claim 6.399 (Exclusion audit). *Where exclusion materially affects the interpretation or transport of a research claim, the research record should identify the principal exclusion pathway and distinguish design-based exclusion, access-based exclusion, ethical restriction, missingness, and category-generated invisibility where these differences*

matter:

6.25.6 Unequal Evidential Resources

Epistemic participation depends partly on resources. Institutions with extensive funding, legal support, computing, archival access, measurement infrastructure, professional networks, and publication capacity can produce evidence in forms that travel widely. Communities or researchers with fewer resources may possess deep situated knowledge while lacking comparable means to standardize, preserve, analyze, or circulate it. Section 6.24 treated resource constraints as a research-design problem; the present subsection considers their distributive epistemic effects.

Definition 6.400 (Evidential resource asymmetry). *Evidential resource asymmetry* is a structured difference in the capacity of actors or institutions to generate, access, preserve, verify, analyze, circulate, or contest evidence relevant to a research claim.

Such asymmetry does not imply that low-resource evidence is automatically stronger or that high-resource evidence is suspect. It changes the conditions under which evidential authority is produced. A large administrative dataset may support broad comparison while remaining weak on informal relations. A small community archive may preserve unique histories while offering limited population coverage. Epistemic justice requires differentiated evaluation of these strengths rather than equating evidential capacity with institutional wealth.

Proposition 6.401 (Resource-aware evidential evaluation). *When evidential resources are distributed unevenly, research evaluation should distinguish the quality and relevance of the evidence from the institutional capacity that made its production, preservation, or circulation possible, while remaining explicit about limits created by unequal access.*

This principle also applies within research teams. Technical staff, data stewards, community partners, translators, field coordinators, and archivists can contribute epistemically significant capacities that disappear when evidential production is represented solely through the final analytic author.

6.25.7 Representational Authority

Research does more than collect evidence; it produces accounts that can travel beyond the original encounter. Representational authority concerns whose account becomes durable and portable enough to stand for a relation in later scholarship, policy, education, administration, or public discussion. This authority may be distributed differently from firsthand access. A researcher can possess publication authority while a participant possesses situated experiential access. An institution can possess administrative records while a community retains local historical knowledge. A technical team can control the model while affected actors observe consequences the model does not represent.

Definition 6.402 (Representational authority in research). *Representational authority in research* is the capacity of an actor, institution, method, or artifact to establish a representation that receives durable epistemic uptake concerning a research object, relation, population, or process.

Representational authority should be calibrated to the property represented. Situated actors can have strong authority concerning experienced meaning or local practice without thereby settling prevalence or hidden mechanism. Researchers can have comparative authority derived from cross-case evidence while remaining weakly positioned to interpret tacit meanings. Statistical systems can detect patterns while carrying thin accounts of lived significance. Justice therefore supports differentiated authority rather than a single hierarchy of speakers.

Longino's emphasis on critical interaction supports the need for recognized avenues through which claims can be challenged and background assumptions exposed (Longino 1990). Within GRE, representational authority becomes more defensible when provenance, inferential scope, alternative interpretations, and routes of contestation remain visible.

Proposition 6.403 (Differentiated representational authority). *Representational authority should be indexed to the form of access and inferential reach supporting the representation, while consequential representations should preserve feasible routes through which differently positioned actors can challenge material errors, omissions, or category failures.*

6.25.8 Contestability

Contestability is the practical capacity to question, inspect, challenge, revise, or contextualize a research representation or decision. It is stronger than the abstract possibility of disagreement. A representation may be publicly available yet difficult to contest because its data are inaccessible, its categories undocumented, its technical procedures opaque, or no institution is responsible for receiving challenges.

Definition 6.404 (Epistemic contestability in research). *Epistemic contestability in research* is the capacity of relevant actors to identify a consequential research claim or representation, understand enough of its evidential and inferential basis to formulate a challenge, submit materially relevant counterevidence or interpretation, and obtain a reasoned pathway of review where revision is warranted.

Contestability does not require every disagreement to alter the conclusion. It requires a relation between challenge and review. The threshold can vary with consequence. A low-stakes exploratory model can require modest documentation. A classification that affects public allocation, reputation, access, or durable institutional records can warrant substantially stronger routes of explanation and correction.

Proposition 6.405 (Consequence-sensitive contestability). *The practical strength of contestability should increase with the consequence, persistence, opacity, and representational authority of the research output, while review procedures remain proportionate to feasible evidential and institutional conditions.*

Contestability also supports cumulative research. Challenges can reveal missing categories, inaccessible evidence, mistranslation, historical discontinuity, or boundary errors that would otherwise persist through repeated reuse. In this sense, contestability is not only procedural protection; it is a mechanism of methodological correction.

6.25.9 Justice in Research Relations

The preceding subsections identify several sites at which research relations can become epistemically asymmetric. Justice in research relations concerns how these capacities are organized together. It includes opportunities to contribute relevant evidence and interpretation, protections against harmful visibility, calibrated credibility, recognition of differentiated access, contestability of consequential representations, and preservation of provenance sufficient for later reassessment.

Definition 6.406 (Epistemic justice in research relations). *Epistemic justice in research relations* is the just organization of opportunities, protections, resources, authority, and contestability through which differently positioned actors can contribute to, be represented within, and challenge research concerning relations and processes in which they are materially implicated.

Definition 6.406 does not assign equal evidential weight to every contribution. Epistemic justice and evidential adequacy remain distinct. A participant's testimony can deserve serious uptake while remaining limited concerning population prevalence. An institutional dataset can be methodologically strong for some questions while reproducing category exclusions relevant to others. A community interpretation can reveal meaning inaccessible to an external researcher while remaining open to counterevidence. Justice governs the conditions under which these differences are recognized and assessed rather than flattening them into equivalence.

Proposition 6.407 (Justice-sensitive research relation). *A justice-sensitive research relation seeks to align epistemic authority with relevant access and evidential support, preserve meaningful opportunities for contestation, avoid unnecessary exposure or exclusion, and disclose material asymmetries in the resources through which evidence and representation are produced.*

This proposition remains narrower than a complete ethics of research. Consent, benefit sharing, compensation, ownership, liability, and broader distributive justice can require additional principles. The present concern is specifically the epistemic organization of the research relation.

6.25.10 Reflexive Limitation of Research Power

Research power becomes especially consequential when it disappears from the researcher's own account of inquiry. A classification can appear as if it were discovered rather than introduced; a metric can appear as a transparent property rather than an operational construction; publication can appear as mere communication even when it alters reputation or institutional behavior. Reflexive limitation begins by making these research-mediated pathways explicit.

Definition 6.408 (Reflexive limitation of research power). *Reflexive limitation of research power* is the deliberate identification, documentation, contestation, and where appropriate restraint of research capacities that materially shape naming, classification, measurement, visibility, exclusion, evidential access, or representational authority beyond what the epistemic and practical purpose of the inquiry warrants.

Limitation can take several forms: narrower classification scope, participatory category review, controlled disclosure, preservation of alternative vocabularies, explicit

uncertainty, restricted data linkage, independent review, documentation of metric construction, or revision pathways after publication. The appropriate mechanism depends on the pathway of power. Reflexivity therefore should remain specific enough to guide design rather than functioning as a general declaration that researchers possess power.

Foucault's analysis of power relations is relevant insofar as power operates through structured possibilities for action rather than only through direct command (Foucault 1982). Research classifications, infrastructures, and representations can similarly structure later possibilities without determining them completely. This makes reflexive limitation compatible with research ambition: the aim is to preserve the capacity to know while reducing unjustified conversion of epistemic tools into unexamined authority.

Proposition 6.409 (Reflexive restraint principle). *Where a research operation generates epistemic or practical power beyond what is necessary for the warranted purpose of inquiry, the design should consider proportionate limits, countervailing review, or contestability mechanisms, with the chosen response indexed to the operation's consequence, reversibility, and persistence.*

Reflexive limitation also has a generative dimension. A research field that preserves contestability, differentiated authority, and multiple routes of evidential contribution can support future correction and new inquiry more effectively than one that secures short-term coherence by suppressing alternatives. Epistemic justice therefore belongs inside research praxis rather than appearing only as an external ethical constraint. It shapes which evidence can emerge, which representations remain revisable, and whose capacities to participate in future re-epistemization are preserved.

The next section broadens the analysis from epistemic justice to the aesthetic and normative conditions that operate across both research-dominant and application-dominant praxis. Having examined how research power organizes visibility and authority, the inquiry can now ask how aesthetic and normative judgment orient selection, evaluation, and action across the wider field of praxis.

6.26 Aesthetic and Normative Conditions across Praxis

The preceding section located epistemic power within the ordinary operations of research and showed that naming, classification, measurement, visibility, exclusion, and representation can reorganize the conditions of knowledge production. The present section broadens the analysis from epistemic justice within research to the aesthetic and normative conditions that operate across both research-dominant and application-dominant praxis. Its role is to clarify how judgments concerning elegance, coherence, significance, fairness, responsibility, urgency, and value orient what questions are pursued and what actions are taken. The objective is to preserve the analytical distinction among aesthetic, epistemic, and normative judgment while showing that practical orientation often depends on their interaction. The discussion proceeds from aesthetic and normative judgment in research and application to the selection of questions and actions, plural values, conflict among judgment forms,

the historical formation of practical taste, and the revisability of practical judgment. The method is relational and historically situated: judgments are treated as configurations formed through persons, institutions, traditions, material conditions, representations, and anticipated consequences rather than as isolated mental acts or timeless criteria.

Section 6.12 developed judgment within research and distinguished aesthetic, epistemic, and normative dimensions. The present section extends that architecture across the wider field of praxis. Kant's account of aesthetic judgment remains useful as a classical reference for the distinctive structure of judgments of taste, while Dewey's account of aesthetic experience and valuation places judgment within temporally organized interaction and consequence (Kant 1987; Dewey 1934; Dewey 1939). GRE draws on these lineages without treating them as a complete theory of practical judgment. Its narrower concern is how aesthetic and normative conditions participate in the orientation of research and application under relational complexity, heterogeneous values, and incomplete knowledge.

Definition 6.410 (Practical judgment configuration). A *practical judgment configuration* is the historically situated combination of aesthetic, epistemic, normative, institutional, and contextual judgments through which a praxis evaluates questions, representations, actions, consequences, and possible future trajectories.

Definition 6.410 avoids reducing practical orientation to a single scalar criterion. A research project can appear theoretically elegant yet normatively problematic; an intervention can be ethically urgent yet weakly supported by available evidence; a policy can satisfy one conception of fairness while degrading another valued capability. Praxis therefore requires differentiated judgment together with explicit treatment of conflict among judgment forms.

6.26.1 Aesthetic Judgment in Research

Aesthetic judgment in research can orient attention before a full epistemic assessment is available. Researchers may be drawn toward a conjecture because it exhibits economy, a model because it reveals a striking symmetry, a historical pattern because it has an unexpected structural coherence, or a question because it appears capable of reorganizing several otherwise disconnected problems. Such judgments can be generative because they influence which possibilities receive sustained inquiry.

Section 6.12 already established that aesthetic attractiveness does not establish truth. The additional point here concerns praxis orientation. Aesthetic judgment can affect resource allocation, collaboration, model choice, problem formation, and the persistence with which an unresolved question is pursued. McAllister's historical analysis of aesthetic preferences in science is relevant because it shows that standards of scientific beauty themselves can change with theoretical development (McAllister 1996).

Definition 6.411 (Aesthetic orientation in research). An *aesthetic orientation in research* is the influence of judgments concerning form, elegance, coherence, simplicity, surprise, depth, or generative appeal on the selection, continuation, representation, or development of research activity.

Aesthetic orientation can be productive when it helps preserve possibilities whose value is not yet captured by established evaluation criteria. It can also become restrictive when a historically dominant style of elegance excludes phenomena that are irregular, heterogeneous, context-dependent, or resistant to concise representation. The epistemic task is therefore to retain aesthetic judgment as a source of orientation while preserving routes through which evidence can correct aesthetic preference.

Proposition 6.412 (Aesthetic orientation discipline). *When aesthetic judgment materially influences research selection or persistence, its orienting role should remain distinguishable from the epistemic warrant later offered for the resulting claim, model, or explanation.*

6.26.2 Aesthetic Judgment in Application

Application-dominant praxis also contains aesthetic conditions. Built environments, interfaces, institutions, legal forms, public spaces, technologies, and organizational procedures are experienced through qualities such as clarity, proportion, continuity, legibility, harmony, friction, rhythm, and fit. These qualities can affect whether an intervention is usable, inhabitable, trusted, memorable, or capable of sustaining participation.

Aesthetic judgment in application should therefore be distinguished from decorative preference. A design can alter how relations are encountered and enacted. The spatial organization of a public service can communicate dignity or surveillance; an interface can make some actions intuitive and others difficult; an institutional procedure can feel coherent or alienating; a legal or administrative form can either support intelligibility or intensify symbolic distance. Dewey's account of aesthetic experience is relevant here because it locates aesthetic quality within organized experience rather than in ornament detached from practice (Dewey 1934).

Definition 6.413 (Aesthetic condition of application). *An aesthetic condition of application is a formally, sensorially, spatially, symbolically, or experientially organized feature of an intervention that materially affects how actors encounter, interpret, participate in, or reproduce the practical relation generated through that intervention.*

Aesthetic quality can support accessibility, participation, and continuity while remaining normatively ambiguous. A highly coherent system can also intensify control; an elegant interface can conceal asymmetry; a compelling symbolic form can stabilize exclusion. Application therefore requires aesthetic evaluation to remain connected to normative and relational analysis.

Caution 6.414 (Aesthetic success in application). Aesthetic coherence or attractiveness can improve practical uptake while remaining compatible with harmful distribution, weak epistemic justification, or unjust relations. Aesthetic success should therefore remain analytically distinct from practical and normative success.

6.26.3 Normative Judgment in Research

Normative judgment enters research through the selection of problems, treatment of participants, distribution of burdens, use of categories, management of uncertainty, preservation of records, communication of findings, and anticipation of downstream

use. These judgments can shape the evidential field itself. A decision to restrict data access can reduce one form of evidential availability while protecting participants from exposure; a decision to include a marginalized category can improve visibility while creating new risks of identification.

The epistemic-justice analysis of Section 6.25 shows that normative research judgment is especially important when research capacities are asymmetrically distributed. Fricker's analysis of epistemic injustice and Longino's account of critical interaction provide relevant precedents for treating participation, credibility, and criticism as epistemically consequential (Fricker 2007; Longino 1990).

Definition 6.415 (Normative condition of research). A *normative condition of research* is a value-laden constraint, commitment, or evaluative relation that materially shapes what inquiry may pursue, how it may proceed, whose interests and vulnerabilities must be considered, and how its products may be represented, preserved, circulated, or used.

Normative research judgment should remain explicit enough to distinguish ethical or political reasons from evidential ones. A project can be rejected because its likely harm exceeds its epistemic value even when the proposed method is technically rigorous. Conversely, an ethically important question can remain empirically unresolved. Keeping these judgments distinct supports more transparent justification.

Proposition 6.416 (Normative-epistemic separation in research). *Where normative considerations materially constrain research design or interpretation, the constraint should be stated without converting the normative reason into evidence for the substantive claim or the substantive evidence into a complete normative justification.*

6.26.4 Normative Judgment in Application

Application-dominant praxis makes normative judgment unavoidable because practical closure distributes benefits, burdens, risks, opportunities, recognition, and future capacities. Section 6.5 showed that action often occurs before uncertainty can be eliminated. Normative judgment therefore enters the decision architecture alongside epistemic confidence, urgency, reversibility, systemic spillover, and the distribution of consequences.

Dewey's theory of valuation is useful because it treats ends and values as objects of inquiry within problematic situations rather than as wholly external inputs (Dewey 1939). Sen's work on ethics and economics likewise illustrates the limitations of reducing practical evaluation to a narrow informational basis (Sen 1987). GRE extends this concern by asking how heterogeneous values arise, interact, conflict, and become institutionally represented within practical relations.

Definition 6.417 (Normative judgment in application). A *normative judgment in application* is a provisional evaluation of the permissibility, priority, fairness, responsibility, desirability, or acceptability of a practical option relative to the values, rights, vulnerabilities, relations, and anticipated consequences materially implicated in the decision.

Such judgment remains provisional because application can transform the very value configuration within which it was evaluated. An intervention can generate new

capabilities, dependencies, harms, constituencies, expectations, or forms of recognition. Normative evaluation should therefore continue after implementation rather than being exhausted at the moment of decision.

Proposition 6.418 (Normative revision after application). *When application materially changes the relations, affected parties, consequence structure, or available possibilities that grounded the original normative judgment, that judgment should become eligible for reassessment even when the intervention achieved its initial operational objective.*

6.26.5 Selection of Questions

Research questions are selected through more than epistemic tractability. They can be oriented by curiosity, beauty, historical importance, institutional demand, injustice, practical urgency, theoretical anomaly, available methods, career incentives, or perceived future generativity. Section 6.13 treated orientation as the bridge between judgment and sustained inquiry. The present subsection emphasizes that question selection is therefore already an aesthetic and normative act as well as an epistemic one.

Definition 6.419 (Question-selection judgment). *A question-selection judgment is the provisional evaluation through which a possible research question receives, retains, or loses priority relative to its epistemic promise, aesthetic appeal, normative importance, feasibility, opportunity cost, and anticipated contribution to future inquiry or practice.*

Question selection becomes especially consequential under abundance. When many technically difficult or formally interesting questions can be generated, difficulty alone provides weak guidance regarding worth. A research community must still judge which questions deserve scarce attention, validation effort, preservation, and long-horizon commitment.

The generative-relational perspective adds a further consideration: some questions generate new fields of inquiry by creating concepts, methods, archives, datasets, or collaborations that expand future question space. Their value may therefore exceed the immediate answer obtained.

Proposition 6.420 (Generative question selection). *Question selection may legitimately consider the capacity of a research problem to generate new evidential access, concepts, methods, relations, or future questions, provided this generative promise remains distinct from established epistemic significance or normative priority.*

6.26.6 Selection of Actions

Application requires selection among actions, including the option to delay, pilot, monitor, restrict, reverse, or decline intervention. Action selection combines evidence with judgments about consequence, urgency, value conflict, reversibility, institutional capacity, and uncertainty. The same evidence can therefore support different actions under different normative configurations without making the underlying facts arbitrary.

Definition 6.421 (Action-selection judgment). An *action-selection judgment* is the practical evaluation through which one intervention, sequence, delay, pilot, restraint, or non-intervention is provisionally preferred over alternatives given the available evidence, value configuration, uncertainty, urgency, reversibility, and distribution of plausible consequences.

Aesthetic judgment can also enter action selection. A coherent intervention architecture may be easier to communicate, maintain, or inhabit. Yet practical elegance should remain subordinate to evidential and normative scrutiny where the two conflict. Likewise, a morally attractive goal does not determine the mechanism by which it should be pursued.

Proposition 6.422 (Action-selection non-substitution). *Within application-dominant praxis, aesthetic attractiveness, epistemic support, normative desirability, operational feasibility, and reversibility can each contribute to action selection, while strength on one dimension should not be treated as sufficient evidence of adequacy on the others.*

6.26.7 Plural Values

Practical judgment often involves values that differ in kind. Accuracy, dignity, autonomy, care, efficiency, resilience, equality, liberty, ecological continuity, transparency, privacy, stability, participation, and generativity cannot always be reduced without remainder to one shared scale. Sen's critique of informationally narrow evaluation provides one important economic precedent for preserving plurality in practical reasoning (Sen 1987).

GRE treats value plurality as a relational condition rather than as a demand for permanent incomparability. Values can sometimes be compared locally, prioritized provisionally, or translated through institutional procedures. The key requirement is that practical commensuration should not be mistaken for proof that the underlying values are intrinsically identical.

Definition 6.423 (Plural value configuration). A *plural value configuration* is the historically and relationally situated set of distinct evaluative considerations materially relevant to a research or application problem, together with the relations, tensions, and provisional comparison procedures through which they enter judgment.

Plural values also imply plural affected positions. A research infrastructure can create openness for one community and exposure for another. An intervention can increase aggregate capability while intensifying dependence for a subgroup. Practical judgment should therefore specify whose values and consequences are represented rather than referring abstractly to a single social preference.

Proposition 6.424 (Value-plurality disclosure). *Where a practical judgment depends on heterogeneous values, the materially relevant value dimensions, affected positions, and any procedure used to compare or prioritize them should remain sufficiently explicit for later contestation and revision.*

6.26.8 Conflicting Judgments

Aesthetic, epistemic, and normative judgments can conflict. An elegant model can fit the evidence weakly. A well-supported intervention can distribute burdens unfairly.

A morally urgent problem can lack a reliable mechanism of action. A technically effective policy can be aesthetically alienating or institutionally corrosive. These conflicts belong inside praxis rather than being treated as defects that disappear once analysis becomes sufficiently sophisticated.

Definition 6.425 (Practical judgment conflict). A *practical judgment conflict* occurs when materially relevant aesthetic, epistemic, normative, institutional, or practical evaluations support incompatible orientations, priorities, or actions within the same praxis configuration.

Conflict requires articulation before adjudication. The first task is to identify which judgment forms disagree and whether the disagreement concerns evidence, values, time horizon, scale, affected population, or representation. Some conflicts can be reduced through further evidence or redesign. Others remain genuine normative tradeoffs.

Proposition 6.426 (Conflict-preserving practical judgment). *Where materially relevant judgment forms remain in tension after clarification and feasible inquiry, practical closure should record the unresolved conflict and the basis of the provisional priority rather than representing the decision as if all evaluative dimensions had converged.*

This principle preserves future revisability. Later evidence, changed circumstances, new affected parties, or altered value priorities can reopen a decision whose earlier closure was reasonable under a different configuration.

6.26.9 Historical Formation of Practical Taste

Judgments concerning elegance, importance, proper evidence, desirable intervention, credible institutions, and acceptable tradeoffs have histories. Research taste develops through training, disciplinary traditions, canonical examples, instruments, institutional incentives, and encounters with prior successes and failures. Practical taste develops through legal traditions, administrative routines, professional norms, social movements, technologies, and cultural expectations.

Bourdieu's relational analysis of fields and habitus is relevant because dispositions of judgment are formed through historically structured participation rather than arising from isolated preference (Bourdieu 1984). McAllister similarly shows that aesthetic criteria in science can acquire historical trajectories (McAllister 1996). GRE uses these insights to make the history of practical taste available for reflexive analysis without reducing present judgment to social determination.

Definition 6.427 (Practical taste). *Practical taste* is the historically formed disposition through which actors or institutions experience some questions, representations, solutions, values, or forms of action as especially fitting, elegant, serious, urgent, credible, or worthy within a field of praxis.

Practical taste can encode accumulated expertise. Experienced researchers may perceive a promising question before they can fully articulate why; practitioners may recognize an intervention as institutionally unworkable before formal analysis captures the relevant friction. Such tacit judgment deserves neither automatic authority nor automatic dismissal. Its historical and relational formation can be investigated, compared, and subjected to counterevidence.

Remark 6.428 (Taste and accumulated expertise). Historically formed practical taste can function as compressed experiential knowledge while also carrying inherited exclusions, stylistic conventions, and institutional biases. Its epistemic and practical value should therefore be assessed through performance, comparison, provenance, and contestability rather than status alone.

6.26.10 Revisability of Practical Judgment

Practical judgment should remain revisable because its evidential, aesthetic, normative, and institutional conditions can change. New evidence can reveal previously invisible harms. A formerly elegant model can become inadequate after the object changes. A normative priority can shift when new affected parties become visible. A practical design can generate capabilities that make alternatives feasible which were unavailable at the time of the original decision.

Definition 6.429 (Revisable practical judgment). *A revisable practical judgment is a provisional orientation whose evidential basis, aesthetic criteria, normative commitments, affected relations, and closure conditions remain sufficiently explicit to permit reassessment when materially relevant conditions change.*

Revisability does not require perpetual reopening of every decision. Some decisions require institutional stability, predictable expectations, and durable coordination. The relevant problem is to distinguish stability from insulation against correction. Review thresholds can therefore depend on consequence, reversibility, time horizon, newly available evidence, and the materiality of changed conditions.

Proposition 6.430 (Practical-judgment revision). *A practical judgment should become eligible for substantive revision when new evidence, changed relations, newly visible affected positions, altered value configurations, or transformed possibilities materially undermine the conditions that supported its earlier closure.*

The aesthetic and normative conditions developed in this section therefore belong inside the recursive architecture of praxis. They orient questions and actions, participate in institutional selection, and shape the value configuration through which later outcomes are judged. Their historical formation makes them intelligible; their plurality makes conflict expectable; and their revisability prevents inherited taste or normative closure from becoming invisible authority.

The next section turns to AI-assisted research praxis. This transition is especially consequential because AI systems can dramatically expand the generation of representations, models, syntheses, and candidate problems while leaving the judgment of significance, historical fit, relational sensitivity, and normative responsibility incompletely delegated. The distinction among aesthetic, epistemic, and normative orientation established here will therefore become a central constraint on how AI assistance is incorporated into research praxis.

6.27 AI-Assisted Research Praxis

The preceding sections developed research praxis as a historically situated and relational process in which encounter, salience, judgment, orientation, method, preserva-

tion, power, and normative responsibility remain analytically distinguishable while continuously interacting. The present section examines how artificial-intelligence systems enter that process. Its role is to specify the epistemic and practical functions that AI can perform within research-dominant praxis without collapsing assistance into authority, automation into understanding, or computational abundance into research value. Its objective is twofold: first, to identify where AI can enlarge the space of search, formalization, simulation, pattern discovery, interpretation, and theory revision; second, to specify the forms of judgment, historical sensitivity, relational sensitivity, verification, infrastructure awareness, and responsibility that remain necessary when those capabilities expand. The discussion proceeds from AI as instrument and dialogic interface through automated research operations, problem abundance, preservation of human judgment, interpretation and theory revision, methodological evolution, epistemic asymmetry, verification and infrastructure dependence, limits of delegation, and the transition from AI-assisted research toward AI-mediated praxis. The method is relational and function-sensitive: AI systems are treated as historically generated research infrastructures whose epistemic significance depends on the relations among models, researchers, data, institutions, participants, computational resources, and downstream uses.

The phrase *AI-assisted research* therefore names a configuration rather than a discrete tool category. A language model used to generate alternative formulations, a machine-learning system used to detect structure in high-dimensional data, an automated theorem prover, a simulation agent, and an AI-supported literature-search system can participate in research through very different epistemic functions. Their outputs can also occupy different positions in the evidential chain. Some outputs remain exploratory representations; others become inputs to formal analysis, empirical selection, interpretation, or practical action. Noy and Zhang's experimental study of generative AI in professional writing tasks provides one concrete example of substantial productivity effects under bounded task conditions, while Bender and colleagues provide an important caution against inferring understanding or epistemic authority from fluent language generation alone (Noy and Zhang 2023; Bender et al. 2021). GRE uses this contrast as a starting point: increased productive capacity can reorganize research praxis without itself settling the epistemic status of what is produced.

Definition 6.431 (AI-assisted research praxis). *AI-assisted research praxis* is a research configuration in which one or more artificial-intelligence systems materially participate in search, representation, generation, comparison, formalization, simulation, interpretation, evaluation, or revision while research responsibility remains distributed through a wider human–institutional–technical relational field.

Definition 6.431 makes two points explicit. AI participation can be substantial without implying autonomous epistemic authority, and research responsibility remains relational even when a machine system performs a large share of visible production. The remaining subsections develop the consequences of this configuration.

6.27.1 AI as Research Instrument

At the most familiar level, AI functions as a research instrument. It can transform inputs, rank documents, generate representations, classify observations, estimate parameters, propose code, construct summaries, or operate within a larger analytical workflow. Instrumental use places AI alongside other epistemic infrastructures, but the analogy should remain qualified. Many AI systems are adaptive, probabilistic, opaque, dependent on large training corpora, and capable of producing plausible outputs outside the domain in which their reliability is well characterized. Their use therefore combines ordinary questions of instrument calibration with questions about provenance, model behavior, hidden preprocessing, training conditions, and output variability.

Definition 6.432 (AI research instrument). An *AI research instrument* is an artificial-intelligence system used to perform a specified epistemic operation within a research workflow, where the operation, target, relevant inputs, output status, and verification pathway are sufficiently explicit for the resulting contribution to be inspected.

Instrumental framing is useful precisely because it resists anthropomorphic overreach. The relevant question is not whether the system “knows” in a general sense, but what operation it performs, what representation it produces, what assumptions enter that operation, and what kind of claim can reasonably inherit support from it. Burrell’s differentiated account of algorithmic opacity is important here because opacity can arise from proprietary secrecy, technical-literacy barriers, or the internal complexity and scale of a model itself (Burrell 2016). Each form produces a different burden for research use.

Proposition 6.433 (Instrument-function traceability). *Where an AI system materially contributes to a research claim, the epistemic function assigned to the system and the pathway from its output to the claim should remain inspectable independently of the system’s apparent fluency, generality, or sophistication.*

6.27.2 AI as Dialogic Research Partner

Generative systems can also participate through dialogue. A researcher may ask for objections, alternative hypotheses, missing assumptions, possible analogies, candidate formalizations, counterexamples, or different explanatory framings. The interaction can resemble discussion because the system returns context-sensitive language and can sustain local argumentative structure across multiple turns. This dialogic form can be generative even when the system lacks the social, historical, practical, or experiential position of a human interlocutor.

The phrase *dialogic research partner* should therefore describe a mode of interaction rather than an equivalence between human and machine agency. The system can widen the accessible space of formulations and contrasts; it can externalize partial thoughts quickly and enable repeated interrogation of a draft idea. Yet its responses remain generated through a technical system whose training history, data composition, internal representations, and institutional constraints differ fundamentally from the situated participation described in Section 6.8.

Definition 6.434 (Dialogic AI research interface). A *dialogic AI research interface* is

an AI-mediated interaction in which iterative prompts and responses are used to generate, clarify, challenge, compare, or reorganize research representations without presuming that the machine contribution carries the situated experience, responsibility, or epistemic authority of a human collaborator.

Bender and colleagues' warning concerning fluent language generation is especially relevant to this distinction (Bender et al. 2021). Dialogue can support research precisely because generated language can function as an exploratory object. Its usefulness does not require that every generated sentence be treated as knowledge.

6.27.3 Automated Search and Synthesis

AI can greatly expand the practical scale at which a researcher searches and provisionally synthesizes literature, archives, datasets, code repositories, and other research materials. Search can become semantically broader, multilingual, and more iterative; synthesis can compare large sets of documents, extract recurring concepts, or identify potential disagreement more rapidly than manual reading alone. This changes the allocation of attention described in Section 6.13: researchers can inspect a larger candidate field before deciding where deeper reading is required.

Search abundance, however, does not eliminate selection. It relocates selection into ranking, query construction, retrieval architecture, inclusion criteria, source provenance, and later verification. An AI-generated synthesis can also compress disagreement or erase the distinction between primary and secondary evidence if its source relations are not preserved. The epistemic advantage of automated synthesis therefore depends on whether it increases access while leaving enough provenance for claims to be checked against their sources.

Proposition 6.435 (Source-preserving synthesis). *AI-assisted search and synthesis should preserve sufficient source identity and claim-level provenance for consequential assertions to be reconstructed from the underlying materials rather than accepted from synthesis alone.*

This principle extends the preservation architecture developed in Section 6.23. The faster synthesis becomes, the more important it becomes to preserve the path from compressed representation back to documentary evidence.

6.27.4 Automated Formalization

AI systems can assist formalization by translating verbal hypotheses into equations, logical relations, causal diagrams, code, network representations, optimization problems, or simulation rules. This capacity can lower the cost of exploring several formal representations of the same conceptual structure and can expose ambiguities that remain hidden in prose. It can also enable researchers without deep expertise in a particular formal language to construct provisional models that later receive specialist scrutiny.

Automated formalization inherits the representational cautions of Sections 6.16 and 6.18. A system can produce a mathematically valid formal object that fails to preserve the intended meaning of the source concept. It can introduce closure assumptions, symmetry, independence, stationarity, metric structure, or optimization

criteria that were absent from the original claim. Because fluent code or notation can conceal these shifts, the translation remainder should remain explicit.

Definition 6.436 (AI-assisted formalization). *AI-assisted formalization* is the use of an AI system to propose, construct, or transform a formal representation of a research claim, with explicit comparison between the source concept, the generated formal structure, the assumptions introduced in translation, and the properties left unrepresented.

Automation can accelerate formal exploration. It does not dissolve the need to ask whether the formal object represents the intended research object.

6.27.5 Automated Simulation

AI can participate in simulation at several levels: generating model code, calibrating components, constructing synthetic agents, proposing parameter regimes, accelerating surrogate models, interpreting simulation output, or adaptively exploring large state spaces. The research advantage is not limited to speed. Automated simulation can widen the set of counterfactual configurations practically available for exploration and can reveal regions of parameter or state space that a researcher would not have inspected manually.

The widening of simulation space increases the importance of function-sensitive model judgment. A simulation can show that a represented mechanism is sufficient to generate a pattern under specified conditions, but it does not thereby establish that the mechanism generated the empirical pattern under investigation. Model-generated trajectories can also become so numerous that the problem shifts from generating possibilities to evaluating which possibilities deserve attention.

Proposition 6.437 (Simulation-abundance burden). *As AI increases the feasible number and complexity of simulations, the epistemic burden increasingly shifts toward specification of model purpose, validation, comparison, sensitivity analysis, and judgment concerning which simulated possibilities are materially relevant to the research question.*

The proposition anticipates a recurrent theme of this section: automation can reduce the scarcity of production while increasing the relative scarcity of judgment.

6.27.6 Automated Pattern Discovery

Machine-learning systems can identify statistical, spatial, temporal, textual, network, or multimodal regularities that are difficult to detect through unaided inspection. Such pattern discovery can generate new encounters in the sense developed in Section 6.10. A cluster, anomaly, latent representation, recurring motif, or predictive dependency can become available to inquiry before a substantive interpretation exists.

The discovered pattern should remain distinct from the relation it is later taken to represent and from the generative process that might explain it. Pattern discovery therefore belongs early in the epistemic chain. The system may reveal a candidate regularity, while historical, interpretive, institutional, formal, or causal inquiry determines what the regularity means and whether it supports a stronger relational

claim.

Proposition 6.438 (Pattern-to-relation discipline). *An AI-discovered pattern should enter inquiry first as a candidate regularity whose substantive relational and generative interpretation requires additional warrant appropriate to the claimed object, boundary, scale, and historical context.*

This discipline protects pattern discovery from becoming an automatic ontology.

6.27.7 Automated Generation of Problems

AI systems can generate possible research questions, conjectures, anomalies, comparisons, missing links, and combinations of previously separate literatures. This capability is significant because problem formation was treated in Section 6.13 as part of inquiry rather than a pre-scientific preliminary. Automated problem generation can enlarge the interrogative space available to a research community.

Yet question generation and question worthiness remain different operations. A system can generate thousands of syntactically coherent and technically difficult problems at very low marginal cost. Many may be redundant, historically unimportant, normatively trivial, poorly connected to evidence, or generated from distinctions that matter only within the system's representational habits. The generative abundance of questions therefore increases the importance of the judgment architecture developed in Sections 6.12 and 6.26.

Definition 6.439 (AI-generated research problem). *An AI-generated research problem is a candidate object of inquiry proposed substantially through machine-mediated generation, whose research status remains provisional until its conceptual coherence, evidential accessibility, historical and relational relevance, and potential significance are independently assessed.*

6.27.8 Abundance of Difficult Problems

When problem generation, formal manipulation, literature synthesis, and simulation become inexpensive, research can enter a condition of problem abundance. The limiting resource is no longer the ability to formulate a difficult task. It becomes the capacity to decide which difficult tasks deserve scarce human attention, institutional commitment, verification, preservation, and long-horizon development.

This shift has direct implications for research evaluation. Difficulty has often functioned as an indirect signal of expertise, scarcity, or potential contribution. AI can weaken that association by making some forms of technical difficulty easier to generate and solve while multiplying unresolved tasks elsewhere. The research system can therefore face a paradox: a larger supply of difficult problems can make difficulty itself a less informative signal of significance.

Definition 6.440 (Research problem abundance). *Research problem abundance is a condition in which the feasible generation of technically nontrivial research questions substantially exceeds the available capacity for historically informed, relationally sensitive, normatively responsible, and empirically sustained evaluation of their worth.*

The condition changes what becomes scarce. Attention, taste, problem selection, verification, and institutional memory can become more valuable precisely because generative production has become cheaper.

6.27.9 Difficulty and Research Worth

Section 6.12 separated difficulty from significance. AI-assisted research makes that separation operationally urgent. A machine can increase apparent difficulty through elaborate formalism, large search spaces, long derivations, or combinations of specialized vocabularies. It can also reduce formerly difficult operations to routine generation. Neither direction establishes the worth of the underlying research question.

Research worth is better treated as a multidimensional and revisable judgment concerning what a problem may disclose, connect, preserve, explain, transform, or make possible. Technical difficulty can remain relevant when it reflects genuine barriers to access or proof, but it should not become a surrogate for epistemic, historical, generative, or normative value.

Proposition 6.441 (Difficulty–worth non-substitution). *The technical difficulty of a problem, whether produced by human or AI-assisted inquiry, cannot by itself establish its research worth; assessments of worth require additional judgment concerning significance, evidential relation, historical position, generative potential, and relevant normative conditions.*

This proposition becomes increasingly important as AI changes the cost structure of research production.

6.27.10 Preservation of Aesthetic Judgment

AI can generate many candidate models, proofs, research questions, titles, visualizations, and conceptual combinations. In such an environment, aesthetic judgment remains relevant because researchers often sense coherence, elegance, depth, tension, or generative promise before a complete epistemic evaluation is available. Section 6.12 treated this judgment as an orienting resource rather than a truth criterion. AI abundance strengthens the need for that distinction.

Aesthetic judgment should not be reduced to selecting the most polished machine output. Machine systems can imitate established styles of scientific elegance and thereby amplify dominant taste. Preserving aesthetic judgment therefore includes preserving the capacity to notice unfamiliar forms that initially appear awkward, heterogeneous, or resistant to conventional compression. McAllister’s historical treatment of scientific beauty is useful precisely because standards of elegance can shift with theoretical development (McAllister 1996).

Proposition 6.442 (Aesthetic judgment under generative abundance). *Where AI can generate many formally coherent candidates, aesthetic research judgment should remain historically aware, open to noncanonical forms, and explicitly separated from evidential warrant.*

6.27.11 Preservation of Historical Sensitivity

AI systems can flatten historical sequence when they compress documents into thematic summaries or generate apparently timeless syntheses. Similar language produced in different periods can conceal different institutions, categories, constraints, and feasible alternatives. Historical sensitivity therefore remains indispensable when AI accelerates cross-period comparison.

Preserving historical sensitivity means retaining temporal provenance, category change, sequence dependence, and the difference between later interpretation and earlier possibility structures. A generated synthesis that treats a contemporary concept as if it had the same meaning in an earlier institutional setting can create anachronistic coherence. Historical research should therefore use AI to widen access without allowing compression to erase temporal structure.

Definition 6.443 (Historical sensitivity in AI-assisted research). *Historical sensitivity in AI-assisted research* is the preservation of temporal sequence, historically specific categories, institutional conditions, feasible alternatives, and provenance when AI systems search, compare, summarize, or interpret materials across time.

This definition links AI use to the historical disciplines developed in Sections 6.21 and 6.22.

6.27.12 Preservation of Relational Sensitivity

AI systems often transform complex relational phenomena into representations optimized for retrieval, prediction, classification, or generation. Such representations can be useful while suppressing interaction history, asymmetry, institutional embedding, tacit coordination, or differences among relation types. Relational sensitivity requires the researcher to ask what relations are preserved, what relations are inferred, what relations disappear, and which relation types are being treated as comparable.

This issue is especially important in automated network construction or entity extraction. A co-occurrence edge can be mistaken for social relation; a predicted association can be mistaken for causal dependence; a shared label can conceal unequal power. AI therefore increases the value of the translation discipline established in Section 6.18.

Proposition 6.444 (Relational remainder under AI mediation). *When an AI system translates relational phenomena into computational representations, the inquiry should preserve or document materially relevant relational properties that the target representation omits, aggregates, or reclassifies.*

6.27.13 Preservation of Generative Judgment

Generative judgment concerns whether a relation, configuration, method, question, or intervention may open new capacities, connections, representations, or future possibilities. AI can assist this judgment by producing alternatives and simulating consequences, but it can also encourage shallow novelty: endless recombination can look generative while leaving the underlying research field unchanged.

Preserving generative judgment therefore requires attention to downstream struc-

ture. A candidate idea has generative promise when it can plausibly reorganize later inquiry, make previously inaccessible relations observable, create reusable conceptual or methodological capacity, connect separated domains, or transform the space of feasible questions. Novel wording alone is insufficient.

Definition 6.445 (Generative judgment in AI-assisted research). *Generative judgment in AI-assisted research* is the assessment of whether an AI-generated or AI-mediated research possibility can plausibly expand or transform subsequent epistemic capacities, relational access, methodological resources, theoretical structures, or spaces of inquiry beyond the immediate artifact produced.

The definition preserves generativity as a relational and temporal property rather than a stylistic impression of novelty.

6.27.14 Normative Responsibility for Research Orientation

AI can influence research orientation before any explicit decision is made. Search rankings, suggested questions, generated literature maps, default benchmarks, and available training data can make some problems easier to notice and pursue than others. Research orientation can therefore become partially delegated through infrastructure even when researchers believe they remain fully autonomous.

Normative responsibility requires these orientation effects to remain visible. The research community must still ask whose problems enter the system, which harms and capabilities are represented, what groups remain weakly documented, and what forms of future value are systematically neglected. Fricker's work on epistemic injustice remains relevant because unequal visibility and credibility can be reproduced within machine-mediated research pipelines (Fricker 2007).

Proposition 6.446 (Orientation-responsibility principle). *The use of AI to rank, recommend, generate, or prioritize research possibilities does not transfer normative responsibility for research orientation from researchers and institutions to the system that produced the recommendation.*

AI can broaden the space of options. Responsibility for which options become research commitments remains embedded in human and institutional praxis.

6.27.15 Human Responsibility for Problem Selection

Problem selection is a particularly concentrated site of responsibility because it allocates scarce attention and shapes future research capacity. AI can generate candidate problems rapidly, but the selection of which problem deserves years of human effort, institutional resources, participant involvement, archival preservation, or practical risk remains a judgment with epistemic and normative consequences.

The word *human* here should not imply isolated individual sovereignty. Problem selection is distributed across researchers, communities, funders, participants, institutions, infrastructures, and sometimes public or political processes. The point is that responsibility cannot be discharged by appealing to machine generation alone. A system has no independent standing to justify why one social problem, historical archive, species, community, or theoretical puzzle should receive priority over another.

Proposition 6.447 (Non-delegation of final problem responsibility). *AI may generate, compare, or criticize candidate research problems, while final responsibility for committing consequential research resources to a problem remains within the human and institutional relations capable of giving reasons, receiving contestation, and bearing responsibility for foreseeable consequences.*

6.27.16 AI-Assisted Interpretation

Interpretation is increasingly AI-assisted when models summarize interviews, compare documents, suggest themes, translate languages, propose readings, or generate competing explanations. Such assistance can be valuable because interpretation often benefits from contrast. A machine-generated alternative reading can expose assumptions in the researcher's initial account, especially when it is used as a counterposition rather than as an authority.

Interpretive assistance nevertheless encounters strong limits. Meaning depends on historical context, linguistic nuance, institutional practice, relation to audiences, and sometimes tacit or embodied experience. A system can generate plausible interpretations from textual patterns while lacking access to many of these conditions. Bender and colleagues' distinction between form and grounded meaning therefore remains relevant (Bender et al. 2021).

Proposition 6.448 (AI-assisted interpretive plurality). *AI-generated interpretations are most defensible when treated as candidate readings whose provenance, contextual adequacy, relation to primary materials, and divergence from alternative interpretations remain open to inspection.*

This use positions AI as an amplifier of interpretive plurality rather than a final interpreter.

6.27.17 AI-Assisted Theory Revision

Theory revision can also be assisted by AI. Systems can search for counterexamples, trace inconsistencies across a long manuscript, compare theoretical vocabularies, suggest alternative mechanisms, generate formal consequences, or identify tensions between claims and newly incorporated evidence. Such operations can make revision more continuous and less dependent on the researcher's unaided memory.

The danger is that theory revision becomes optimization for local coherence rather than responsiveness to reality. A language model can make a theory more internally fluent while insulating it from counterevidence, especially when it is asked primarily to repair contradictions rather than diagnose whether a contradiction should remain visible. The iterative-reconstruction architecture of Section 6.19 therefore remains essential.

Definition 6.449 (AI-assisted theory revision). *AI-assisted theory revision* is the use of AI systems to identify, generate, compare, or formalize candidate modifications to a theory while preserving traceability to the evidence, anomalies, competing theories, and historical conditions that motivate revision.

Theory revision is strongest when the system helps expose the reason for change rather than merely producing a smoother replacement text.

6.27.18 AI and the Evolution of Research Methods

AI changes research methods by lowering the cost of operations that previously required specialized labor and by creating new hybrid procedures. Coding, transcription, translation, extraction, classification, visualization, formal proof search, simulation, and literature mapping can become integrated into adaptive workflows. New research objects can also emerge because previously inaccessible corpora or high-dimensional datasets become tractable.

The historical analysis of Section 6.21 suggests that these changes should be understood as methodological evolution rather than simple substitution. Existing methods can be reorganized, extended, or partially displaced. Human expertise may shift from routine execution toward design, verification, interpretation, maintenance, and judgment. At the same time, dependence on AI infrastructure can introduce new forms of opacity and standardization.

Proposition 6.450 (AI-induced methodological redistribution). *As AI automates or accelerates particular research operations, methodological expertise can be redistributed toward problem specification, data and representation design, validation, interpretation, historical contextualization, cross-method correction, and responsibility for downstream use.*

The proposition describes a possible reorganization of research labor rather than an inevitable disappearance of existing expertise.

6.27.19 Epistemic Asymmetry between Researcher and AI

AI-assisted research creates new epistemic asymmetries. A researcher can receive a highly competent output without being able to reconstruct the training process, internal representation, retrieval path, parameter interactions, or institutional choices that produced it. Conversely, the system may process patterns across vast corpora while lacking direct access to the researcher's situated aims, field experience, ethical obligations, tacit knowledge, or responsibility relations.

The asymmetry is therefore multidirectional. Machine scale can exceed human inspection, while human situatedness can exceed machine representation. Burrell's analysis of opacity clarifies one side of this relation, and the Stanford AI Index documents the contemporary concentration of frontier-model development and compute infrastructure in a limited set of industrial actors (Burrell 2016; Stanford Institute for Human-Centered Artificial Intelligence 2026). These conditions make epistemic dependence partly institutional.

Definition 6.451 (Human–AI epistemic asymmetry). *Human–AI epistemic asymmetry is the unequal distribution of access, scale, reconstructability, contextual position, and responsibility between researchers and AI systems participating in the same research process.*

The relevant response is neither complete trust nor complete rejection. It is role-sensitive verification and explicit dependence mapping.

6.27.20 Verification, Contestability, and Audit

AI-assisted research requires verification architectures proportional to the consequence of the machine contribution. Low-stakes brainstorming may require little more than ordinary critical reading. A machine-generated reference, empirical classification, causal claim, code path, or recommendation that materially supports a published conclusion requires stronger reconstruction and checking.

Kroll and colleagues' analysis of accountable algorithms is useful because it shows that consequential computational systems require institutional and technical mechanisms of scrutiny beyond ordinary reliance on a decision maker's explanation (Kroll et al. 2017). Gebru and colleagues similarly show the value of systematic documentation for datasets and their intended uses (Gebru et al. 2021). These insights can be adapted to research workflows.

Definition 6.452 (AI research audit trail). An *AI research audit trail* is a proportionate record of the model or service used, relevant version or configuration where available, input or prompt conditions where materially important, source data or retrieved materials, transformations performed, outputs relied upon, human verification steps, and consequential revisions.

Proposition 6.453 (Consequence-sensitive verification). *The required depth of verification, contestability, and audit should increase with the epistemic centrality, practical consequence, irreversibility, and opacity of the AI-mediated operation.*

This principle prevents verification from becoming either a ritual requirement applied equally to every use or an optional afterthought.

6.27.21 Dependency on AI Research Infrastructure

AI-assisted research depends on infrastructures that include models, compute, cloud services, proprietary APIs, data centers, benchmark ecosystems, dataset pipelines, software libraries, licensing arrangements, and organizational policies. These dependencies can shape which methods are affordable, which languages are well supported, which data remain accessible, and which research institutions can reproduce a result.

Infrastructure dependence also has a temporal dimension. A commercial model can change or disappear; an API can be retired; access conditions can shift; a formerly reproducible result can become difficult to reconstruct. The concentration documented in the AI Index gives these concerns institutional significance (Stanford Institute for Human-Centered Artificial Intelligence 2026). Preservation therefore requires more than saving prompts. It may require recording model identity, version, data interfaces, environment assumptions, and enough intermediate output to enable future reanalysis.

Definition 6.454 (AI research infrastructure dependency). *AI research infrastructure dependency* is the degree to which a research process or claim relies on computational services, models, data pipelines, institutional providers, or technical environments whose continued accessibility and behavior are outside the researcher's direct control.

Infrastructure dependence becomes epistemically relevant when it affects repro-

ducibility, contestability, access equality, or long-term preservation.

6.27.22 Limits of Delegating Research Judgment

The preceding analysis identifies a broad domain of legitimate delegation: search, synthesis, candidate generation, formal manipulation, simulation, pattern detection, and even structured critique can be delegated in part. The boundary becomes more demanding where judgment determines significance, responsibility, interpretation under contested context, acceptable risk, or allocation of scarce attention among heterogeneous values.

This boundary should not be defended through a romantic claim that only unaided human cognition is authentic. Human judgment is itself historically conditioned, institutionally mediated, and fallible. The point is relational responsibility. A research system needs identifiable actors and institutions capable of giving reasons, receiving criticism, revising commitments, and bearing responsibility for consequences. AI outputs can inform those judgments without becoming their final normative ground.

Proposition 6.455 (Delegation limit for consequential research judgment). *Research judgment may be computationally assisted to the extent that reasons, evidence, alternatives, and consequences remain contestable, while final responsibility for consequential significance attribution, problem selection, normative orientation, and irreversible research commitments remains within accountable human and institutional relations.*

The principle is deliberately narrower than a claim that every micro-decision must be manually human. It concerns consequential closure.

6.27.23 Transformation from AI-Assisted Research to AI-Mediated Praxis

AI-assisted research can become AI-mediated praxis when the system moves from performing bounded operations within a human-organized workflow to shaping the relations through which questions, evidence, collaboration, evaluation, publication, and action are organized. The transition can occur gradually. Recommendation systems influence what literature is read; generative systems influence what questions are formulated; automated evaluation influences which projects are funded; agentic systems coordinate research tasks; machine-generated reports influence practical decisions. AI then becomes part of the relational field that produces research orientation itself.

Definition 6.456 (AI-mediated research praxis). *AI-mediated research praxis is a research configuration in which AI systems materially participate in organizing the relations among problem selection, evidence production, interpretation, evaluation, collaboration, resource allocation, or action, such that the research field cannot be adequately described by treating AI as an isolated instrument.*

This transition increases the need for reflexivity. If AI systems help shape the very categories, attention structures, and institutional decisions through which later evidence is produced, the system participates in the generative conditions of research. The relevant questions therefore extend beyond whether individual outputs are correct. Researchers must ask how AI mediation reorganizes who can participate, what

becomes visible, which problems become salient, how authority is distributed, what infrastructures become indispensable, and which future research trajectories are made easier or harder.

Proposition 6.457 (Praxis-transformation threshold for AI mediation). *AI-assisted research approaches AI-mediated praxis when machine systems materially and recurrently shape the relations through which research orientation, evidential production, evaluation, collaboration, or practical closure are organized, rather than merely executing bounded operations selected independently by researchers.*

The proposition provides a transition criterion rather than a fixed technological threshold. The same model can remain a narrow instrument in one project and become infrastructurally mediating in another. This distinction also prepares the next section's analysis of collective and distributed knowledge production: once AI systems participate in the organization of research relations, the unit of inquiry can no longer be the isolated researcher using a tool. It becomes a heterogeneous research collective in which expertise, judgment, memory, and responsibility are distributed across persons, institutions, and technical systems.

6.28 Collective and Distributed Knowledge Production

Section 6.27 concluded by shifting the unit of analysis from an isolated researcher using an AI instrument toward a heterogeneous research collective in which persons, institutions, archives, infrastructures, and computational systems can participate in the organization of inquiry. The present section develops that transition. Its role is to clarify how knowledge production becomes distributed across differentiated relations without presuming that expertise, interpretation, judgment, memory, authority, and responsibility share the same distribution. The objective is to provide a relational account of collective inquiry that can accommodate disciplinary communities, cross-cultural collaboration, institutional memory, and human–AI research configurations while preserving contestability and local accountability. The discussion proceeds through research communities, distributed expertise, interdisciplinary and cross-cultural relations, human–AI collectives, institutional memory, collective interpretation, distributed judgment, distributed responsibility, and the generativity of research communities. The method remains historically situated and function-sensitive: distribution is treated as a property of particular research operations and relations rather than as a single characteristic assigned to a group as a whole.

Collective knowledge production is familiar in the history and sociology of science, yet its implications become sharper under the praxis architecture developed in this chapter. Longino's account of social knowledge emphasizes the epistemic role of criticism, interaction, and transformed background assumptions, while Hutchins demonstrates how cognitive work can be distributed across persons, artifacts, procedures, and organized environments (Longino 1990; Hutchins 1995). GRE draws on these precedents to formulate a narrower proposition. Research communities can become part of the generative conditions of inquiry because they organize access, attention, question formation, interpretation, memory, criticism, and the circulation of provisional judgments. Their epistemic importance therefore extends beyond the aggrega-

tion of individually produced findings.

Definition 6.458 (Distributed knowledge production). *Distributed knowledge production* is a research configuration in which materially relevant epistemic functions are performed across differentiated persons, groups, institutions, artifacts, infrastructures, or computational systems, such that the resulting inquiry depends on relations among these contributions.

Definition 6.458 leaves open how wide the distribution is and which functions are distributed. A project can distribute observation while centralizing interpretation; distribute interpretation while centralizing authorization; or distribute computation while concentrating responsibility within a small institutional node. The analytical task is therefore to identify the functions, relations, asymmetries, and closure procedures through which the collective operates.

6.28.1 Research Communities

Research communities provide durable relational environments in which questions acquire salience, methods become intelligible, standards of evidence are learned, criticism becomes routinized, and findings enter shared histories. A community can take many forms: a disciplinary field, laboratory, archive network, professional association, distributed open-source project, Indigenous or local knowledge community, interdisciplinary consortium, policy-research organization, or a more temporary collaboration organized around a problem. The relevant feature is sustained relational organization around inquiry rather than formal institutional status alone.

The community participates in research before publication. Training shapes what a researcher notices; shared vocabularies make some distinctions readily expressible; canonical problems influence which questions appear serious; instruments and infrastructures delimit available forms of observation; and peer expectations affect the form in which uncertainty is presented. Section 6.26 described the historical formation of practical taste. Research communities are among the environments through which such taste is reproduced, contested, and revised.

Definition 6.459 (Research community). A *research community* is a relatively persistent relational configuration through which participants share, contest, transmit, or transform epistemic resources, research practices, evaluative expectations, records, questions, and interpretive repertoires.

A community can increase epistemic capacity by widening access to criticism and by preserving knowledge that exceeds one researcher's memory. It can also narrow inquiry when reputational incentives, methodological uniformity, linguistic closure, or inherited categories make some observations difficult to articulate or some questions costly to pursue. Longino's account of critical interaction is useful here because objectivity can be strengthened when criticism has recognized channels of uptake and when relevant perspectives can enter the process (Longino 1990).

The GR perspective adds a generative question: what kinds of future inquiry does a research community make easier to initiate? A community that preserves methods, data, conceptual distinctions, failed attempts, and disagreements can expand the option space available to later researchers. A community that compresses its history

into a small set of canonical conclusions can create coordination while reducing reconstructability. The epistemic evaluation of a community therefore concerns both current output and the conditions it generates for subsequent inquiry.

Proposition 6.460 (Community-conditioned inquiry). *Where a research community materially shapes access, problem salience, methodological availability, criticism, or preservation, those relations should be treated as part of the conditions through which the resulting knowledge claim was produced and remains revisable.*

This proposition does not assign a uniform causal role to community membership. Its scope is limited to relations that materially affect the inquiry under examination.

6.28.2 Distributed Expertise

Collective inquiry often depends on expertise that differs in object, scale, medium, and form. Statistical expertise, field familiarity, archival knowledge, experimental technique, software maintenance, linguistic competence, historical contextualization, legal interpretation, participant experience, instrumentation knowledge, and normative analysis can enter the same project without becoming interchangeable. Their distribution creates both productive complementarity and dependence.

Hutchins's analysis of distributed cognition is a useful precedent because it shows that competent performance can emerge through coordination among persons, artifacts, and procedures even where the relevant cognitive work is not located within a single individual (Hutchins 1995). In research praxis, a similar distribution can occur while preserving stronger distinctions among epistemic roles. A technician can know how an instrument behaves under unusual conditions; a participant can know how an institutional rule is actually encountered; a statistician can identify inferential instability; a historian can recognize that a seemingly stable category changed meaning across periods. The project can depend on each form of expertise while keeping its authority local to the relations in which that competence is relevant.

Definition 6.461 (Expertise distribution profile). *An expertise distribution profile is the project-relative mapping of which actors or systems possess materially relevant capacities for observation, interpretation, formalization, contextualization, verification, maintenance, judgment, or action, together with the dependencies among those capacities.*

The profile is more informative than a generic division between experts and non-experts. Expertise can be deep but local. It can be tacit, experiential, formal, infrastructural, or institutionally certified. Some forms are easier to articulate and audit than others. A collective therefore needs translation relations capable of moving relevant information across expertise boundaries without silently converting local competence into general authority.

Distributed expertise also changes vulnerability. A project can become fragile when one obscure software component, one language specialist, one archive custodian, or one institutional broker carries a function that is poorly documented elsewhere. Conversely, redundancy can increase resilience while raising coordination cost. The relevant design problem is to identify dependencies that materially affect reconstructability, continuity, or interpretation.

Proposition 6.462 (Locality of expertise). *Epistemic authority derived from expertise should be indexed to the domain, operation, evidence, or relation in which the relevant competence is demonstrated, with broader authority requiring additional justification.*

This locality principle protects distributed inquiry from two opposite errors: ignoring specialized competence and allowing specialized competence to expand silently into authority over unrelated judgments.

6.28.3 Interdisciplinary Relations

Interdisciplinary research places heterogeneous conceptual systems, methods, evidential standards, and objects into sustained relation. Its difficulty extends beyond coordination among specialists. Disciplines can organize reality differently: they may define different entities, use different temporal scales, assign different meanings to explanation, and recognize different forms of evidence. Section 6.18 treated translation across methodological representations as an epistemic operation with a remainder. Interdisciplinary collaboration generalizes that problem from methods within a project to partially distinct traditions of inquiry.

A productive interdisciplinary relation therefore requires more than exchanging conclusions. Participants often need to expose assumptions that remain tacit within their home disciplines. A term such as *institution*, *agency*, *value*, *state*, *network*, *field*, or *causation* can carry different inferential commitments across disciplines. Apparent agreement can conceal divergent meanings, while apparent disagreement can arise from differences in scale, object, or representation.

Definition 6.463 (Interdisciplinary translation relation). An *interdisciplinary translation relation* is a documented mapping through which concepts, evidence, methods, or claims from one disciplinary configuration are rendered usable within another while preserving the material differences, assumptions, and residual meanings that remain relevant to interpretation.

Translation can generate new objects of inquiry. A legal category interpreted through historical research may reveal the institutional conditions of its emergence; a dynamical model confronted with ethnographic evidence may expose a missing state distinction; a political-economic account brought into relation with ecological data may change the scale at which a resource process is understood. These gains arise from relational friction as much as from synthesis.

For this reason, interdisciplinary disagreement can be epistemically productive. A method that appears decisive within one disciplinary representation may become partial when another discipline reveals a different causal pathway or historical boundary. The collective should therefore preserve enough disciplinary provenance to reconstruct how a concept or claim changed during translation.

Remark 6.464 (Interdisciplinary remainder). Successful interdisciplinary collaboration can produce locally adequate shared concepts while leaving parts of the participating disciplinary meanings untranslated. Recording such remainders can protect later researchers from treating operational convergence as complete theoretical identity.

The aim is a relation capable of learning across difference while preserving enough

difference for mutual correction to remain possible.

6.28.4 Cross-Cultural Knowledge Production

Cross-cultural knowledge production intensifies the problems of translation, situatedness, and unequal epistemic power. Languages, institutions, historical experiences, practical categories, and conventions of evidence can differ across research settings. A concept developed in one context can become misleading when transferred without attention to the relations through which it acquired meaning. Likewise, a locally generated category can be made invisible when publication, funding, indexing, or evaluation systems recognize only the vocabulary of a dominant research center.

Section 6.25 treated unequal evidential resources and representational authority as problems of epistemic justice. Fricker's account of testimonial and hermeneutical injustice provides a relevant precedent for analyzing credibility deficits and unequal participation in the practices through which shared understanding becomes possible (Fricker 2007). In cross-cultural research, the question extends to who has authority to name the object, select the comparison category, translate testimony, determine what counts as context, and decide when interpretation is complete.

Definition 6.465 (Cross-cultural epistemic relation). *A cross-cultural epistemic relation is a research relation in which materially relevant meanings, categories, evidential practices, or interpretive authorities are distributed across cultural, linguistic, historical, or institutional contexts that need not be presumed to share a complete conceptual frame.*

A responsible relation can preserve local categories long enough for their inferential and practical roles to become intelligible before translation into a shared analytical vocabulary. It can also distinguish translation for coordination from translation as a claim of equivalence. The same English term can carry substantially different local histories, and two different local terms can occasionally support similar practical distinctions without becoming semantically identical.

Cross-cultural collaboration also expands the encounter surface of research. Researchers situated in different environments encounter different anomalies, institutional frictions, sensory arrangements, archives, ordinary practices, and forms of tacit knowledge. This diversity can enlarge the set of contingent encounters from which research questions emerge. Its value depends partly on whether the collective has channels through which unfamiliar observations can become salient before dominant categories classify them as irrelevant.

Proposition 6.466 (Plural access in cross-cultural inquiry). *Where materially different cultural or linguistic positions provide distinct access to a research object, a collective should preserve the provenance of those access relations and provide routes through which locally grounded interpretations can challenge the shared analytical frame.*

The proposition concerns epistemic access rather than an assumption that cultural positions are internally uniform or automatically authoritative. Local interpretation remains open to evidence, disagreement, and revision.

6.28.5 Human–AI Research Collectives

Section 6.27 developed the transition from bounded AI assistance to AI-mediated research praxis. Collective analysis makes that transition more explicit. AI systems can occupy different functional positions within a research collective: retrieval interface, coding assistant, simulation engine, translation system, pattern detector, drafting partner, critique generator, orchestration layer, or agent that coordinates other tools. Their epistemic significance depends on the relations through which these functions are connected to evidence, verification, interpretation, and institutional decision.

A human–AI research collective therefore differs from a researcher who occasionally consults a tool. Machine outputs can circulate among team members, influence what evidence is inspected, determine which anomalies receive attention, structure project memory, or become inputs to later machine operations. Once these feedback relations become recurrent, the AI contribution can shape the collective’s trajectory even where individual machine outputs remain candidate contributions without functioning as authoritative conclusions.

Definition 6.467 (Human–AI research collective). *A human–AI research collective is a research configuration in which human participants, AI systems, institutions, data resources, and technical infrastructures perform interdependent epistemic functions whose coordination materially shapes the trajectory or products of inquiry.*

The definition is functional and relational. It does not require treating AI systems as equivalent to human researchers in agency, experience, moral standing, or responsibility. It records their participation in a knowledge-producing configuration where that participation materially affects the research process.

Human–AI collectives can expand productive capacity and increase the diversity of candidate interpretations. They can also create recursive dependence. Machine-generated summaries can shape human attention; human selections can become prompts for further generation; generated classifications can alter the dataset inspected next; and AI-mediated evaluation can influence which research directions receive resources. The audit and infrastructure-dependency principles of Section 6.27 therefore become collective properties rather than individual workflow concerns.

A further issue concerns heterogeneity of access. Members of a research team may have unequal ability to inspect model behavior, underlying data, system settings, or commercial infrastructure. The collective can therefore contain internal epistemic asymmetries in addition to the human–AI asymmetry already defined in Section 6.27. A transparent role map can help identify which members can verify which operations and where the project depends on opaque external services.

Proposition 6.468 (Role-explicit human–AI collaboration). *Where AI systems materially shape research orientation, evidence processing, interpretation, evaluation, or closure, the collective should keep their functional roles, verification pathways, infrastructure dependencies, and accountable human or institutional decision points sufficiently explicit for reconstruction and contestation.*

This proposition preserves the possibility of extensive machine contribution while keeping epistemic and normative closure connected to accountable relations.

6.28.6 Institutional Memory

Collective knowledge production extends across time. Laboratories, archives, journals, professional communities, research infrastructures, public institutions, and long-running collaborations carry records that allow later inquiry to inherit more than the current members' personal memories. Institutional memory includes formal repositories and tacit practices: datasets, notebooks, version histories, correspondence, methodological conventions, maintenance knowledge, unresolved disputes, negative results, calibration practices, and remembered reasons for earlier decisions.

Section 6.23 treated evidence preservation as infrastructure for future re-epistemization. Institutional memory is the collective counterpart of that argument. Preservation becomes generative when it allows later researchers to reconstruct earlier evidence and also to understand how a research community arrived at particular categories, methods, or closures. Knowledge commons research offers a useful institutional precedent for treating knowledge resources as objects of collective governance involving access, preservation, enclosure, and stewardship (Hess and Ostrom 2007). Peer-production research likewise shows that durable knowledge production can depend on architectures for coordinating distributed contributions (Benkler 2002).

Definition 6.469 (Institutional epistemic memory). *Institutional epistemic memory* is the organized persistence of records, practices, provenance, contextual knowledge, and reconstructive capacity through which a research collective can retain or recover materially relevant features of earlier inquiry across changes in personnel, technology, or institutional form.

Memory quality depends on more than volume. A repository can preserve large quantities of data while losing the context required to interpret them. Conversely, a concise decision record can retain crucial information about why one model was rejected, why a category was revised, or why a measurement procedure became unreliable. Institutional memory therefore benefits from selective structure: provenance, dependencies, alternative interpretations, failure records, and context can have high future option value even when they were peripheral to the publication produced at the time.

Institutional forgetting can occasionally be functional. Privacy obligations, legal requirements, security concerns, and maintenance costs can justify deletion or access restriction. The key analytical question is whether the collective understands which future reconstructive capacities are being relinquished when records disappear.

Proposition 6.470 (Memory as future research capacity). *Where preserved records or practices materially affect the ability of later researchers to reconstruct, challenge, reinterpret, or extend earlier inquiry, institutional memory should be treated as part of the collective's future research capacity.*

This framing links preservation to generativity: memory is valuable partly because it changes what later inquiry can become.

6.28.7 Collective Interpretation

Interpretation in a collective can draw on perspectives that differ in expertise, position, language, experience, and theoretical commitment. This plurality can reveal assumptions that remain invisible within a single interpretive standpoint. It can also generate persistent disagreement. The relevant research task is therefore to organize interpretation so that plurality becomes inspectable and corrigible rather than being compressed prematurely into a consensus statement.

Longino's emphasis on transformative criticism is again relevant because critical interaction can alter background assumptions and improve the conditions of objectivity (Longino 1990). The GRE formulation places additional emphasis on provenance and trajectory. An interpretation can change as it passes through different participants. A field observation can be redescribed in disciplinary vocabulary, recoded as a variable, compared with archival evidence, summarized by AI, and incorporated into a theoretical narrative. Each transformation can add insight while also changing what remains visible.

Definition 6.471 (Collective interpretation trajectory). *A collective interpretation trajectory is the sequence of materially relevant interpretive transformations through which observations, records, representations, or claims are redescribed, compared, contested, synthesized, or revised across participants in a research collective.*

Exhaustive recording of conversational moves would rarely be proportionate. Consequential transformations deserve greater attention: reclassification of evidence, rejection of a competing interpretation, translation of a local concept into a general category, or machine synthesis that materially changes the direction of inquiry. The purpose is reconstructability rather than exhaustive surveillance of collaboration.

Collective interpretation also benefits from preserving minority readings when the disagreement concerns uncertain evidence, heterogeneous contexts, or distinct scales. Consensus can be useful for action or publication, yet it can conceal unresolved structure. A later finding may vindicate an interpretation that appeared weak under earlier evidence. Preserving the basis of disagreement can therefore provide future epistemic option value.

Proposition 6.472 (Interpretive plurality preservation). *Where competing interpretations remain materially plausible and their difference affects later inference, a research collective should preserve the principal alternatives and the evidential or conceptual basis of their disagreement until sufficient grounds for stronger closure emerge.*

The proposition permits interpretations to receive different weight in proportion to their support while preserving enough differentiation to keep uncertainty and disagreement visible at the level relevant to later reconstruction.

6.28.8 Distributed Judgment

Judgment can be distributed without becoming reducible to voting or numerical aggregation. Research collectives make judgments about significance, methodological adequacy, evidential sufficiency, aesthetic promise, ethical acceptability, practical relevance, and readiness for closure. Different participants can be better positioned to judge different dimensions. The difficulty lies in coordinating these judgments

when they conflict and when the authority to decide is itself unequally distributed.

Section 6.26 distinguished aesthetic, epistemic, normative, and practical judgment. Collective inquiry adds a second dimension: each judgment form can be distributed across different actors. A statistician may assess inferential robustness; a field researcher may evaluate contextual adequacy; affected participants may identify harms invisible to the analytical team; a principal investigator may control publication; an ethics body may constrain permissible procedures; an AI system may generate candidate evaluations without bearing responsibility for closure.

Definition 6.473 (Distributed judgment configuration). *A distributed judgment configuration is the project-relative arrangement through which different actors or systems contribute to aesthetic, epistemic, normative, practical, or institutional evaluations and through which those evaluations are compared, weighted, contested, or brought to provisional closure.*

A defensible configuration makes the basis of authority visible. Authority can derive from demonstrated expertise, direct exposure to consequences, formal responsibility, methodological competence, legal mandate, or other relevant relations. These bases need not coincide. A project can therefore benefit from distinguishing who contributes a judgment from who has the institutional power to close the decision.

Collective judgment also raises the problem of aggregation. Averaging can be appropriate for some measurements or probabilistic assessments. It becomes less informative when judgments concern heterogeneous values or incompatible interpretations. Deliberation, staged review, role-specific vetoes, explicit dissent, or conditional decisions can preserve structure that a single score would erase.

Proposition 6.474 (Function-sensitive judgment allocation). *The weight assigned to a participant's judgment should be related to the relevant epistemic, experiential, normative, or institutional relation for the decision at issue, with the basis of that weight remaining open to contestation where consequences are substantial.*

The proposition avoids a general hierarchy of participants. Judgment authority is indexed to function and consequence.

6.28.9 Distributed Responsibility

Distributed research can produce a familiar ethical danger: responsibility becomes harder to locate as contributions multiply. Data may be collected by one team, processed by another, modeled by a third, interpreted through AI services, approved by an institution, and communicated by authors who did not directly inspect the full sequence of transformations. The resulting product can be genuinely collective while the consequences still require identifiable relations of accountability.

Responsibility therefore needs its own distribution map. Epistemic responsibility concerns verification, accurate representation, disclosure of uncertainty, and correction. Normative responsibility concerns treatment of participants, distribution of risks and benefits, and foreseeable consequences. Institutional responsibility concerns governance, infrastructure, access, authorization, and procedures for responding to failure. These forms overlap, yet their overlap does not imply that responsibility is evenly shared.

Definition 6.475 (Responsibility distribution map). A *responsibility distribution map* identifies the actors and institutions that hold materially relevant duties of verification, authorization, care, disclosure, correction, preservation, or consequence management within a research collective, together with the relations through which those duties can be exercised and reviewed.

Human–AI collectives make this especially important. AI systems can participate in causal and epistemic pathways while lacking the institutional position through which research communities presently assign many forms of answerability. Responsibility therefore tends to remain concentrated in the human and institutional relations that choose systems, configure tasks, accept outputs, authorize conclusions, publish results, or deploy downstream actions. The exact distribution depends on the research configuration and on applicable institutional or legal arrangements.

Diffusion of labor can also obscure the ability to correct. A researcher who discovers a serious error may lack authority to retract a dataset; a platform provider may control access to a model needed for reproduction; a journal may control correction procedures; participants affected by a representation may lack a route to contest it. Accountability therefore requires pathways as well as named roles.

Proposition 6.476 (Responsibility retention under distributed production). *As the number or heterogeneity of contributors expands, the traceability of consequential research responsibilities should remain visible. Where responsibility is shared, the collective should preserve identifiable duties and correction pathways proportionate to the consequences of the relevant research operation.*

This principle supports collective production while resisting responsibility evaporation through complexity.

6.28.10 Generativity of Research Communities

The preceding analysis allows research communities to be evaluated as generative structures. A community produces findings, yet it can also generate researchers, vocabularies, methods, infrastructures, habits of criticism, standards of judgment, archives, collaborations, and future questions. These outputs alter the conditions under which later research becomes possible. The generativity of a research community therefore concerns the trajectories it enables as well as the conclusions it currently produces.

Definition 6.477 (Generativity of a research community). The *generativity of a research community* is its capacity, within specified historical and institutional conditions, to create, preserve, transform, or widen the relational conditions through which future inquiry, criticism, learning, question formation, collaboration, and responsible revision can occur.

Generativity includes the preservation of difference. A community with multiple methodological traditions can possess a larger repertoire for correcting local failures. Cross-cultural collaboration can widen the field of encounter. Institutional memory can make earlier evidence available for re-epistemization. Human–AI systems can increase productive and exploratory capacity. Distributed expertise can make previously inaccessible objects tractable. These capacities become most valuable when the

relations among them remain sufficiently open for unexpected observations to alter research orientation.

This point returns to the account of encounter, salience, and judgment developed in Sections 6.10–6.13 and to the AI-era problem of research abundance in Section 6.27. As generative systems make it easier to produce candidate texts, models, hypotheses, simulations, and even candidate research questions, the research community faces a different scarcity structure. Attention, orientation, historical sensitivity, verification, and the capacity to recognize a promising encounter can become relatively more important.

Contingent encounter acquires particular significance within this structure. A field visit, archival fragment, anomalous measurement, conversation, unfamiliar cultural practice, ecological event, technical failure, or unexpected juxtaposition can introduce a relation that was absent from the collective's current model of the problem. Such encounters do not carry their research value automatically. They become generative when researchers recognize a possible significance and allow the encounter to reorganize inquiry.

Aesthetic judgment can participate in this recognition. A researcher may experience an encounter as strange, elegant, dissonant, unexpectedly coherent, or difficult to ignore before a full epistemic justification is available. Section 6.26 distinguished this orienting role from later evidential warrant. Under conditions of AI-mediated abundance, that distinction becomes increasingly consequential. Machine systems can expand the number of internally generated possibilities, while contingent encounters can bring the collective into relation with phenomena, contexts, or combinations that were not selected by its existing symbolic and computational trajectory.

Proposition 6.478 (Contingency-sensitive research generativity). *A research community can increase its generative capacity by maintaining recurrent opportunities for contact with contingent observations, heterogeneous environments, unfamiliar interpretations, and unexpected failures, together with judgment practices capable of recognizing potentially significant encounters before their value is fully formalized.*

The proposition assigns novelty, surprise, and aesthetic attraction an orienting role upstream of evidential evaluation. Research worth remains to be established through the subsequent inquiry through which worthwhile questions can become visible and testable. Subsequent investigation still bears the burden of evidence, interpretation, comparison, and revision.

This insight suggests that AI-rich research environments benefit from deliberate openness to encounters outside the immediate generative loop of models and already formalized corpora. Fieldwork, archives, direct observation, interdisciplinary exchange, cross-cultural collaboration, experimental practice, engagement with affected communities, and sustained attention to anomalies can expose the collective to contingencies that are difficult to specify in advance. The practical form will differ across research domains, and some fields encounter contingency primarily through instruments, proofs, simulations, or archival evidence rather than physical travel. The common structure is exposure to relations whose significance has not already been settled by the research system's present categories.

Remark 6.479 (Aesthetic judgment under research abundance). As the cost of gener-

ating plausible research possibilities declines, aesthetic judgment can become more important as an orienting capacity for deciding which contingent encounters and candidate questions deserve sustained attention. Its role remains preparatory and revisable: aesthetic attraction can open an inquiry without functioning as evidence for the truth of its eventual conclusions.

The generative community therefore combines production with exposure, memory with openness, expertise with translation, and judgment with contestability. Publication volume or internal coherence alone provides an incomplete basis for evaluating its quality. A highly productive collective can still narrow future inquiry if it homogenizes methods, obscures provenance, concentrates interpretive authority, or closes itself to contingent evidence. A slower community can preserve valuable option space if it sustains heterogeneity, reconstructability, and responsible disagreement. Evaluation should therefore remain sensitive to the kinds of future research relations a community produces.

Proposition 6.480 (Collective generativity and future option space). *When evaluating a research collective as a generative structure, relevant considerations can include its capacity to preserve reconstructability, support heterogeneous expertise, enable criticism, encounter unanticipated evidence, cultivate revisable judgment, and create viable pathways for future inquiry beyond its current outputs.*

Collective and distributed knowledge production thus extends the praxis framework from individual research conduct to the organization of epistemic relations. Expertise, memory, interpretation, judgment, and responsibility can be distributed in different ways, and their distributions can evolve historically as institutions and technologies change. Research communities become generative when they coordinate these functions while retaining enough plurality, provenance, and openness for correction and new question formation. The next section turns from the collective that produces knowledge to one of its central products: theory itself. Once theories circulate through communities, infrastructures, representations, and revisions, they can be examined as generative relational objects with their own histories of stabilization, transformation, and re-entry into subsequent inquiry.

6.29 Theory as a Generative Relational Object

Section 6.28 treated knowledge production as a distributed praxis in which research communities, institutions, infrastructures, persons, and computational systems participate in differentiated epistemic functions. The present section turns from those productive relations to one of their central products: theory. Its role is to examine theory simultaneously as an epistemic construction oriented toward explanation and as a historically generated object whose concepts, relations, uses, and conditions of persistence can themselves be studied. The objective is to clarify how theories emerge, stabilize, condition inquiry, encounter evidence, compete, hybridize, dissolve, and sometimes re-enter later research under changed conditions. The discussion proceeds from historical generation and community relations through evidence, method, observation, theory change, competition, hybridization, dissolution, re-emergence, and the revisability of GR. The method remains relational and historically restrained. Treating a theory as historically generated does not settle the truth of its propositions, while evaluating its propositions does not remove the historical relations through which the theory becomes available for evaluation.

This dual perspective is important for GRE because a theory can participate in later inquiry after its initial formulation. It can make distinctions available, organize observations, stabilize vocabularies, suggest mechanisms, define anomalies, orient methods, and provide forms through which evidence becomes comparable. A theory can therefore possess generative effects within research praxis even when later inquiry revises substantial parts of it. Kuhn's historical account of scientific change, Longino's account of socially organized criticism, and the Duhem–Quine tradition concerning the relation between evidence and wider systems of assumptions each provide precedents for examining theory within broader epistemic configurations (Kuhn 1962; Longino 1990; Duhem 1954; Quine 1951). GRE adopts these precedents selectively and keeps the present claim narrower: theories can be analyzed as relational objects whose epistemic standing and historical trajectory remain distinct but interacting dimensions.

Definition 6.481 (Generative relational theory object). A *generative relational theory object* is a historically situated configuration of concepts, propositions, explanatory relations, scope conditions, representations, and inferential commitments that participates in inquiry and can alter the conditions under which later questions, observations, comparisons, methods, and revisions become possible.

Definition 6.481 assigns generativity to the theory's participation in later research rather than to its truth by definition. A theory can generate productive questions while containing errors. It can remain locally useful while losing broader explanatory authority. It can also be historically influential while later evidence undermines its central propositions. These possibilities motivate a layered analysis of theory rather than a single measure of theoretical success.

6.29.1 Theories as Historically Generated Objects

Theories enter research at particular historical moments. Their vocabularies depend on available languages of description; their formal structures depend on mathemat-

ical and computational resources; their objects can depend on instruments, classifications, archives, and institutions; and their questions are influenced by the problems that research communities learn to recognize. Historical generation therefore concerns the conditions under which a theoretical configuration becomes thinkable, expressible, investigable, and transmissible.

Historical generation should be distinguished from historical determination. A theory can arise under specific conditions without being exhausted by those conditions. Later researchers can evaluate its arguments, reconstruct its evidence, transfer parts of its conceptual architecture, or discover applications that were not anticipated in its original setting. Hacking's work on historical ontology is useful here because it shows how concepts, classifications, and styles of reasoning can have histories through which objects of inquiry become available in particular forms (Hacking 2002). The present framework extends that sensitivity to theories while preserving a separate question concerning whether the relations posited by a theory are adequately supported.

Definition 6.482 (Theory formation configuration). *A theory formation configuration is the historically specific set of conceptual, evidential, methodological, institutional, technical, and communicative relations through which a theoretical structure becomes formulable and gains a position within research praxis.*

A formation configuration can include inherited concepts, unresolved anomalies, newly available observations, disciplinary disputes, methodological innovations, political or institutional problems, changes in instrumentation, and encounters with neighboring fields. The relative importance of these relations differs across cases. The concept is intended to make such dependencies inspectable without requiring a single historical cause for theoretical emergence.

Historical analysis also helps distinguish the persistence of a proposition from the persistence of the theoretical structure that once contained it. A mechanism, formal relation, or conceptual distinction can survive after the surrounding theory changes. Conversely, a theory name can persist while its internal commitments change substantially. The history of theory therefore benefits from version-sensitive description.

Proposition 6.483 (Historical traceability of theory formation). *Where the historical conditions of theory formation materially affect the meaning, scope, evidential basis, or later interpretation of a theory, those conditions should remain recoverable in accounts of its development and use.*

This principle supports later re-epistemization. A theory inherited without its formation history can appear more timeless, internally unified, or context-independent than its evidential trajectory warrants.

6.29.2 Theories within Research Communities

A theory becomes research-active through communities that teach, criticize, apply, formalize, translate, preserve, and revise it. Section 6.28 described research communities as relational configurations rather than containers of individual researchers. Theories participate in those configurations by offering shared objects around which disagreement and coordination can occur.

Community uptake can stabilize a theory. Textbooks compress arguments into teachable forms; canonical examples establish expected applications; software libraries encode model families; citation networks preserve particular formulations; journals and conferences create venues in which theory-specific questions are recognized; and training transmits tacit expectations about what counts as a legitimate extension. Stabilization can increase cumulative capacity because researchers can work from common distinctions without reconstructing the entire theory during each inquiry. It can also hide unresolved assumptions when the stabilized form becomes easier to reproduce than to interrogate.

Definition 6.484 (Theory–community relation). *A theory–community relation is a historically situated relation through which a research community preserves, teaches, applies, contests, translates, authorizes, or revises a theoretical configuration.*

The relation can vary within the same community. Some participants may treat a theory as a working framework, others as an object of criticism, others as a source of isolated methods, and others as part of disciplinary history. This plurality matters because a theory can remain generative even after consensus around its strongest formulation declines.

Longino’s account of critical interaction suggests that the epistemic quality of a research community depends partly on the availability and uptake of criticism (Longino 1990). Applied to theory, this implies that preservation and criticism should remain connected. A theory protected from criticism can retain institutional presence while losing epistemic responsiveness; a theory discarded without reconstructable criticism can deprive later researchers of the evidence needed to understand why the change occurred.

Proposition 6.485 (Community-mediated theoretical continuity). *The continuity of a theory within research praxis can depend on community relations that preserve its concepts, evidence, criticisms, and revision history; the epistemic value of that continuity increases when preservation remains compatible with contestability.*

The proposition treats continuity as a research resource rather than as evidence of correctness. Longevity can reflect explanatory usefulness, institutional reproduction, pedagogical convenience, unresolved alternatives, or several of these relations together.

6.29.3 Relations among Theory, Evidence, and Method

Theory, evidence, and method interact recursively. Theories can suggest what evidence would be informative; methods shape which evidence can be produced; evidence can support, differentiate, qualify, or challenge theoretical claims; and theoretical change can alter the interpretation of earlier observations. This interaction complicates a picture in which evidence enters a theory from an epistemically neutral exterior.

Duhem’s analysis of physical theory and Quine’s later holist argument provide important precedents for recognizing that empirical testing often engages wider networks of assumptions rather than isolated statements (Duhem 1954; Quine 1951). GRE does not require a strong global holism. A more modest methodological con-

sequence is sufficient: when evidence appears inconsistent with a theoretical prediction, inquiry may need to examine the theory together with relevant measurement procedures, auxiliary assumptions, classifications, background models, and boundary conditions.

Definition 6.486 (Theory–evidence–method configuration). A *theory–evidence–method configuration* is the research-specific relational arrangement through which theoretical propositions, evidential records, and procedures of observation or analysis jointly participate in the production and evaluation of a knowledge claim.

The configuration is claim-relative. An auxiliary assumption that matters for one test may be irrelevant to another. A measurement instrument can be central to one evidential pathway and peripheral to a historical reconstruction. This locality helps avoid transforming holism into an unrestricted claim that the elements of a knowledge system are equally implicated across evaluations.

The relation is also temporally structured. A theory can motivate a method that produces new evidence; that evidence can reveal a limitation in the method; the revised method can produce a different evidential record; and the theory may then be reformulated. Section 6.19 described such processes as iterative reconstruction. Theory becomes generative within that cycle because it can reorganize later evidential and methodological possibilities even while remaining vulnerable to them.

Proposition 6.487 (Configuration-sensitive theory evaluation). *Where the support or failure of a theoretical claim materially depends on auxiliary assumptions, measurement relations, classification choices, or methodological procedures, evaluation should identify those dependencies before attributing the evidential result to the theory alone.*

This principle does not protect theories from criticism. It clarifies the object of criticism so that revision can target the relations through which the evidential tension was produced.

6.29.4 Theories as Conditions of Observation

Theories can shape observation by directing attention, supplying categories, defining expected contrasts, specifying relevant scales, and making some anomalies recognizable. A researcher trained in one theoretical tradition may notice a relation that remains background noise within another. Theory can therefore participate upstream of explicit explanation.

The influence of theory on observation should remain scoped. Observation can surprise the theory that helped organize it. Instruments can register patterns that researchers did not expect. Field encounters can disclose categories that the initial framework handled poorly. Participants can contest the vocabulary through which researchers interpreted their experience. Historical records can force a distinction absent from the original theory. These possibilities preserve the epistemic significance of contingent encounter developed in Sections 6.10–6.13 and Section 6.28.

Definition 6.488 (Observational conditioning by theory). *Observational conditioning by theory* is the influence of a theoretical configuration on the categories, scales, contrasts, expectations, or salience structures through which researchers organize an encounter with potential evidence.

Conditioning differs from determination. The concept allows theory to influence what is easy to notice without implying that observation can only reproduce prior theoretical commitments. The difference is especially important for a generative relational approach because unexpected relations can enter inquiry through environments, instruments, archives, other communities, and forms of experience that exceed the theory's current organization.

Kuhn's account of paradigms and normal science shows how theoretical commitments can structure recognized problems and puzzle-solving practices (Kuhn 1962). The present framework uses that insight while preserving a stronger role for cross-method correction, contingent encounter, and distributed interpretation. A research community can reduce theoretical closure by maintaining relations through which observations that resist current categories can remain visible long enough to be investigated.

Proposition 6.489 (Observation-opening principle). *A theory contributes to generative inquiry when it organizes observation while preserving practical pathways through which anomalous, contingent, or differently interpreted evidence can become available for criticism and revision.*

The proposition makes openness a property of research relations rather than a psychological virtue attributed to an individual researcher.

6.29.5 Theory Change

Theory change can occur through gradual adjustment, differentiation of scope, reorganization of mechanisms, conceptual replacement, altered formal structure, or more substantial changes in the relations through which a research community interprets its object. A single vocabulary such as "revision" can conceal these different trajectories. The analytical task is therefore to identify what changes and what remains continuous.

Section 6.19 defined theory revision as a change in propositions, mechanisms, scope conditions, conceptual architecture, or explanatory relations. The present subsection adds a historical dimension. A theory can change through a sequence of versions whose relation is neither identity nor total replacement. Later formulations can retain some mechanisms, abandon others, reinterpret earlier evidence, and alter the boundaries within which previous claims remain meaningful.

Definition 6.490 (Theory transition). *A theory transition is a historically located change between theoretical configurations in which at least one materially relevant proposition, concept, explanatory relation, scope condition, or representational structure is revised, replaced, differentiated, or abandoned.*

Theory transitions can be reconstructed along several dimensions: conceptual continuity, evidential continuity, methodological continuity, community continuity, representational continuity, and continuity of the research problems being addressed. A transition may be large along one dimension and modest along another. This multi-dimensional account provides an alternative to describing theoretical history solely through binary categories such as continuity or revolution.

Kuhn's analysis remains important because some episodes of scientific change in-

volve shifts in exemplary problems, conceptual organization, and standards of inquiry rather than accumulation within an unchanged framework (Kuhn 1962). Popper's emphasis on criticism and testability provides a different precedent in which theories should remain exposed to possible refutation and revision (Popper 2002). GRE can draw from both without treating either history of science or falsification as a universal template for theory change across heterogeneous research domains.

Proposition 6.491 (Version-sensitive theory change). *Where later theoretical formulations preserve some elements of an earlier theory while revising others, accounts of theory change should identify the relevant continuities and discontinuities rather than treating the transition as either simple accumulation or complete replacement.*

Version sensitivity also supports cumulative reconstruction because later researchers can locate which claims survived, which were narrowed, and which became objects of renewed controversy.

6.29.6 Theory Competition

Research communities often encounter situations in which several theories address overlapping objects while differing in mechanisms, categories, scales, predictions, or explanatory aims. Competition in this setting should not be presumed to produce a single immediate ranking. Theories can differ in the phenomena they illuminate, the evidence they require, the costs of application, and the kinds of questions they make possible.

Definition 6.492 (Theory competition configuration). *A theory competition configuration is a research situation in which two or more theoretical structures make materially different claims, explanations, classifications, predictions, or research orientations concerning an overlapping domain of inquiry.*

Comparison becomes informative when the dimensions of competition are explicit. Predictive performance may matter for one question; historical adequacy, mechanism identification, interpretive fit, formal tractability, or capacity to organize intervention may matter for another. These dimensions can conflict. A theory that compresses observations efficiently can omit relations needed for institutional interpretation. A historically rich theory can be difficult to operationalize for a narrow forecasting task. Such differences call for function-sensitive comparison rather than a single metric of theoretical superiority.

Theory competition can also reveal hidden assumptions. When two theories organize the same evidence differently, their disagreement may expose differences in ontology, scale, category construction, temporal horizon, or evidential relevance. In this sense, competition can be generative before it is resolved.

Proposition 6.493 (Generative role of theoretical disagreement). *When competing theories organize an overlapping evidential domain through materially different assumptions or relations, preserving the disagreement during investigation can help expose otherwise implicit choices concerning scale, category, mechanism, scope, or evidential relevance.*

Resolution may later become possible through new evidence, better translation, narrower scope conditions, or reformulation. In other cases, partial pluralism can

remain methodologically useful when theories answer different questions or access different dimensions of the research object.

6.29.7 Theory Hybridization

Theories can also interact through borrowing, translation, recombination, and partial integration. Hybridization differs from simple competition because the interacting theories become resources for constructing a new configuration. Such processes are common in interdisciplinary research, where concepts or models cross boundaries and enter relations for which they were not originally designed.

Hybridization can be productive when imported elements retain enough of their original assumptions to remain intelligible while being adapted to a new problem. It can become misleading when translation erases incompatible ontologies, changes the meaning of key concepts, or joins elements whose inferential roles do not survive the transfer. Section 6.18 treated methodological translation as an operation with possible remainders. A similar discipline is needed for theoretical translation.

Definition 6.494 (Theory hybridization). *Theory hybridization* is the formation of a theoretical configuration through the selective translation, recombination, or reorganization of concepts, mechanisms, representations, or propositions drawn from previously distinguishable theoretical lineages.

The definition does not imply synthesis into a seamless whole. A hybrid theory can preserve internal tensions and domain-specific components. The relevant questions concern what was transferred, what changed meaning, which assumptions were retained, and whether the resulting relations support the claims made from them.

Proposition 6.495 (Translation discipline in theory hybridization). *When theoretical elements are transferred across lineages, the resulting account should identify consequential changes in meaning, assumptions, scope, and inferential role, especially where apparent similarity could conceal non-equivalence.*

This principle is particularly important for GR because the programme draws from heterogeneous traditions. Relational sociology, pragmatism, systems thinking, dynamical systems, political economy, hermeneutics, historical analysis, and formal relational methods can inform GR without becoming interchangeable descriptions of the same object. Hybridization should therefore preserve productive differences and failed translations rather than presenting theoretical plurality as pre-established unity.

6.29.8 Theory Dissolution

Some theories lose their position as coherent organizing structures. Dissolution can occur when central propositions become difficult to sustain, when the object of inquiry is reclassified, when methods make a previous distinction unnecessary, when a theory fragments into more specialized lineages, or when its useful components are absorbed elsewhere. Institutional decline can also contribute when training, publication venues, archives, or communities that sustained the theory disappear.

Definition 6.496 (Theory dissolution). *Theory dissolution* is a historical process through which a theory ceases to function as a relatively coherent and active orga-

nizing structure for a research community, whether through evidential rejection, conceptual fragmentation, absorption, institutional decline, or transformation of its research object.

Dissolution should be distinguished from simple falsification. A theory may dissolve without a decisive refuting observation, and a refuted claim may remain visible within a broader theory that survives through revision. The Duhem–Quine problem cautions against assuming that one adverse result uniquely determines which theoretical component should be abandoned (Duhem 1954; Quine 1951). Historical reconstruction can therefore ask how evidential, conceptual, methodological, and institutional pressures combined across the dissolution trajectory.

Dissolution can also leave epistemic residues. Concepts, datasets, methods, anomalies, examples, and negative results may remain useful after the theory loses coherence. Preserving those residues supports later inquiry and reduces the risk that theory change erases the evidential history from which it emerged.

Proposition 6.497 (Residual value after theory dissolution). *The dissolution of a theoretical structure does not by itself determine the epistemic value of its constituent concepts, evidence, methods, or unresolved problems; these components can require separate evaluation under later research conditions.*

This proposition prepares the possibility of theory re-emergence without implying that earlier theories should be restored as wholes.

6.29.9 Theory Re-Emergence

Theoretical resources can re-enter research after periods of relative neglect. Re-emergence can occur because new evidence becomes available, computational or formal methods make earlier ideas testable, a neighboring field provides a new interpretation, historical conditions make an old problem newly salient, or later theories recover a distinction that had been lost during earlier synthesis.

Definition 6.498 (Theory re-emergence). *Theory re-emergence* is a historically later return of a previously marginal, dissolved, or displaced theoretical element to active inquiry under changed evidential, methodological, conceptual, institutional, or practical conditions.

Re-emergence is therefore a new relation rather than simple repetition. A concept read through later evidence and methods occupies a different research configuration from the one in which it first appeared. Re-epistemization, developed in Sections 6.21–6.23, becomes central here. Later researchers may ask which parts of an earlier theory remain intelligible, which claims depend on obsolete evidence, which distinctions acquire new relevance, and which historical assumptions should remain visible.

Historical preservation increases the possibility of responsible re-emergence. Archives that contain only canonical conclusions make it difficult to reconstruct abandoned alternatives. Records of failed models, contested categories, and unresolved anomalies can reveal theoretical resources that later conditions make newly interpretable.

Proposition 6.499 (Re-emergence through re-epistemization). *When an earlier the-*

oretical element returns under substantially changed research conditions, its renewed use should be evaluated through the evidence, methods, concepts, and scope conditions available in the later configuration rather than through historical authority alone.

This principle keeps theoretical memory generative while maintaining epistemic discipline.

6.29.10 GR as a Revisable Theory

The preceding analysis applies reflexively to Generative Relational Theory. GR is developed in this book as a research programme and theoretical orientation rather than as a completed ontology. Its concepts of relation, generativity, manifestation, trajectory, field, value conversion, and praxis are intended to organize inquiry while remaining open to differentiation and revision where evidence, conceptual criticism, or neighboring disciplines reveal limitations.

This revisability has several implications. First, GR should distinguish its broad theoretical vocabulary from domain-specific instantiations. A relation that is analytically useful in economics may require a different representation in education, ecology, jurisprudence, or neuroscience. Second, formal resources such as dynamical systems, network representations, field language, or geometric constructions should retain explicit representational scope. Their usefulness in one domain does not establish a universal ontology. Third, empirical findings can motivate changes in GR's conceptual architecture rather than being forced into inherited categories.

Definition 6.500 (GR revisability commitment). The *GR revisability commitment* is the methodological commitment to preserve the reconstructability of GR's concepts, claims, representations, scope conditions, and version history so that materially supported criticism can lead to clarification, differentiation, narrowing, reorganization, or abandonment of theoretical elements.

The commitment is compatible with theoretical ambition. A research programme can pursue broad explanatory questions while stating the provisional status of its current architecture. Epistemic humility concerns the correspondence between claim strength and support, not the avoidance of difficult questions.

Popper's emphasis on exposure to criticism and Peirce's fallibilist conception of inquiry provide useful precedents for this orientation, although GR does not reduce revisability to one criterion of falsification (Popper 2002; Peirce 1877). Longino's account of critical interaction further suggests that revisability depends on social pathways through which criticism can be articulated and taken up (Longino 1990). GR therefore treats revisability as both a property of claims and a property of research relations.

Proposition 6.501 (Reflexive application of GR). *GR should be subjected to the same historical, relational, evidential, methodological, and reconstructive scrutiny that it proposes for other theoretical objects, with revisions recorded in forms that allow later researchers to identify changes in scope, meaning, and support.*

A failure to apply this principle would create an asymmetry between GR's account of knowledge and its treatment of itself.

6.29.11 Evolution of the GR Research Programme

A revisable theory requires an account of programme-level evolution. GR can change through empirical work, domain applications, formal developments, conceptual criticism, interdisciplinary encounters, and failed attempts at translation. The programme's evolution should therefore be understood as a lineage of related theoretical configurations rather than as the preservation of an invariant textual core.

Definition 6.502 (GR research-programme trajectory). *A GR research-programme trajectory is the reconstructable sequence of theoretical, methodological, empirical, and domain-specific configurations through which GR develops, including the relations among retained concepts, revisions, abandoned elements, unresolved tensions, and newly opened questions.*

This trajectory can contain branching. Different domains may develop distinct representations of relation or generativity. Some branches may later become mutually translatable; others may reveal genuine differences in scale, ontology, or evidential structure. Premature synthesis would obscure these possibilities. Programme-level coherence can instead come from shared questions and reconstructable relations among branches.

The research programme also has a generative criterion. Its value is not exhausted by the number of phenomena that can be redescribed in GR vocabulary. A productive programme should help researchers encounter new problems, formulate discriminating questions, identify relations previously obscured by existing categories, construct testable or interpretable distinctions, and revise its own architecture when those distinctions fail. Under this criterion, theoretical expansion without increased capacity for inquiry can become terminological accumulation.

Proposition 6.503 (Generative programme evolution). *The evolution of GR is epistemically productive when changes in its theoretical architecture increase or refine the capacity for inquiry, criticism, comparison, explanation, interpretation, or responsible application while preserving enough provenance for later reconstruction of what changed and why.*

Programme evolution also returns to contingent encounter and aesthetic judgment. New theoretical directions can begin with anomalies, cross-disciplinary encounters, unexpected analogies, empirical failures, or observations whose significance is initially sensed before it is fully justified. Such moments can orient inquiry, while later evidence and criticism determine whether the emerging theoretical relation can be sustained. The generative process therefore joins openness to contingency with disciplined reconstruction.

Remark 6.504 (Theory generation under conditions of abundance). AI-assisted systems can lower the cost of generating candidate theoretical combinations, analogies, formalizations, and extensions. Under such conditions, theoretical generativity depends increasingly on the quality of problem selection, encounter, interpretation, verification, historical reconstruction, and judgment through which candidate structures are differentiated and revised.

Theory as a generative relational object thus occupies several positions at once. It is produced within historical and collective relations; it organizes later observa-

tion and method; it remains vulnerable to evidence and criticism; it can compete, hybridize, dissolve, and re-emerge; and its preserved history can become a resource for future inquiry. GR falls within the same architecture. Its development should remain reconstructable, plural enough to encounter counterevidence, and disciplined enough to distinguish theoretical generation from theoretical warrant. The next section turns to a particularly important source of such reconstruction: failure, negative results, and revision. It examines failed inquiry as a possible epistemic and generative resource when the conditions and consequences of failure remain visible.

6.30 Failure, Negative Results, and Revision

Section 6.29 treated theories as historically generated and revisable relational objects. The present section examines a central mechanism through which such revision becomes possible: research failure. Its role is to differentiate several forms of failure that are often compressed into a single retrospective judgment and to clarify which parts of an inquiry each form can place under pressure. The objective is to develop a research praxis in which failed hypotheses, formalizations, measurements, interventions, methods, and theories can remain epistemically legible when their conditions are sufficiently documented. The discussion proceeds from local failures of hypotheses, formalization, and measurement to negative and contradictory results, unsuccessful research interventions, methodological and theoretical failure, the preservation of failure as knowledge, and proportionate revision. The method is diagnostic rather than celebratory. Failure can generate knowledge under some conditions, while poorly identified failure can also mislead inquiry.

Within a generative relational framework, failure is rarely a property of an isolated result. It emerges from a relation among an expectation, a procedure, a research object, a set of conditions, and an evaluative criterion. A prediction can fail while the measurement relation remains uncertain. A formal model can fail because its assumptions are unsuitable for the target rather than because the underlying phenomenon lacks structure. An intervention can fail operationally before it provides a meaningful test of the mechanism it was designed to examine. Conversely, a technically successful study can fail epistemically if its procedures are incapable of discriminating among the interpretations placed upon its result. Research praxis therefore benefits from locating the failure before deciding what should be revised.

Definition 6.505 (Research-failure configuration). A *research-failure configuration* is a historically and methodologically situated relation in which an inquiry does not satisfy a specified epistemic, representational, measurement, procedural, or theoretical expectation under the conditions in which that expectation was evaluated.

Definition 6.505 makes the criterion and conditions part of the failure description. This helps distinguish a failed attempt from a generalized conclusion about the research object. It also creates a basis for revision: once the locus of failure is sufficiently clear, researchers can ask whether the relevant response concerns the hypothesis, representation, measurement relation, method, scope condition, theory, or research arrangement.

Table 6.1 summarizes the main loci developed in this section. The categories can

Table 6.1: Selected loci of research failure and possible revision targets

Failure locus	Diagnostic question	Possible revision target
Hypothesis	Did the expected relation appear under the stated conditions and evidential test?	Local proposition, mechanism, boundary condition, auxiliary assumption
Formalization	Did the formal representation preserve the distinctions and relations required by the research question?	Variables, state space, mapping, assumptions, scale, mathematical structure
Measurement	Did the procedure produce evidence that remains meaningfully related to the intended object or construct?	Instrument, operationalization, classification, sampling, calibration, interpretation
Research intervention	Did the intervention create the intended research condition without introducing decisive distortions?	Protocol, access relation, timing, implementation, ethical design, field relation
Method	Was the method adequate to the question, object, scale, and available evidence?	Method choice, combination, translation, inferential procedure
Theory	Do recurrent evidential and conceptual difficulties place central theoretical relations under sustained pressure?	Scope, architecture, concepts, mechanisms, theory lineage

overlap in practice. Their analytical value lies in preventing a local difficulty from being transferred too quickly to a wider level of theory.

6.30.1 Failed Hypotheses

A failed hypothesis is among the most familiar forms of research failure, yet its interpretation is often less direct than the phrase suggests. A hypothesis can predict a relation that does not appear in the observed evidence, predict a direction or magnitude that is not supported, or fail to discriminate among competing outcomes. Such a result can place pressure on the hypothesis while leaving open which part of the wider research configuration requires revision.

Popper's methodological emphasis on exposing conjectures to possible refutation remains an important precedent for treating adverse results as epistemically significant (Popper 2002). The Duhem–Quine tradition adds a complementary caution: empirical tests commonly depend on auxiliary assumptions, measurement procedures, classifications, and background relations, so an adverse result may not uniquely identify the proposition that should be revised (Duhem 1954; Quine 1951). The present framework combines these insights at a modest level. Failed predictions deserve attention, while diagnosis should remain sensitive to the configuration through which the prediction was tested.

Definition 6.506 (Local hypothesis failure). A *local hypothesis failure* occurs when evidence produced under a specified research configuration does not provide the expected support for a hypothesis, while the wider theoretical implications remain open

to further diagnosis.

The adjective *local* is important. A hypothesis can fail because a mechanism was misstated, because a proposed relation operates only under narrower conditions, because the relevant temporal scale differs from the one observed, or because a mediating relation was omitted. These possibilities support differentiated revision. A failed hypothesis can sometimes improve a theory by revealing a boundary that successful confirmation would have left invisible.

Research records should therefore preserve the original hypothesis, its scope conditions, the evidential test, relevant auxiliary assumptions, and the observed deviation. Rewriting the hypothesis after seeing the result can obscure the epistemic history through which the later formulation emerged. A reconstructable record allows later researchers to distinguish initial expectation from post hoc interpretation.

Proposition 6.507 (Diagnostic value of local failure). *When a failed hypothesis is documented together with its testing conditions and relevant auxiliary assumptions, the failure can help identify boundaries, omitted relations, scale dependence, or conceptual distinctions that were weakly visible in the original formulation.*

This proposition describes a possibility rather than a guarantee. Some failed hypotheses remain uninformative because the test was weak, the data were insufficient, or the initial proposition was too indeterminate to discriminate among outcomes.

6.30.2 Failed Formalizations

Formalization can fail even when the research question remains valuable. A model may be mathematically coherent while representing the target poorly; a state space may omit relations needed to interpret the dynamics; an optimization structure may impose an objective that the research object does not possess; a network representation may compress qualitatively different relations into a single edge type; or a tractable model may depend on assumptions whose local consequences dominate the phenomenon of interest.

Such failures are especially relevant to GR and GRE because the programme draws on dynamical systems, networks, geometry, fields, and other formal resources. Section 6.29 emphasized that theoretical hybridization requires translation discipline. The same principle applies within formal work: the act of translating a relational object into variables, states, edges, parameters, functions, or categories can generate a remainder that matters for the research question.

Definition 6.508 (Formalization failure). *A formalization failure occurs when a formal representation does not adequately preserve, discriminate, or operationalize the relations required for the analytical purpose for which the representation was introduced.*

Formalization failure can be mathematical, representational, or inferential. Mathematical failure can involve inconsistency, non-identifiability, numerical instability, or computational intractability. Representational failure can arise when the formal objects erase distinctions that the substantive inquiry requires. Inferential failure can occur when a model supports conclusions that depend more strongly on imposed assumptions than on the evidence to which the model is connected.

Recording unsuccessful formalizations can have substantial future value. A failed state-space construction can show which variables require historical indexing. An unsuccessful metric can reveal that two value forms are insufficiently commensurable for the proposed operation. A network model that produces misleading equivalences can reveal the need for multilayer relations or typed edges. These records can prevent later researchers from repeating an apparently attractive translation without encountering the reasons it was abandoned.

Remark 6.509 (Formal elegance and representational adequacy). Formal elegance can orient attention and support aesthetic judgment during model construction, while representational adequacy remains a separate epistemic question. A beautiful formal structure can fail for the local research purpose, and an inelegant representation can remain empirically useful within a limited domain.

The remark reconnects failure to the distinction developed in Sections 6.10–6.13. Aesthetic judgment can guide inquiry before sufficient evidence is available, yet later evidential and representational evaluation can revise the initial attraction.

6.30.3 Failed Measurements

Measurement failure concerns the relation between an evidential procedure and the object, construct, or distinction it is intended to make observable. It can arise through instrument malfunction, poor calibration, unstable operationalization, inappropriate classification, sampling limitations, reactivity, missingness, historical category drift, or a mismatch between the scale of measurement and the scale of the process being studied.

The GR perspective adds a relational concern. Measurement is itself an intervention into an epistemic relation. A survey question can alter how a respondent frames an experience; a ranking can change the behavior of the institutions it measures; a sensor can capture one physical dimension while leaving relevant contextual relations outside the record; an administrative category can stabilize distinctions that later researchers mistakenly treat as naturally given. Failure can therefore occur even when the instrument functions exactly as designed.

Definition 6.510 (Measurement-relation failure). A *measurement-relation failure* occurs when the evidential relation produced by a measurement procedure becomes inadequate for the inference or distinction assigned to it under the research conditions at issue.

This definition separates technical operation from epistemic adequacy. A scale can be internally reliable while poorly related to the target construct. A database can be complete relative to an administrative system while excluding populations whose absence matters for the research question. A proxy can correlate with an intended construct during one historical period and lose that relation after institutional change.

Failed measurements can therefore reveal features of the object and the measurement system simultaneously. Unexpected missingness can expose access inequalities. Category instability can reveal historical change in the object being classified. Divergence between instruments can indicate multidimensionality rather than simple er-

ror. The diagnostic task concerns which interpretation is supported by the surrounding evidence.

Proposition 6.511 (Measurement failure as relational evidence). *Where a measurement procedure fails in a patterned way, the pattern can provide evidence about the relation among instrument, classification, research population, historical context, and target construct, provided that technical error and alternative explanations remain under examination.*

The qualification is important because patterned failure can also arise from mundane implementation problems. Generativity enters when the failure changes what researchers know to ask about the measurement relation.

6.30.4 Negative Results

A negative result deserves distinction from research failure. A study can competently investigate a hypothesis and produce evidence that does not support the expected effect. Such an outcome may be a successful inquiry whose substantive result is negative, null, absent, or inconsistent with the tested expectation. Conversely, a poorly designed study can produce a statistically non-significant result that offers little information about the underlying relation.

Definition 6.512 (Negative research result). *A negative research result is an evidential outcome that does not support a specified expected relation, effect, mechanism, or difference under a research design capable of giving the outcome interpretable meaning.*

The final clause prevents non-detection from being treated automatically as evidence of absence. The informational value of a negative result depends on design sensitivity, measurement quality, statistical or interpretive adequacy, scope conditions, and the alternatives the study can discriminate among.

The research literature also provides evidence that negative or null findings can receive less visibility than stronger positive findings. Franco, Malhotra, and Simonovits examined a known population of 221 social-science experiments and found that strong results were substantially more likely to be written up and published than null results (Franco et al. 2014). Fanelli's cross-disciplinary work similarly documented changes in the prevalence and visibility of negative findings across scientific literatures (Fanelli 2012). These studies concern particular samples and publication systems, yet they illustrate a wider epistemic risk: when research memory disproportionately preserves supportive outcomes, later theories can be evaluated against a selectively visible evidential history.

This asymmetry is especially consequential for generative research programmes. A failed path can prevent duplicated effort, reveal boundary conditions, or preserve evidence against an attractive mechanism. If these paths disappear from the accessible record, later researchers may repeatedly rediscover the same limitations or overestimate the stability of the surviving theory.

Proposition 6.513 (Epistemic value of preserved negative results). *Negative results can contribute to cumulative inquiry when their research conditions, design sensitivity, and interpretive limits remain visible enough for later researchers to evaluate what the*

result constrains and what it leaves open.

Preservation therefore concerns more than publishing a binary outcome. It concerns maintaining the relations required to interpret the outcome.

6.30.5 Contradictory Results

Research fields frequently contain results that appear to conflict. One study identifies a relation, another does not; one historical reconstruction supports a mechanism, another emphasizes a different sequence; one model performs well at one scale and poorly at another. Contradiction can indicate error, but it can also reveal heterogeneity that an earlier research frame compressed.

Section 6.17 argued that disagreement among competent methods can itself become evidence. The same logic applies to contradictory results. Rather than treating inconsistency as a defect to be averaged away immediately, researchers can ask which relations differ across the studies: population, period, scale, measurement, institutional setting, intervention intensity, model assumptions, evidential access, or interpretive framework.

Definition 6.514 (Contradictory-result configuration). *A contradictory-result configuration is a set of research outcomes whose substantive interpretations are difficult to sustain simultaneously under the same assumed scope conditions, thereby creating pressure to examine differences in evidence, method, context, scale, or theory.*

The phrase *assumed scope conditions* matters because apparent contradiction can dissolve when the studies are shown to concern different relational configurations. A policy mechanism may operate in one institutional environment and not another. A causal relation can reverse when the dominant pathway changes over historical time. A qualitative study can reveal a category distinction that explains heterogeneity hidden in an aggregate estimate.

Proposition 6.515 (Contradiction-driven differentiation). *When well-supported results remain in tension, preserving the tension during diagnosis can help reveal missing scope conditions, latent heterogeneity, scale dependence, historical change, or translation problems that premature synthesis would obscure.*

The proposition does not make contradiction intrinsically productive. Some contradictions result from mistakes, weak designs, or incompatible uses of terminology. The generative possibility lies in disciplined comparison.

6.30.6 Unsuccessful Interventions within Research

Research contains interventions before it reaches application-dominant praxis. Researchers recruit participants, negotiate access, introduce experimental conditions, conduct interviews, build archives, prompt computational systems, select model settings, and modify observational environments. These interventions can fail operationally or epistemically.

An unsuccessful intervention may fail to create the intended condition, may generate substantial reactivity, may produce ethically unacceptable burdens, may encounter institutional resistance, or may interact with the field in ways that make the

resulting evidence difficult to interpret. Such outcomes deserve separation from a failed substantive hypothesis. If an experimental manipulation does not meaningfully alter the intended relation, the resulting data provide a weak test of the hypothesis that assumed the alteration occurred.

Definition 6.516 (Research-intervention failure). A *research-intervention failure* occurs when an intervention introduced for the purpose of inquiry does not establish the intended research condition, or establishes it through relations that materially compromise the evidential, ethical, or interpretive purpose of the inquiry.

This form of failure can be particularly informative in field research. Difficulty obtaining access may reveal institutional boundaries that are themselves substantively relevant. Participant resistance can indicate that the research categories conflict with lived classifications. An AI-assisted workflow that repeatedly generates plausible but untraceable claims can reveal an infrastructure-level limitation in provenance rather than a lack of generative capacity.

Ethical diagnosis is part of this analysis. A research intervention can produce informative data and still be inappropriate because the burdens, power relations, or risks are poorly justified. In such cases, practical success does not erase normative failure. Research praxis should preserve that distinction.

Remark 6.517 (Operational and epistemic success). An intervention can succeed operationally while remaining epistemically weak, or fail operationally while revealing consequential relations in the research field. Evaluation benefits from separating these dimensions before drawing broader conclusions.

6.30.7 Methodological Failure

Methodological failure arises when the procedure used to access, compare, infer, interpret, or reconstruct a research object proves inadequate to the question under investigation. The failure can concern a single implementation or a wider family of methods within a particular domain.

A method can fail because its assumptions are violated, because it requires data unavailable in the field, because its categories distort the relevant distinctions, because its temporal resolution misses the process of interest, because it treats dependent observations as independent, or because the form of evidence it produces is poorly suited to the question being asked. Methodological failure can also emerge historically. A procedure that was adequate under one institutional or technical arrangement can become less informative after the object of study changes.

Definition 6.518 (Methodological failure). A *methodological failure* occurs when a method or methodological configuration is insufficiently adequate to the research question, object, evidence, scale, or inferential task for which it is being used.

Methodological pluralism becomes important here. Failure of one mode of access does not establish the superiority of another in general. Historical reconstruction, qualitative inquiry, formal modeling, quantitative estimation, ethnography, legal interpretation, and computational methods expose different aspects of relational objects. A failed method can therefore motivate triangulation, translation, or a change in the question rather than a hierarchy among disciplines.

Methodological failure can also reveal that the initial question presupposed an unavailable form of evidence. A demand for precise causal attribution may exceed the historical record. A request for a single metric may be incompatible with heterogeneous value forms. A computational classification task may lack a stable target because the categories are institutionally contested. In these cases, revising the question can be more appropriate than forcing the method to produce an answer.

Proposition 6.519 (Question–method co-revision). *When methodological failure arises from a mismatch between the form of the research question and the evidence or relations available for inquiry, revision can appropriately target the question, the method, or their relation rather than treating the method in isolation.*

This proposition aligns with the chapter’s broader account of iterative reconstruction.

6.30.8 Theoretical Failure

Theoretical failure concerns a wider level of organization than local hypothesis failure. It becomes relevant when recurrent empirical, conceptual, or methodological difficulties place central relations within a theoretical architecture under sustained pressure. The diagnosis can involve failed predictions, unresolved anomalies, internal tensions, weak transfer across domains, persistent dependence on ad hoc auxiliary assumptions, or inability to discriminate among the phenomena the theory was intended to organize.

Theoretical failure remains historically graded. A theory can lose broad explanatory authority while retaining useful local mechanisms. A conceptual distinction can survive the framework in which it originated. A theory can be narrowed to a smaller domain rather than abandoned. Section 6.29 therefore distinguished theory dissolution from simple falsification and emphasized the residual value that can remain after dissolution.

Definition 6.520 (Theoretical failure). *A theoretical failure is a sustained condition in which central relations, mechanisms, or organizing distinctions of a theory become insufficiently supported, discriminating, coherent, or productive for the scope of inquiry assigned to them.*

The definition contains several possible dimensions because theories perform multiple epistemic functions. A theory can remain empirically serviceable while conceptually confused, or conceptually elegant while repeatedly unsuccessful in empirical discrimination. A theory can explain past evidence yet generate few new questions. Diagnosis should therefore identify which function has weakened and over what scope.

Caution 6.521 (Premature theory rejection and indefinite protection). A single adverse result can provide insufficient grounds for abandoning a wider theoretical architecture, while repeated reinterpretation of adverse evidence can also insulate a theory from meaningful revision. The relevant judgment concerns the accumulated configuration of evidence, auxiliary assumptions, alternative explanations, and the theory’s stated scope.

Caution 6.521 expresses the balance needed for an open research programme. Re-

visability requires exposure to failure together with enough diagnostic patience to locate what failed.

6.30.9 Failure as Research Knowledge

Failure becomes cumulative research knowledge when later researchers can reconstruct enough of the failed pathway to understand what was attempted, under which conditions, with which assumptions, and with what evidential consequences. The object of preservation is therefore a trajectory rather than a label such as “failed” or “null.”

A useful failure record can include the initial question, hypothesis or objective, relevant theory, research design, data provenance, formal assumptions, measurement choices, implementation conditions, observed result, diagnostic alternatives, subsequent revisions, and remaining uncertainties. The appropriate level of documentation depends on consequence, cost, privacy, security, and feasibility, as discussed in Section 6.23.

Definition 6.522 (Reconstructable failure record). *A reconstructable failure record is a preserved account of an unsuccessful or adverse research trajectory containing enough provenance, conditions, assumptions, evidence, and diagnostic interpretation for later inquiry to evaluate what the episode constrains and which questions remain open.*

Such records can possess option value. A failed model may become informative after a new measurement technology appears. An abandoned hypothesis may acquire a narrower interpretation after a previously hidden subgroup is recognized. An unsuccessful archival search can tell later researchers which sources were unavailable at a particular time. A failed AI workflow can preserve evidence about model version, prompting conditions, and provenance limitations that becomes relevant after infrastructure changes.

Failure records also have a justice dimension. Selective preservation can privilege successful institutional narratives while erasing abandoned approaches, participant objections, negative findings, and unsuccessful interventions. Preserving relevant failure can therefore widen the historical visibility of how knowledge was actually produced. This argument remains subject to ethical limits: some records require restriction, anonymization, or non-retention because preservation itself can create harm.

Proposition 6.523 (Failure memory as future epistemic option). *Where ethically and practically appropriate, preserving reconstructable records of consequential research failures can increase the future capacity to avoid repeated error; reinterpret earlier evidence, recover abandoned alternatives, and diagnose the historical formation of later theories and methods.*

This proposition connects failure memory to the intergenerational research memory developed in the following section.

6.30.10 Revision after Failure

Revision closes the local cycle opened by failure while keeping the wider inquiry reopenable. The central problem is proportionality. An adverse result can justify a small parameter change, a narrower scope condition, a redesigned measurement, a new method, a reformulated mechanism, or a substantial theoretical reorganization. The appropriate level depends on what the diagnosis can support.

A generative relational approach treats revision as a transformation of a research configuration. Changing one element can alter the interpretation of others. Revising a category can change which observations count as comparable; changing a method can alter the evidential record; narrowing a theory can shift previously anomalous cases outside its intended scope; adding a historical condition can transform a universal-looking proposition into a period-specific one. Revision should therefore preserve enough provenance to make these changes visible.

Definition 6.524 (Proportionate research revision). A *proportionate research revision* is a documented change to a hypothesis, representation, measurement, method, scope condition, theoretical relation, or research arrangement whose breadth is matched to the failure diagnosis and the available evidential support.

Proportionate revision resists two symmetrical temptations. One is overreaction, in which a local failure is converted rapidly into rejection of a wider programme. The other is protective absorption, in which the theory or method is repeatedly modified in ways that make adverse evidence increasingly difficult to count against it. Responsible revision keeps the relation between evidence and change inspectable.

A practical revision sequence can therefore ask: What expectation failed? Under which conditions? Which parts of the research configuration were independently supported? Which alternative diagnoses remain plausible? What is the narrowest revision that addresses the supported diagnosis? Which new observations or comparisons could discriminate among the remaining alternatives? These questions orient revision without presuming that the earliest diagnosis is final.

Proposition 6.525 (Failure-sensitive revision). *Research revision is epistemically stronger when the scope of change remains traceable to the diagnosed locus of failure, competing explanations remain visible where consequential, and the revised configuration creates opportunities for later discrimination among unresolved alternatives.*

The proposition returns failure to generativity. A failure is epistemically productive when it changes the space of inquiry in a discriminating way: a previously hidden boundary becomes visible, a measurement relation is clarified, an attractive formalization is abandoned for documented reasons, or a theoretical architecture is reorganized around evidence it could not previously accommodate. The generative value lies in the transformation of future inquiry rather than in failure itself.

Failure also reconnects with contingent encounter and aesthetic judgment. Researchers can encounter an anomaly whose significance is initially unclear, or experience a formal mismatch that appears aesthetically disturbing before its epistemic importance is established. Such impressions can orient attention toward a possible failure configuration. Later investigation determines whether the anomaly is robust, which relation it concerns, and what level of revision is warranted. In this sense, the openness to encounter developed earlier in the chapter remains compatible with

disciplined revision.

The treatment of failure developed here prepares the transition from individual episodes of revision to the infrastructures that make revision cumulative. Negative results, abandoned models, contradictory findings, unsuccessful interventions, and changed theories become more useful when concepts, data, assumptions, relational maps, and disagreement remain accessible across research generations. The next section therefore turns from failure-sensitive revision to open and cumulative research practice.

6.31 Open and Cumulative Research Practice

Section 6.30 treated failure, negative results, and revision as parts of a reconstructable research history. The present section develops the institutional and epistemic conditions under which such histories can remain available for later inquiry. Its role is to specify how concepts, data, models, relational maps, assumptions, disagreements, replications, and reinterpretations can become reusable without being detached from the conditions that made them meaningful. The objective is to formulate an open and cumulative research praxis that preserves provenance, contestability, revision histories, and future possibilities of re-epistemization. The discussion proceeds from reusable research objects to transparent assumptions and open disagreement, then to replication, reinterpretation, cumulative revision, research commons, and intergenerational research memory. The method is relational and historical: openness is treated as a governed relation among researchers, artifacts, institutions, rights, infrastructures, and future users, while cumulation is treated as a trajectory of preservation and transformation rather than a simple increase in stored results.

Open research has often been associated with transparency, reproducibility, accessible materials, and infrastructures that permit research objects to circulate beyond their original projects (Nosek et al. 2015; UNESCO 2021). These commitments are important for GRE, yet their epistemic value depends on the relations through which openness is organized. A dataset without provenance can be widely accessible while remaining difficult to interpret. A model can be publicly released while depending on undocumented assumptions or unavailable computational environments. A historical archive can be accessible while its classificatory history remains obscure. Conversely, some research materials may require restricted access because of privacy, legal obligation, community stewardship, security, or other ethically relevant conditions. Openness therefore benefits from being analyzed through access, intelligibility, provenance, governance, and reuse rather than through availability alone.

Definition 6.526 (Open and cumulative research practice). An *open and cumulative research practice* is a research arrangement in which relevant epistemic objects, assumptions, transformations, disagreements, and revision histories are preserved with sufficient provenance and governance to support later examination, reuse, replication, reinterpretation, criticism, or revision under appropriate access conditions.

Definition 6.526 combines openness with cumulation because the two can strengthen one another when research objects remain recoverable across time. It also places governance inside the definition. Research becomes more cumulative when later investigators can determine what was done, under which conditions, with which concepts, and with which unresolved alternatives. The resulting accumulation can contain correction, abandonment, branching, and reclassification alongside retention.

Table 6.2 summarizes several research objects developed in this section and the conditions that can make their reuse epistemically informative.

Table 6.2: Selected research objects and conditions for responsible reuse

Research object	Conditions supporting reuse	Risks when context is lost
Concept	Definition history, scope, neighboring concepts, disputed uses, translation record	Apparent equivalence, category drift, anachronism
Data	Provenance, collection relation, metadata, permissions, transformations, missingness	Decontextualized measurement, hidden selection, invalid transfer
Model	Assumptions, code or specification, parameters, target relation, computational environment	Black-box reuse, scope expansion, apparent precision
Relational map	Boundary, scale, time index, edge semantics, uncertainty, source trace	Reified relations, frozen dynamics, false comparability
Assumption set	Type, role, dependence of conclusions, alternatives, sensitivity	Invisible premises, overgeneralized conclusions
Disagreement record	Competing interpretations, evidence, standards, unresolved points, later revisions	Retrospective consensus, loss of live alternatives
Failure record	Intended test, conditions, observed failure, diagnosis, subsequent revision	Repeated dead ends, publication-memory bias, distorted theory history

6.31.1 Reusable Concepts

Concepts are among the most portable objects in research. Terms such as *institution*, *trust*, *power*, *value*, *relation*, or *generativity* can travel across projects, disciplines, and historical periods. Their portability can support cumulative inquiry by allowing later work to inherit distinctions, compare cases, and refine theoretical structures. The same portability can also conceal changes in meaning. A concept reused across contexts may preserve its label while its boundary, scale, normative loading, or evidential role changes.

For this reason, concept reuse benefits from a recoverable conceptual history. Such a history can include the definition used in a particular project, the problem the concept was introduced to address, neighboring concepts from which it was distinguished, known ambiguities, contested translations, and later revisions. The objective is not to immobilize concepts. Research concepts often gain usefulness precisely because they can be modified. The objective is to make modification visible enough that later comparison remains meaningful.

Definition 6.527 (Reusable research concept). A *reusable research concept* is a concept whose definition, scope, relevant contrasts, and revision history are preserved sufficiently for later investigators to determine what continuity and transformation are involved when the concept is applied in a new inquiry.

This definition is especially important for GR because many of its concepts are intended to operate across domains. A relation in economic inquiry, legal inquiry, ecology, education, or aesthetics may share structural features while retaining domain-specific content. Reuse therefore requires a translation record rather than an assump-

tion of identity. A concept can support cumulative research when later work can say which properties are being inherited, which are being modified, and which remain unresolved.

Conceptual reuse also has a generative dimension. A well-preserved concept can become a scaffold for questions that its initial formulation did not anticipate. Later investigators may discover new cases, counterexamples, interactions, or formalizations. In this sense, preservation of conceptual provenance creates future research option value. The value arises through the possibility of responsible transformation, rather than through indefinite preservation of an original wording.

6.31.2 Reusable Data

Data reuse extends the temporal and institutional reach of an inquiry. Observations collected for one question can sometimes support later questions, comparisons, replications, historical reconstruction, or methodological testing. The FAIR principles provide an influential infrastructure-oriented account of research data as findable, accessible, interoperable, and reusable, with particular attention to metadata, provenance, licensing, and community standards (Wilkinson et al. 2016). GRE can inherit this emphasis while adding a stronger concern with the relational history through which data came to exist.

A datum is produced through relations among an object or participant, a measurement or recording procedure, classificatory decisions, institutional conditions, material infrastructures, and later transformations. Reusability therefore depends partly on whether these relations remain reconstructable. Variables may have changed definition across waves of a survey. Administrative records may reflect changes in law or eligibility rules. Sensor data may depend on calibration histories. Archival collections may preserve some actors more densely than others. A reusable dataset benefits from documentation that keeps such conditions visible.

Definition 6.528 (Relational data provenance). *Relational data provenance* is the recoverable record of the principal relations through which data were generated, selected, classified, transformed, stored, governed, and made available for later inquiry.

Relational provenance expands ordinary source citation. It can include collection procedures, sampling relations, participant or community conditions, measurement instruments, transformations, exclusions, uncertainty, missingness, access restrictions, and version history. The appropriate level of documentation is problem-relative. A later causal analysis may require different provenance from a descriptive reuse, while historical reinterpretation may require institutional and classificatory context that was peripheral to the original project.

Openness also has ethical limits. Privacy, confidentiality, contractual restrictions, indigenous or community stewardship, security, and risks of re-identification can justify differentiated access. UNESCO's Recommendation on Open Science explicitly places openness within a broader institutional and cultural framework and recognizes diversity of knowledge systems and contexts (UNESCO 2021). An open research praxis can therefore include controlled repositories, trusted access procedures, community-governed permissions, or delayed release where these arrangements

preserve both future research possibility and legitimate protections.

6.31.3 Reusable Models

Models can accumulate research capacity when their internal structure and intended use remain recoverable. A statistical model, simulation, formal mechanism, agent-based model, or dynamical representation can be reused to test a new case, compare assumptions, reproduce an earlier result, or expose how conclusions depend on a particular representation. Model reuse can shorten the distance between research projects, yet it can also transport hidden assumptions into new domains.

A reusable model therefore includes more than executable code or equations. Its research record can specify the target phenomenon, conceptual interpretation, variables or state space, parameter meanings, boundary and initial conditions, simplifying assumptions, calibration procedure, computational environment, known sensitivity, and domains in which the model has been evaluated. When code is involved, versioning and dependency information can become part of epistemic provenance because software changes can alter the behavior of a nominally identical procedure.

Definition 6.529 (Reusable model package). A *reusable model package* is a formal or computational representation preserved together with sufficient information about its assumptions, semantics, parameters, implementation, target relation, evaluation history, and scope for later investigators to reproduce, adapt, or criticize its use.

The word *package* denotes an epistemic bundle rather than a required technical format. A concise analytical model may need only equations, definitions, assumptions, and derivation notes. A simulation may require source code, parameter files, random seeds, software dependencies, and example outputs. A machine-learning pipeline may require model version, training-data provenance, evaluation procedures, and preprocessing records. The appropriate bundle follows from the operations that later investigators may need to reconstruct.

Model reuse should preserve the distinction between adaptation and validation. Successful execution in a new environment shows that a procedure can run; it does not by itself establish that the model remains substantively adequate for a new domain. Later users therefore carry a responsibility to reassess the model–target relation. Reusability increases the availability of a model for inquiry while leaving epistemic judgment active.

6.31.4 Reusable Relational Maps

Relational maps occupy a distinctive place in GRE because they can connect observations, actors, institutions, resources, values, flows, dependencies, and temporal transformations within a common representation. Their cumulative value arises when later researchers can compare maps across periods, domains, scales, or interventions. Yet relational maps are particularly vulnerable to reification. A visual or computational edge can appear more stable and more ontologically definite than the evidence warrants.

Reusable relational maps therefore require explicit edge semantics. Researchers should be able to determine whether an edge represents communication, legal au-

thority, material transfer, statistical association, causal dependence, perceived trust, formal membership, or another relation. Directionality, weight, uncertainty, time index, boundary conditions, and source type may also matter. A map that preserves these distinctions can support later remapping when new evidence changes the represented relation.

Definition 6.530 (Reusable relational map). A *reusable relational map* is a relational representation whose entities, relation types, boundaries, scales, temporal index, evidential sources, uncertainties, and transformation history are documented sufficiently for later comparison, extension, reinterpretation, or correction.

This form of reuse is especially relevant to historical inquiry. A relational map of an institution at one moment may later become one layer in a trajectory showing entry, exit, concentration, fragmentation, or changing forms of authority. The map then functions less as a final picture than as a versioned representation of a historically indexed field.

Relational maps can also preserve disagreement. Researchers may maintain alternative maps when evidence supports competing interpretations of the same field. Such plural representation can be more informative than forcing early convergence. Later evidence can then alter the relative support for the alternatives while preserving the path through which the disagreement developed.

6.31.5 Transparent Assumptions

Cumulative research depends partly on the visibility of assumptions because later researchers inherit consequences produced under those assumptions. Assumptions enter inquiry in several forms: constitutive definitions specify what a research object counts as; simplifying assumptions reduce complexity; identification assumptions support causal or statistical inference; measurement assumptions connect indicators to constructs; normative assumptions shape evaluative criteria; and infrastructural assumptions concern the reliability or accessibility of data, software, archives, or institutions.

Transparency can be improved by linking important assumptions to the claims that depend upon them. A long undifferentiated list of caveats may satisfy a procedural requirement while providing little help to later inquiry. A more useful record states what role an assumption plays, which conclusions depend strongly on it, what alternatives were considered, and which evidence could place it under pressure.

Definition 6.531 (Assumption dependency record). An *assumption dependency record* is a structured account connecting a consequential research assumption to the concepts, methods, models, interpretations, or conclusions whose warrant materially depends on it.

This record supports cumulative revision because later investigators can alter one assumption and identify which parts of the argument require reconsideration. It also reduces the tendency for assumptions to become invisible through repeated citation. A proposition that travels across a literature can gradually appear self-standing even when its original support depended on narrow conditions. Recoverable assumption dependencies make such inherited conditions easier to re-examine.

Transparency should remain proportionate. Research can contain tacit competencies and background knowledge that are difficult to exhaustively document. The practical objective is to preserve assumptions whose loss would materially alter interpretation, replication, or transfer. This standard keeps transparency connected to epistemic function rather than to indiscriminate documentation.

6.31.6 Open Disagreement

Cumulative research can advance through disagreement as well as convergence. Competing interpretations may draw attention to different evidence, scales, mechanisms, or values. Section 6.17 treated disagreement among competent methods as potentially diagnostic; Section 6.30 showed that contradictory results can identify unresolved differences in research configuration. Open research practice extends this principle by preserving the structure of serious disagreement rather than recording only the view that later became dominant.

Definition 6.532 (Open disagreement record). An *open disagreement record* preserves competing research interpretations together with the evidence, assumptions, methods, standards of evaluation, and unresolved points that distinguish them, while allowing later evidence or argument to alter their relative standing.

Such records can take many forms: parallel interpretations in an article, registered commentary, adversarial collaboration, versioned annotations, debate archives, or repositories that preserve rejected alternatives alongside accepted revisions. Their epistemic value lies in future reconstructability. A later researcher may possess evidence that changes the significance of an earlier disagreement, or may discover that the disagreement arose from different boundaries or definitions rather than incompatible observations.

Open disagreement also protects against retrospective flattening. Once a field converges, earlier alternatives can appear obviously mistaken because the later conceptual vocabulary is projected backward. Preserving the arguments that made an alternative plausible at the time supports more accurate history of inquiry and can reveal assumptions that the dominant trajectory later inherited without further examination.

Openness toward disagreement does not imply equal evidential standing. Some positions can become weakly supported, empirically contradicted, or conceptually incoherent. A cumulative practice preserves their history when that history remains informative while allowing current evaluation to reflect the available evidence. The distinction between preservation and endorsement is therefore central.

6.31.7 Replication

Replication is one mechanism through which research claims can be tested beyond the conditions of their initial production. Large coordinated replication projects have shown that reproducibility itself can become an empirical research object rather than a background assumption (Open Science Collaboration 2015). Within a relational framework, replication is especially informative when researchers specify which relations and conditions are intended to remain similar and which are allowed to vary.

Definition 6.533 (Relational replication profile). A *relational replication profile* specifies the elements of an earlier research configuration that a replication seeks to preserve, the elements that differ, and the evidential question those similarities and differences are intended to address.

This profile helps distinguish several purposes of replication. A close replication may test whether a result can be reproduced under procedures that approximate the original arrangement. A replication across institutions or populations may examine portability. A replication at a later historical moment may test temporal stability. A conceptual replication may change operationalization while examining whether a proposed relation remains detectable. Each design answers a different question, and differences between original and replication conditions become part of the interpretation.

Replication therefore contributes to cumulative research through structured comparison rather than through a binary label of success or failure. A divergent result may indicate sampling variation, measurement differences, historical change, context dependence, implementation failure, or a weaker original claim than previously believed. The diagnostic approach developed in Section 6.30 remains applicable. Replication can place pressure on a claim while leaving open the level at which revision is warranted.

Transparent materials and reusable data, models, and protocols can lower the cost of replication (Nosek et al. 2015). Yet replication also requires judgment. Procedures may be copied faithfully while the relevant social or institutional relation has changed. Conversely, a modified procedure may preserve the underlying research relation more effectively than literal duplication. Relational replication therefore asks what fidelity means for the claim under examination.

6.31.8 Reinterpretation

Research can accumulate by returning to existing evidence with new concepts, methods, questions, or historical knowledge. Section 6.23 described evidence preservation as infrastructure for future re-epistemization. Reinterpretation is one process through which that future capacity is realized. Archived interviews can be read through categories that were unavailable to the original researchers. Historical administrative data can acquire new meaning after institutional reforms reveal previously hidden selection mechanisms. An old model can be reconsidered under a new understanding of scale or boundary.

Definition 6.534 (Research reinterpretation). A *research reinterpretation* is a historically situated re-examination of preserved evidence, concepts, models, or records under a changed question, method, theoretical framework, or body of contextual knowledge, with the earlier interpretation retained as part of the research history.

Retaining the earlier interpretation matters because reinterpretation is itself historically situated. A newer reading can provide greater explanatory power or evidential fit while remaining open to later revision. Preserving successive interpretations allows researchers to study how the epistemic object changed across time and what new evidence or conceptual resources made the change possible.

Reinterpretation also supports interdisciplinary cumulation. A legal archive may later be examined through economic or sociological questions; ecological data may acquire political significance; an educational dataset may support research on institutional inequality. Such transfers can be productive when the original collection relation and categories remain visible. They become risky when later analysts treat inherited variables as transparent representations of the concepts required by the new field.

The capacity for reinterpretation strengthens the value of rich provenance. Documentation that seemed peripheral during the original project may later become decisive. This creates a practical reason for preserving contextual information around consequential research objects when the expected future use is uncertain.

6.31.9 Cumulative Revision

Cumulation in a generative relational research programme is better represented as a versioned trajectory than as a stack of increasingly complete findings. Research histories include retained claims, modified definitions, abandoned models, recovered alternatives, changed evidence standards, and new questions produced by earlier failures. The cumulative element lies partly in the preservation of these transformations and in the capacity to learn from them.

Definition 6.535 (Cumulative research revision). *A cumulative research revision is a traceable modification of a research object or claim that records what is retained, altered, withdrawn, newly introduced, or left unresolved relative to an earlier version.*

Cumulative revision can operate at several scales. A local revision may change one parameter or measurement procedure. A conceptual revision may alter the definition of a central term. A methodological revision may replace an inferential strategy. A theoretical revision may reorganize relations among several concepts. A field-level revision may change standards of acceptable evidence. The version history should therefore identify the scale of change rather than treating each new publication as an undifferentiated addition.

This view allows research to accumulate through correction. A withdrawn claim can contribute to later knowledge if its evidential history remains reconstructable. A discarded method can remain useful as a record of why a particular approach failed under certain conditions. An abandoned concept can later reappear with a narrower scope. Cumulation therefore includes selective forgetting at the level of active practice while preserving enough historical memory for later recovery.

Proposition 6.536 (Traceable cumulation). *Within a research programme that expects continuing revision, cumulation is strengthened when consequential changes remain traceable to the evidence, assumptions, disagreements, or failures that motivated them.*

Proposition 6.536 states a design principle rather than a universal law of scientific development. Its practical implication is that version control, revision notes, provenance records, and linked evidence can be epistemic infrastructure. They help later researchers distinguish a changed conclusion from a silently changed question.

6.31.10 Research Commons

Open and cumulative research requires infrastructures through which epistemic objects can be shared, maintained, governed, and contested. Research commons provide one institutional vocabulary for these arrangements. Work on knowledge commons emphasizes that shared knowledge resources raise questions of access, enclosure, preservation, intellectual property, contribution, and governance that differ in important ways from natural-resource common-pool problems (Hess and Ostrom 2007). GRE can use this insight to treat openness as an institutional design problem rather than a simple release decision.

Definition 6.537 (Research commons). A *research commons* is a governed arrangement through which a community or network preserves, shares, maintains, and develops research resources under rules concerning access, contribution, attribution, stewardship, revision, and legitimate restriction.

Research commons can include data repositories, code archives, shared ontologies, bibliographic infrastructures, community archives, open laboratory protocols, model libraries, preprint systems, or collectively maintained relational maps. Their governance can vary substantially. Some resources can be openly downloadable; others may use tiered access, trusted research environments, community permission, or stewardship committees. The relevant question is whether the governance arrangement sustains epistemic access while respecting the rights and vulnerabilities attached to the resource.

Commons also require maintenance. File formats decay, links disappear, software dependencies become obsolete, metadata standards change, and institutional funding ends. Preservation therefore involves labor and resource allocation. A repository that accepts deposits without maintaining interpretability may preserve bytes while losing epistemic usability. Sustainable research commons need stewardship capacities that include migration, curation, documentation, access management, and mechanisms for correcting records.

Attribution and contribution relations also matter. Open resources can depend on work that receives limited recognition: data cleaning, archival description, software maintenance, translation, community liaison, replication, and documentation. If cumulative research relies increasingly on reusable infrastructures, evaluation systems may need to recognize these forms of epistemic labor. This is especially relevant in AI-assisted research, where visible outputs can be produced rapidly while the maintenance of trustworthy underlying resources remains comparatively costly.

Research commons therefore connect epistemology to political economy. Questions of who funds infrastructure, who contributes labor, who governs access, who receives credit, and who can contest classification affect the future generativity of the research field. These issues will reappear later in the book's treatment of knowledge, value, and power.

6.31.11 Intergenerational Research Memory

The longest temporal horizon of cumulative research concerns intergenerational memory. Researchers inherit concepts, datasets, archives, methods, unresolved dis-

putes, failures, and institutional practices from investigators separated from them by time, institution, or geography. The quality of that inheritance shapes which questions can be reopened and which historical trajectories remain visible. Intergenerational research memory is therefore more than storage. It is the preservation of sufficient structure for later investigators to recognize what an epistemic object was, how it was produced, and why earlier researchers considered it significant.

Definition 6.538 (Intergenerational research memory). *Intergenerational research memory* is the institutionally and materially sustained capacity of later researchers to recover consequential research objects, their provenance, interpretive histories, unresolved alternatives, and conditions of revision across extended temporal intervals.

This memory can preserve successful results and failures together. Section 6.30 argued that reconstructable failure records can carry future epistemic option value. The same principle applies more broadly. A dataset may become useful after a new method emerges. An apparently peripheral archival note may become important after a political or institutional transformation. A rejected interpretation may acquire new relevance after evidence unavailable to the earlier debate is discovered. Preservation creates the possibility of such later encounters without determining which preserved object will become significant.

Here the relation between memory and contingency becomes especially important. Archives, repositories, model libraries, and historical records enlarge the encounter surface available to future researchers. A later investigator may encounter an overlooked anomaly, forgotten concept, failed experiment, or abandoned relation whose significance was invisible in the earlier period. Aesthetic judgment can participate in the recognition of such generative potential: a strange pattern, elegant relation, unexpected analogy, or unresolved tension may attract attention before its epistemic importance is established. The evidential work begins after this recognition. Intergenerational memory therefore supports contingency by preserving heterogeneous materials from which future inquiry can emerge.

AI systems may increase the searchable range of research memory by supporting retrieval, comparison, translation, and synthesis across large archives. They can also compress provenance when generated summaries detach claims from their original context or when changing model infrastructures make earlier outputs difficult to reconstruct. AI-assisted cumulative research consequently benefits from source recoverability, version information, and clear separation between preserved records and later machine-generated interpretations. The generative capacity of AI becomes more valuable when it remains coupled to inspectable historical materials.

Proposition 6.539 (Future epistemic option value). *Preserving a research object together with sufficient provenance can create future epistemic option value when later questions, methods, evidence, or historical conditions make possible an informative use that was unavailable or unanticipated at the time of preservation.*

Proposition 6.539 does not imply indiscriminate retention. Storage, curation, privacy protection, security, and stewardship have costs, and some materials may require destruction or restricted retention. The proposition identifies a reason to evaluate preservation prospectively: deletion can close future trajectories that current

researchers are poorly positioned to foresee.

Open and cumulative research practice therefore links several commitments developed throughout Chapter 6. Inquiry is historically situated, methods and standards evolve, evidence remains partially incomplete, research is distributed across communities and infrastructures, theories are revisable objects, and failure can become knowledge when it remains reconstructable. Openness supports these commitments when research objects remain accessible under legitimate conditions, intelligible through provenance, and contestable through preserved alternatives. Cumulation supports them when later work can inherit prior achievements while also reconstructing their limits, revisions, and abandoned paths.

The resulting research programme remains bounded by practical and ethical limits. Documentation can become burdensome; infrastructures can fail; openness can expose vulnerable people or communities; preservation can reproduce classificatory harms; replication can be infeasible; and cumulative systems can privilege what is easiest to standardize. These limits require explicit treatment before Chapter 7 turns from research praxis to concrete methodology. Section 6.32 therefore examines the limits of research praxis itself.

6.32 Limits of Research Praxis

The preceding sections have described research praxis as relational, historically situated, methodologically plural, reflexive, increasingly distributed, and capable of cumulative revision. These capacities can expand what inquiry is able to encounter, represent, test, and preserve. They also operate within boundaries. This section identifies several such boundaries in order to clarify the conditions under which research claims remain proportionate to the practices that support them. The objective is neither to establish a general skepticism about inquiry nor to convert limitation into a virtue. It is to distinguish forms of partiality, dependence, and incompleteness that can persist even in careful research, and to show how these limits can become methodological design constraints. The discussion proceeds through partiality, interpretation, historical and institutional situatedness, computation, evidence, normativity, reflexivity, methodological integration, and the classification of praxis itself.

Definition 6.540 (Praxis limit). A *praxis limit* is a boundary on what a research configuration can presently encounter, represent, infer, integrate, evaluate, or justify under its available relations, evidence, methods, institutions, computational resources, and historical conditions.

Definition 6.540 is deliberately conditional. Some boundaries can be displaced when instruments improve, archives open, communities change, computational resources expand, or alternative methods become available. Other boundaries arise from more persistent features of inquiry, including finite attention, selective representation, dependence on interpretation, and the difficulty of occupying the full range of relevant standpoints within one research configuration. A useful account of limits therefore asks which boundary is being encountered, what produces it, whether it is movable, and what follows for the strength of the claim.

A limit can also be generative. A mismatch between what a project seeks to know and what its present configuration can support may redirect inquiry toward new evidence, collaborators, scales, or concepts. This possibility does not make the limit desirable in itself. It indicates that recognizing a boundary can become part of research orientation. The same aesthetic judgment that notices an anomaly or an unexpectedly fertile relation can sometimes notice the shape of a research programme's own insufficiency. Epistemic work then begins by determining whether that impression identifies a durable boundary, a temporary obstacle, or a weakness in the current representation.

6.32.1 Irreducible Partiality

Research proceeds through selection. Investigators choose objects, scales, variables, archives, participants, time intervals, languages, methods, and forms of representation. These selections can be justified and revised, yet they also produce a perspective from which some relations become comparatively visible while others remain peripheral. Section 6.8 located the researcher within a relational field; the present subsection draws a consequence from that location. A research configuration can achieve substantial knowledge without exhausting the relations through which its object exists.

Proposition 6.541 (Situated partiality). *For research on relational and historically evolving objects, the warrant of a claim is strengthened when the claim identifies the dimensions, scales, populations, temporal ranges, and evidential relations through which the object has been accessed, while leaving open dimensions that the research configuration did not adequately examine.*

Proposition 6.541 treats partiality as a condition to be described rather than a defect to be concealed. A national dataset may support strong claims about measured distributions while providing limited access to meanings produced within particular communities. An ethnographic study may reveal fine-grained relational mechanisms while leaving population prevalence uncertain. A formal model may clarify possible dynamics while remaining agnostic about whether its state variables correspond closely to an empirical system. The relevant limitation differs across these cases.

Partiality also occurs across scale. A relation that appears stable within an organization can depend on wider legal, infrastructural, ecological, or geopolitical arrangements. Conversely, a macro-level regularity can obscure local heterogeneity that becomes causally important under changing conditions. Multi-scale analysis can reduce some blind spots, although adding scales also increases demands on evidence and interpretation. The aspiration to include more relations can therefore encounter diminishing epistemic returns when integration becomes too weak to support the additional complexity.

This perspective cautions against equating partial knowledge with arbitrary knowledge. A telescope provides a partial view of the sky while still enabling highly warranted observations. A bounded archive can support reliable historical claims about the documents it contains while leaving questions about absent voices unresolved. Partiality concerns the relation between a claim and its accessible field. Its methodological implication is scope discipline: conclusions should travel only as far as their evidential and representational relations plausibly permit.

6.32.2 Interpretive Dependence

Research evidence becomes informative through concepts, categories, background assumptions, and interpretive practices. Contextual empiricism emphasizes that evidential relevance can depend on background assumptions and that critical interaction among perspectives contributes to the assessment of those assumptions (Longino 1990). Within the framework developed in this chapter, interpretive dependence appears whenever an observation has to be classified, translated, compared, or connected to a claim.

A recorded interview, for example, does not arrive with a uniquely determined analytical category. A statistical coefficient acquires substantive meaning through choices about operationalization, model structure, population, and causal interpretation. A legal document can be read as doctrine, institutional artifact, historical record, or evidence of a power relation. Each reading can be disciplined by evidence while still depending on an interpretive frame.

Definition 6.542 (Interpretive dependence). *Interpretive dependence* is the dependence of an evidential or theoretical conclusion on concepts, classifications, background assumptions, or meaning-making practices that mediate the relation between

encountered material and the claim drawn from it.

Interpretive dependence introduces at least two limits. First, some assumptions can remain tacit until disagreement, failure, or translation makes them visible. Second, alternative interpretations can sometimes remain compatible with the same available evidence. Section 6.18 treated translation as an operation with a remainder; interpretive dependence is one reason that remainder can matter. Moving from testimony to coded category, from institutional rule to variable, or from historical description to model parameter can preserve analytically useful structure while losing other relations.

The response is not to suspend interpretation. Research without interpretation would have difficulty connecting observations to questions. A more workable response is to make consequential interpretive choices contestable. Researchers can preserve primary materials where legitimate, state classification rules, compare plausible readings, invite criticism from differently positioned participants, and identify conclusions that depend strongly on one interpretive choice. Such practices can narrow uncertainty without claiming to eliminate mediation.

Interpretive plurality can also become excessive if alternative readings are treated as equally informative without further comparison. Evidence, coherence, domain knowledge, predictive performance, explanatory reach, and critical scrutiny can change the relative standing of interpretations. Humility therefore coexists with discrimination. The existence of interpretive dependence supports careful comparison rather than an inference that interpretation is unconstrained.

6.32.3 Historical Situatedness

Research questions, methods, categories, and standards of significance develop within historical trajectories. Kuhn's account of normal science and scientific change remains one influential description of how problem selection can be organized by historically specific disciplinary commitments (Kuhn 1962). Sections 6.21 and 6.22 extended this concern to the evolution of methods and evaluation. Historical situatedness places a limit on the ease with which present categories can be projected backward or present findings projected forward.

An economic category may acquire meaning within a particular institutional order. A diagnostic category can change with clinical practice and classification systems. Administrative data can preserve distinctions created for a previous policy regime. A model calibrated during one technological period may lose relevance after infrastructures or behavior change. These examples differ in substance, yet they share a temporal problem: the relations that make a category or regularity intelligible can themselves evolve.

Caution 6.543 (Temporal transport). A claim supported within one historical configuration should be transported across periods with attention to changes in institutions, categories, technologies, populations, meanings, and measurement relations that could alter the object under study.

Historical situatedness can also affect what researchers are able to recognize. Later investigators sometimes possess conceptual resources that make an earlier

pattern visible in a new way. Earlier researchers may preserve distinctions that later standardization has erased. Section 6.31 therefore treated intergenerational research memory as infrastructure for reinterpretation. The limit here is reciprocal: present researchers can recover earlier materials, yet their reconstruction is also performed from a later historical position.

This reciprocity encourages versioned knowledge. Rather than asking whether a category or theory is simply timeless or obsolete, researchers can examine the period in which it was generative, the relations it represented successfully, the transformations that weakened its fit, and the residual questions it leaves available for later inquiry. Historical reconstruction can then support transport without presuming invariance.

6.32.4 Institutional Dependence

Research requires infrastructures. Funding, laboratories, universities, archives, journals, legal permissions, data platforms, professional associations, ethics review, computing systems, and employment relations can affect which inquiries are feasible and which results become visible. Institutional dependence therefore concerns more than administrative context. It can shape access, time horizons, categories, incentives, standards of credibility, and the distribution of epistemic authority.

Bourdieu and Wacquant's reflexive sociology provides one established vocabulary for examining how fields, positions, and forms of capital enter intellectual practice (Bourdieu and Wacquant 1992). The relational approach taken here is compatible with the narrower proposition that research positions can influence access and orientation without mechanically determining the truth or falsity of a resulting claim. Section 6.25 similarly separated epistemic justice from evidential warrant while showing that power can affect whose observations receive uptake.

Institutional dependence can create several types of limit. Proprietary datasets can make external scrutiny difficult. Short funding cycles can discourage research whose evidential horizon is long. Publication incentives can favor visible positive findings over less dramatic negative results, as discussed in Section 6.30. Language regimes can make some communities easier to cite than others. Security or privacy rules can legitimately restrict access while also limiting independent verification. Research employment can place practical constraints on which questions an investigator is able to pursue.

Proposition 6.544 (Institutional condition of inquiry). *When institutional arrangements materially affect research access, incentives, preservation, contestability, or interpretive authority, those arrangements form part of the conditions under which the resulting knowledge claims are produced and evaluated.*

Proposition 6.544 does not imply that institutional origin settles epistemic standing. A privately funded result can be well supported; a publicly funded result can be weak. The proposition instead identifies institutional relations that may become relevant to assessment. Disclosure, independent replication, plural funding sources, community governance, open materials, or protected access arrangements can sometimes reduce particular dependencies. Other dependencies remain because sustained research requires organized resources of some kind.

The methodological challenge is therefore to distinguish dependence from capture. Dependence is widespread wherever inquiry requires infrastructure. Capture is a stronger diagnosis involving a relation in which institutional interests substantially constrain questions, evidence, interpretation, or dissemination in ways that undermine the relevant epistemic or ethical standards. That distinction should be established through evidence rather than presumed from organizational affiliation.

6.32.5 Computational Limits

Computational capacity expands the range of models, simulations, searches, comparisons, and AI-assisted operations available to research. It also has boundaries. Turing's formalization of effective computation established that well-defined mathematical decision problems can exist for which a general mechanical procedure is unavailable (Turing 1937). Many practical research limits arise at less fundamental levels: tractability, memory, data quality, algorithmic approximation, model size, energy, latency, and human capacity to inspect computational outputs.

These levels should be distinguished. A problem can be computable in principle while remaining impractical at the required scale. A tractable algorithm can operate on data that poorly represent the relevant relation. A powerful predictive system can remain difficult to interpret for the purpose at hand. An AI system can rapidly generate candidate explanations while leaving source verification or normative judgment unresolved. Section 6.27 therefore treated computational abundance as capable of relocating scarcity toward orientation, judgment, verification, and responsibility.

Definition 6.545 (Computational research limit). A *computational research limit* is a boundary arising from formal computability, practical tractability, resource requirements, data representation, model architecture, or the capacity to validate and interpret computational operations within the relevant research task.

This definition prevents several different problems from being collapsed into one claim that a task is “too complex.” If the main limitation is runtime, approximation may be appropriate. If the limitation lies in representation, more computation can amplify the wrong abstraction. If the limitation lies in validation, a larger model can increase the volume of outputs faster than the research community can evaluate them. If the limitation is formal, engineering effort may not remove it within the stated problem class.

Computational limits also have institutional dimensions. Access to advanced computing, proprietary models, specialized datasets, and technical expertise is uneven. Consequently, the practical frontier of computable research differs across laboratories, countries, organizations, and historical periods. A method that appears reproducible in principle may be difficult to reproduce under materially different infrastructure. Reporting computational dependencies therefore contributes to the scope discipline developed throughout this chapter.

6.32.6 Evidential Limits

Evidence is frequently incomplete, selective, noisy, historically damaged, or produced through measurement relations that require interpretation. Section 6.24

developed research under incomplete evidence; the present subsection concerns a broader limit on inferential closure. Quine's holistic account of confirmation emphasized that statements confront experience within wider webs of belief (Quine 1951), while contemporary discussions of underdetermination distinguish several ways in which available evidence can leave more than one theoretical response open (Stanford 2023).

Within a generative relational framework, evidential limits can arise because the object itself changes while it is being studied, because relevant relations leave weak traces, because records were produced for purposes different from the research question, or because causal pathways are only partially observable. Evidence can also be abundant while remaining narrow: millions of transactions may describe behavior within a platform while offering limited information about activity excluded from that platform.

A useful response is graded warrant. Claims can be differentiated by the strength, diversity, independence, and relevance of the evidence supporting them. Convergent evidence from different methods can increase confidence when the methods have sufficiently independent failure modes. Contradictory evidence can indicate heterogeneity, measurement problems, historical change, or a weakness in the proposed relation. Missing evidence should remain visible where its absence could materially alter the conclusion.

Caution 6.546 (Closure under incomplete evidence). Practical research closure can be appropriate before epistemic completion when the remaining uncertainty, missing evidence, and plausible alternatives are documented at a level proportionate to the consequence of the claim or decision.

Caution 6.546 restates the distinction between practical closure and epistemic completion developed in Section 6.24. It becomes especially important in applied and policy-relevant research, where postponing judgment can itself have consequences. The appropriate evidential threshold can vary with reversibility, stakes, available alternatives, and the cost of additional inquiry. The limitation is therefore not resolved by one universal threshold.

Preservation can mitigate some evidential limits over time. New methods can recover patterns from old data, newly opened archives can alter historical interpretation, and later observations can test earlier conjectures. Yet some evidence disappears irreversibly. Research design can consequently include preservation as a prospective response to uncertainty about which traces future inquiry may require.

6.32.7 Normative Limits

Research praxis often intersects with questions of justice, welfare, responsibility, legitimacy, harm, and desirable futures. Evidence can inform these questions by describing consequences, distributions, causal pathways, institutional histories, and feasible alternatives. It can also reveal that a normative proposal rests on mistaken empirical assumptions. Such contributions do not by themselves establish a uniquely warranted ranking among plural values.

Normative limits become visible when empirical findings are asked to carry evalu-

ative conclusions for which additional premises are required. A finding that one policy increases aggregate income does not by itself settle the importance of distribution, rights, ecological effects, or procedural legitimacy. Evidence that an intervention is effective at achieving a specified objective does not establish that the objective should dominate competing aims. Conversely, normative commitments that ignore relevant empirical consequences can become practically fragile.

Definition 6.547 (Normative remainder). A *normative remainder* is the portion of an evaluative judgment that remains dependent on ethical, political, legal, aesthetic, or other value commitments after the relevant empirical and causal questions have been examined as far as the research configuration presently permits.

The normative remainder does not imply that evaluation is arbitrary. Reasons can be articulated, principles compared, affected parties consulted, legal commitments interpreted, and consequences examined. The point is that empirical research and normative justification have partly distinct burdens. Section 6.26 distinguished aesthetic, epistemic, normative, and practical judgment for a similar reason: interaction among these forms of judgment is common, while substitution among them can obscure what supports a conclusion.

Normative limits also constrain research itself. Some evidence could be obtained only through practices that are ethically unacceptable. Some datasets should remain restricted because disclosure would expose vulnerable people. Some experimental interventions may create risks disproportionate to their expected epistemic value. These constraints reduce accessible evidence while expressing commitments that form part of responsible inquiry. The epistemic cost should be acknowledged rather than treated as if the inaccessible evidence did not exist.

6.32.8 Limits of Reflexivity

Reflexivity helps researchers examine how their positions, categories, instruments, incentives, and interventions participate in knowledge production. Section 6.20 treated reflexivity as a disciplined investigation of plausible pathways through which research can modify its field. Reflexivity itself remains situated. A researcher can identify some assumptions while remaining unaware of others; a team can criticize an institutional arrangement while sharing background commitments that make another arrangement difficult to imagine.

This creates a recursive problem. A reflexive account can itself become an object of reflexive examination. Further reflection may expose new assumptions, yet the process does not yield an obvious point at which the investigator can claim complete self-transparency. Bourdieu and Wacquant's reflexive programme is useful here precisely because reflexivity is directed toward the social conditions of intellectual practice rather than reduced to introspective sincerity (Bourdieu and Wacquant 1992).

Proposition 6.548 (Bounded reflexivity). *Reflexive inquiry can improve the visibility and contestability of consequential research conditions without requiring a claim that the researcher or research collective has made its own position fully transparent.*

Bounded reflexivity suggests several practical supports: diverse collaborators, external critique, participant feedback, audit trails, preregistered assumptions where

appropriate, institutional disclosure, version histories, and deliberate comparison with alternative conceptual schemes. These practices create additional viewpoints from which hidden dependencies can become visible. They also carry costs and can generate new blind spots. A larger deliberative group may increase perspective diversity while creating coordination pressures that suppress minority interpretations.

Reflexivity therefore benefits from proportionality. Research on a consequential classification system may warrant extensive examination of researcher position and institutional incentives. A narrowly technical calibration may require less. Reflexivity becomes unproductive when it expands without a plausible relation to the warrant, ethics, or consequences of the research object. The relevant question is which reflexive pathway could materially alter interpretation or responsibility.

6.32.9 Limits of Methodological Integration

Methodological pluralism can expose relations that one method alone would miss. Sections 6.14–6.18 developed this argument through plural inquiry, mutual correction, and translation across representations. Integration nevertheless has limits. Formal, quantitative, historical, ethnographic, interpretive, legal, and computational methods can operate with different objects, standards of evidence, temporalities, and forms of abstraction. Their outputs may be mutually informative without becoming fully commensurable.

A temptation in interdisciplinary research is to seek one super-representation into which each method can be translated. Such a representation can be useful for a specific problem, yet the translation can remove precisely the feature that made one method informative. Turning a legal distinction into a binary variable can support statistical analysis while losing doctrinal ambiguity. Converting an ethnographic relation into a network edge can make structural comparison possible while compressing meaning and temporal sequence. Rendering historical change as model states can reveal dynamics while weakening the specificity of contested periodization.

Definition 6.549 (Integration remainder). An *integration remainder* is a consequential feature of a method, evidence form, or representation that is not adequately preserved when heterogeneous research outputs are combined within a common analytical structure.

Integration remainders suggest that synthesis can preserve interfaces rather than demand complete fusion. A study may place a formal model beside historical reconstruction and specify where they constrain one another. Quantitative results can define a population pattern while qualitative inquiry investigates mechanisms in selected cases. Legal analysis can establish institutional categories that become conditions in an economic model while retaining doctrinal uncertainties outside the model. These arrangements support coordination without claiming a single metric of validity.

Methodological conflict can also remain unresolved. Two well-executed approaches may generate interpretations that remain unreconciled because they rely on different boundaries, scales, or ontological commitments. Section 6.17 treated such disagreement as potentially diagnostic. The limit of integration is reached when additional translation would create more apparent unity than epistemic gain.

Preserving the disagreement can then be more informative than forcing synthesis.

6.32.10 Limits of Praxis Classification

Chapter 6 has distinguished research-dominant and application-dominant praxis through their principal contradictions and orientations. This distinction organizes the transition between the present chapter and the application-oriented chapters that follow. It should also remain available for revision. Actual projects can combine inquiry, intervention, administration, care, advocacy, design, and institutional maintenance in configurations that change over time.

A field experiment, for example, may begin as research-dominant praxis and become application-dominant when participants depend on the intervention. A humanitarian programme may begin with urgent application and later generate a research infrastructure. A public-interest technology project may alternate rapidly between design, evidence gathering, deployment, monitoring, and political negotiation. Human–AI research collectives can further blur older institutional cues because generation, evaluation, and operational action can occur within the same technical workflow.

Caution 6.550 (Praxis classification). The categories of research-dominant and application-dominant praxis should be used as analytical orientations whose relevance is assessed from the configuration's current contradictions, responsibilities, and closure conditions, rather than inferred solely from the institution or occupation in which the activity occurs.

This caution preserves the analytical value of classification while acknowledging mixed and transitional cases. Classification can be revised when the principal contradiction changes. Some projects may also contain several sub-configurations with different orientations: a clinical trial can include research-dominant analysis, application-dominant patient care, regulatory evaluation, and infrastructure maintenance at the same time. The task is to identify which orientation governs the particular decision or relation under examination.

The classification also has normative consequences. Research-dominant praxis may tolerate extended uncertainty that application-dominant praxis may not permit to the same degree. Application can impose duties of care or reversibility that a purely epistemic description would understate. Conversely, urgency in application can create pressure to present provisional evidence as settled. Identifying the dominant praxis orientation helps specify which closure conditions and responsibilities are currently salient without pretending that one category exhausts the project.

The limits developed across this section therefore function as a map of methodological obligations. Partiality calls for scope discipline. Interpretive dependence calls for contestable classification and recoverable translation. Historical situatedness calls for temporal specification and versioned knowledge. Institutional dependence calls for attention to access, incentives, and authority. Computational limits call for distinctions among computability, tractability, representation, and validation. Evidential limits call for graded warrant and documented uncertainty. Normative limits call for explicit value premises and ethical constraints. Bounded reflexivity calls for proportionate examination of the researcher's own conditions. Integration limits call for

preserved remainders and interfaces among methods. Praxis classification calls for revisable orientation rather than fixed institutional labels.

Taken together, these limits do not close the research programme. They help specify where methodological design begins. A methodology can be understood partly as an organized response to recurrent limits of praxis: a way of choosing observations, constructing representations, testing relations, preserving uncertainty, and making revision possible under finite conditions. The closing section of this chapter therefore turns from the general praxis of inquiry to the methodological commitments that prepare Chapter 7.

6.33 From Research Praxis to Research Methodology

The chapter has approached research through praxis before turning to methodology. This ordering matters. Methods enter inquiry within a prior configuration of questions, relations, institutional conditions, evidential access, judgments, responsibilities, and limits. The role of this closing section is to translate the chapter's praxis-level commitments into methodological requirements while preserving the distinction between a research orientation and a concrete technique. The objective is therefore transitional: to specify how research design, method selection, method combination, relational standards, generative standards, formal and empirical inquiry, and reuse within application-dominant praxis can be organized by the account developed in Sections 6.1–6.32. The section does not attempt to provide the detailed procedures of relational inquiry. Those procedures begin in Chapter 7. Its task is to clarify what such procedures should remain answerable to.

A methodology can be understood here as an organized relation among a research question, a provisional object, a field of possible evidence, a set of operations for producing or interpreting evidence, standards of warrant, and procedures for revision. This formulation places technique inside a wider design problem. A survey, archival reconstruction, simulation, interview, network model, statistical estimator, ethnography, legal analysis, or AI-assisted workflow acquires methodological meaning through the role it performs within that relation.

Definition 6.551 (Methodological configuration). A *methodological configuration* is a revisable arrangement linking a research question, provisional research object, boundary and scale choices, evidence-generating or evidence-interpreting operations, inferential standards, ethical constraints, and procedures for comparison and revision.

Definition 6.551 provides a bridge between research praxis and the more concrete discussions that follow. It also preserves the chapter's emphasis on relationality. A method is rarely informative in isolation from the object it constructs, the evidence it can access, the transformations it performs, and the claims for which it is used.

6.33.1 Research Praxis and Research Design

Research design gives a practical form to an orientation of inquiry. The preceding chapter sections have shown that orientation can begin before evidence is complete and can be influenced by contingent encounter, salience, aesthetic judgment, institutional position, prior theory, available methods, and practical constraints. Research design converts that open orientation into a sufficiently structured configuration for inquiry to proceed.

This conversion should remain visible. A design does more than choose a sample or schedule a sequence of methods. It specifies what is being treated as the provisional object of inquiry, which relations enter the analytic field, which boundaries and scales are initially relevant, what kinds of evidence could alter the working interpretation, and which forms of uncertainty are expected to remain. In relational research, design therefore includes decisions about the architecture through which an object becomes investigable.

The chapter's distinction between research-dominant and application-dominant praxis also affects design. Research-dominant praxis can sometimes preserve uncertainty for longer periods because its principal activity is inquiry. Application-dominant praxis can impose earlier closure when decisions have to be made under finite time, responsibility, or resource conditions. Section 6.32 cautioned that these categories are orientations rather than institutional identities. Design should consequently respond to the current contradiction and responsibility structure of the project rather than infer its methodological form from whether the work takes place in a university, government, company, community organization, or laboratory.

Proposition 6.552 (Praxis-conditioned design). *A research design is methodologically stronger when its boundaries, evidence strategy, revision procedures, and closure conditions are explicitly related to the dominant questions, responsibilities, and limits of the praxis configuration in which the inquiry occurs.*

Proposition 6.552 does not require a complete map of the research situation before inquiry begins. Such completeness would conflict with the partiality and iterative reconstruction developed earlier in the chapter. It asks instead for recoverable design reasoning. Researchers should be able to explain why a particular object, boundary, scale, evidence source, or sequence of operations was initially selected and what kinds of encounter could justify changing that selection.

This creates a place for contingency within design. A design can be disciplined without becoming closed to the unexpected. Section 6.10 treated encounter as a basic moment of inquiry, while Sections 6.11–6.13 distinguished salience, judgment, and orientation. Methodological design can preserve channels through which anomalous observations, new archives, participant interpretations, unexpected model behavior, or cross-disciplinary encounters can reorganize the inquiry. The design is therefore structured enough to produce comparable evidence and open enough to register when its own structure has become part of the problem.

6.33.2 Method Selection

Method selection follows from the research problem more plausibly than from allegiance to a methodological camp. Section 6.14 defended methodological pluralism by treating historical, interpretive, qualitative, quantitative, formal, computational, legal, and institutional approaches as partially irreducible modes of access. The implication for selection is that a method should be justified by the relation between its operations and the question it is expected to illuminate.

This requires attention to both capability and distortion. A method makes some relations comparatively accessible while rendering others indirect or invisible. Administrative data can provide extensive coverage while inheriting categories created for administrative purposes. Interviews can reveal meaning and situated interpretation while remaining selective with respect to participants and retrospective accounts. Formal models can expose structural consequences of explicit assumptions while depending on the adequacy of those assumptions. Network representations can reveal patterns of connectivity while omitting relations that are difficult to encode as edges. AI-assisted systems can increase search, synthesis, and generation while creating new burdens of provenance, verification, and responsibility.

Methodological adequacy is therefore target-relative. The same method can be highly informative for one question and weak for another. The relevant question is not whether a method is advanced, fashionable, computationally powerful, or traditionally authoritative. It is whether its evidential and representational operations are appropriate to the claim being pursued.

Definition 6.553 (Methodological adequacy). *Methodological adequacy* is the degree to which a method's operations, assumptions, evidential access, and characteristic limitations are suitable for investigating the specified research object and supporting the intended class of claims.

Methodological adequacy can change during research. A question initially framed as a problem of distribution may become a problem of classification after archival inquiry reveals that the categories have changed historically. A network model can become insufficient when fieldwork shows that apparently identical ties carry different institutional meanings. A qualitative interpretation may require quantitative comparison when the inquiry shifts from mechanism discovery toward prevalence. Method selection should therefore remain revisable in response to what the research process reveals.

This revisability also helps protect contingent encounter from being filtered out too early. A method can guide attention without exhausting the possible significance of what is encountered. When something appears important outside the method's representational vocabulary, the appropriate response may be to extend the method, add another method, revise the object, or preserve the encounter for later inquiry. Aesthetic judgment can initiate that redirection by recognizing an unusual relation or pattern; epistemic judgment then determines whether the resulting methodological change is warranted.

6.33.3 Method Combination

Method combination becomes useful when different methods provide access to different properties of the same research configuration or when one method can test assumptions that another method leaves weakly examined. Sections 6.16–6.19 developed this possibility through plural inquiry, mutual correction, translation, and iterative reconstruction. Combination is therefore more demanding than placing several methods beside one another.

A combined design should specify the relation among its components. One method may generate categories that another estimates at scale. Historical inquiry may define the temporal boundaries within which a statistical model is meaningful. Interviews may identify mechanisms later represented formally. A simulation may expose implications that return the researcher to an archive in search of previously unnoticed evidence. Legal analysis may identify institutional constraints that change the interpretation of observed behavior. These relations can be sequential, recursive, comparative, nested, or partially independent.

Proposition 6.554 (Relational method combination). *Method combination becomes epistemically informative when the contribution of each method, the translations among representations, and the points at which methods can confirm, challenge, or reframe one another are made sufficiently explicit for the combined inference to be*

reconstructed.

This proposition preserves the idea of a translation remainder from Section 6.18. Moving from interview themes to variables, from archival categories to model states, or from legal concepts to network relations can create useful correspondences while leaving some meaning behind. A combined methodology should record consequential transformations rather than allow them to disappear inside a final integrated result.

Combination can also reveal disagreement that should remain unresolved. Section 6.17 treated disagreement among competent methods as potentially informative. Historical evidence and contemporary survey evidence may describe different periods rather than mutually falsifying accounts. A formal model and an ethnographic reconstruction may disagree because the formal variables omit a locally decisive relation. Two datasets may diverge because their sampling infrastructures reach different populations. Integration is strongest when it can diagnose these differences rather than convert them prematurely into one number or narrative.

The practical consequence is selective combination. Adding methods can increase evidential coverage, but it also increases translation costs, interpretive complexity, resource demands, and opportunities for incoherence. The methodological question concerns which additional relation of evidence is worth constructing. A smaller configuration with clear mutual correction can be more informative than a broad collection of weakly connected methods.

6.33.4 Standards for Relational Inquiry

Relational inquiry requires standards suited to claims about relations, configurations, fields, and relational histories. Chapter 5 developed the epistemic side of this problem, including evidence for relational claims, uncertainty, higher-order relations, fields, identity, persistence, and attribution. Research praxis adds design requirements concerning how these standards are operationalized.

At a minimum, a relational claim should clarify what entities or provisional entities participate in the relation, what kind of relation is proposed, the scale and temporal interval at which it is asserted, the evidence through which the relation is accessed, and the uncertainty surrounding its identification. Depending on the question, further requirements may include direction, intensity, reciprocity, duration, dependence, symbolic mediation, institutional embedding, or relations among relations. Chapter 7 develops these dimensions in procedural detail.

The chapter's ontological suspension remains important here. A network edge, field coordinate, statistical dependence, legal relation, interview-reconstructed obligation, or historical connection can function as a representation of a relation without establishing that these representations share one ultimate ontology. Methodological standards should therefore distinguish representational usefulness from ontological commitment.

Claim 6.555 (Minimum relational specification). *Within the present framework, a relational claim should ordinarily identify its candidate relation, relevant participants or positions, boundary and scale, temporal scope, evidential route, and principal uncer-*

tainty at a level sufficient for later scrutiny and revision.

The qualifier in Claim 6.555 is intentional. Some exploratory inquiries begin before several of these dimensions can be specified with confidence. The claim concerns reporting and warrant rather than the requirement that inquiry begin with a fully defined relational ontology. Exploratory research can discover the relevant relation through the inquiry itself, provided that later claims preserve the history of that reconstruction.

Relational standards also involve negative and absent relations. Failure to observe a connection can arise from genuine absence, limited access, poor measurement, inappropriate scale, or a representation that does not readily encode the relevant form of relation. Chapter 7 therefore treats missingness and relation uncertainty as methodological objects rather than residual nuisances. This continues the discipline developed in Section 6.30, where negative results were separated from failed research.

6.33.5 Standards for Generative Inquiry

Generative inquiry asks a stronger class of questions than relational identification alone. It concerns what relations, configurations, institutions, resources, or interventions contribute to the formation of subsequent capacities, relations, structures, values, constraints, or possibility spaces. Chapter 5 distinguished evidence that a relation exists from evidence that a relation contributes to a later generative effect. Methodology should preserve that distinction.

A generative claim therefore requires attention to sequence and transformation. Researchers need to specify the target of generation, the relevant temporal horizon, the proposed pathway or mechanism, plausible alternative explanations, and the evidence connecting earlier conditions to later changes. The generative effect can also be scale-dependent. A relation that expands one actor's capacity can constrain another actor or narrow a collective possibility space. Normative evaluation should consequently remain distinct from the descriptive claim that generation occurred.

Definition 6.556 (Generative methodological burden). The *generative methodological burden* is the additional evidential and interpretive work required to move from identifying a relation or configuration to supporting a claim about its contribution to later capacities, relations, structures, values, constraints, or possibilities across a specified temporal and relational scope.

This burden can be addressed through several forms of evidence: longitudinal observation, historical reconstruction, mechanism tracing, comparative analysis, intervention, simulation, formal analysis, repeated observation, and combinations of these approaches. The appropriate configuration depends on the target. A claim about institutional capacity formation can require a different evidence architecture from a claim about network diffusion, educational development, value conversion, or ecological regeneration.

Generative inquiry also benefits from preserving branch points and unrealized possibilities. A trajectory that produced one observed outcome may have passed through moments at which alternative relations could plausibly have generated dif-

ferent paths. Historical and counterfactual analysis can help identify such branching, while formal or computational models can clarify possible dynamics under explicit assumptions. These representations should remain proportionate to the available evidence. A simulated possibility is evidence about the implications of a model; it is not by itself evidence that the modeled pathway occurred historically.

The distinction between generation and desirability remains methodologically important. A process can be highly generative in the sense of producing new capacities or relations while also producing domination, exclusion, extraction, ecological damage, or unequal conversion power. Later GRE chapters therefore require descriptive generative inquiry to interface with normative and political-economic analysis rather than allowing the language of generation to carry an implicit positive valuation.

6.33.6 Formal and Empirical Methods within Research-Dominant Praxis

Formal and empirical methods can perform complementary roles within research-dominant praxis. Section 6.16 distinguished major modes of inquiry, while Section 6.17 emphasized mutual correction. The transition to methodology requires a more operational statement of this relation.

Formal methods can clarify assumptions, derive implications, identify structural possibilities, expose internal inconsistency, compare dynamic regimes, or construct representations whose consequences are difficult to track verbally. Empirical methods can assess whether the relevant relations, distributions, mechanisms, or trajectories appear in observed settings and can challenge assumptions that seemed plausible inside a formal representation. Historical and interpretive methods can further identify whether formal variables preserve the meaning, sequence, and institutional specificity of the phenomena they are meant to represent.

The resulting relation is recursive. Formalization can suggest measurements. Measurement can reveal heterogeneity that requires a new formal distinction. Historical inquiry can show that a parameter or category changes meaning across periods. Field observation can reveal an omitted interaction. Simulation can expose a possible attractor that motivates a new empirical search. An unexpected empirical pattern can become a contingent encounter whose aesthetic or theoretical salience redirects formal work.

Remark 6.557 (Formal–empirical reciprocity). Formal and empirical methods can be organized as reciprocally revising instruments: formalization makes assumptions and implications comparatively explicit, while empirical and historical inquiry test the adequacy, scope, and interpretation of those representations.

This reciprocity should not be converted into a requirement that each project contain both formal and empirical components. Some questions are appropriately historical, interpretive, conceptual, legal, or theoretical. The relevant requirement is local adequacy. Where formal and empirical methods are combined, their interface should make clear which statements arise from assumptions, which arise from observed evidence, and which depend on the translation between them.

AI-assisted research adds another layer to this interface. AI systems can help gen-

erate formalizations, code, candidate models, literature syntheses, interpretations, or empirical patterns. Their contribution can accelerate recursive inquiry while increasing the importance of provenance and verification. The chapter's earlier conclusion remains applicable: greater generative capacity can relocate scarcity toward orientation, judgment, checking, and responsible closure. Methodology should therefore record where machine-mediated transformations materially enter the evidential chain.

6.33.7 Reuse of Methods within Application-Dominant Praxis

Methods developed for research-dominant praxis often travel into application. Statistical estimators become decision tools; simulations become planning instruments; ethnographic findings influence service design; network analysis informs intervention; legal interpretation structures compliance; AI systems classify cases or generate recommendations. Reuse creates continuity between research and application, but it also changes the conditions under which methodological adequacy should be evaluated.

An application places methods inside a decision relation. The method can affect access, allocation, treatment, exposure, classification, prioritization, or institutional response. This can raise requirements concerning timeliness, interpretability, robustness, reversibility, distributive effects, contestability, and responsibility that were less central in the original research setting. A model that is useful for exploratory explanation may be insufficient for allocating high-stakes resources. An interpretive category developed for analysis may become harmful when operationalized as an administrative label. A historical association can be informative without supporting intervention.

Caution 6.558 (Method transfer across praxis). When a method moves from research-dominant into application-dominant praxis, its previous evidential performance should not be treated as sufficient evidence of practical adequacy. The decision context, affected relations, error consequences, reversibility, normative constraints, and available forms of contestation require renewed assessment.

Caution 6.558 follows from the chapter's broader account of praxis. Method transfer changes relations. It can alter who is affected, what counts as failure, how quickly revision can occur, and who bears the cost of error. The method itself may also become generative: classification can reorganize behavior, prediction can change institutional response, and intervention can create the evidence later used to evaluate the method.

This makes monitoring part of methodological reuse. Application can generate new evidence about the method under conditions that were absent from research. Unexpected outcomes can require recalibration, redesign, suspension, or return to research-dominant inquiry. The coupling between research and application developed in Section 6.6 therefore continues methodologically as a cycle of deployment, observation, interpretation, revision, and renewed judgment.

The distinction also protects against methodological prestige. A method does not become suitable for application merely because it is mathematically sophisticated, statistically accurate, historically respected, or generated by a powerful AI system.

Practical adequacy depends on the relations through which the method acts and on the responsibilities attached to those relations.

6.33.8 Transition to Methodologies of Relational Inquiry

The movement from research praxis to methodology can now be stated more precisely. Research praxis identifies the conditions under which inquiry takes place: finite attention, contingent encounter, situated researchers, plural methods, historical change, institutional power, incomplete evidence, distributed knowledge, machine mediation, failure, cumulative memory, and persistent limits. Methodology organizes concrete procedures in response to those conditions.

Several commitments therefore carry forward into Chapter 7. Research questions should precede automatic method choice. Objects, boundaries, and scales should remain provisional where the inquiry warrants revision. Relations should be specified through evidence rather than inferred from vocabulary alone. Methods should be evaluated for local adequacy, their combinations should preserve translation remainders, and disagreement should remain visible when synthesis would exceed the evidence. Provenance, uncertainty, negative results, and historical context should remain recoverable. Formal, empirical, historical, qualitative, interpretive, legal, and computational approaches should be allowed to correct one another without assuming a universal hierarchy. Ethical and institutional conditions should enter methodology when they materially shape access, evidence, representation, or consequence.

Generative inquiry adds a further commitment: research should distinguish evidence that a relation exists from evidence about what that relation contributes to subsequent change. This distinction is especially important for GRE, where later chapters examine how economic arrangements participate in the production, conversion, circulation, capture, dissipation, and regeneration of heterogeneous forms of value and capacity. The methodological chapters prepare the evidential infrastructure for those substantive claims.

Proposition 6.559 (Praxis-to-methodology transition). *Within the present framework, the transition from research praxis to methodology consists in converting recurrent conditions of inquiry into explicit design choices, evidential procedures, standards of warrant, and revision mechanisms while retaining the possibility that the research process can revise its own initial configuration.*

This proposition also explains why methodology does not close the space of encounter. A method is a disciplined way of entering a field of possible evidence, yet research can remain responsive to what its initial categories did not anticipate. Contingent encounter and aesthetic judgment retain a role at the methodological level because they can reveal where a design is too narrow, where a relation has been overlooked, or where a previously peripheral observation deserves sustained investigation. Their importance can increase in research environments where AI and computational systems make internally generated hypotheses, models, and candidate explanations abundant. Methodological discipline then includes the capacity to distinguish generative abundance from evidential warrant and to preserve encounters that may reorganize the research trajectory.

Chapter 7 begins from this point. It moves from the general praxis of inquiry to

the concrete methodologies through which relational objects are specified, bounded, observed, reconstructed, compared, measured, interpreted, and validated. The chapter will therefore treat research methodology as a revisable architecture of access and inference rather than a fixed menu of techniques. Chapter 8 subsequently extends that architecture from relational identification toward generative inquiry. The present chapter closes by leaving methodology with a demanding but limited task: to make inquiry sufficiently disciplined for its claims to be scrutinized and sufficiently revisable for new relations, evidence, and encounters to change what the inquiry can become.

References

- Althusser, Louis (2006). *For Marx*. Trans. by Ben Brewster. London: Verso.
- Anderson, P. W. (1972). “More Is Different: Broken Symmetry and the Nature of the Hierarchical Structure of Science”. In: *Science* 177.4047, pp. 393–396. doi: [10.1126/science.177.4047.393](https://doi.org/10.1126/science.177.4047.393).
- Aristotle (2014). *Nicomachean Ethics*. Trans. by C. D. C. Reeve. Indianapolis: Hackett Publishing Company.
- Battiston, Federico, Giulia Cencetti, Iacopo Iacopini, Vito Latora, Maxime Lucas, Alice Patania, Jean-Gabriel Young, and Giovanni Petri (2020). “Networks beyond Pair-wise Interactions: Structure and Dynamics”. In: *Physics Reports* 874, pp. 1–92. doi: [10.1016/j.physrep.2020.05.004](https://doi.org/10.1016/j.physrep.2020.05.004).
- Bender, Emily M., Timnit Gebru, Angelina McMillan-Major, and Margaret Mitchell (2021). “On the Dangers of Stochastic Parrots: Can Language Models Be Too Big?” In: *Proceedings of the 2021 ACM Conference on Fairness, Accountability, and Transparency*, pp. 610–623. doi: [10.1145/3442188.3445922](https://doi.org/10.1145/3442188.3445922).
- Benkler, Yochai (2002). “Coase’s Penguin, or, Linux and The Nature of the Firm”. In: *Yale Law Journal* 112.3, pp. 369–446. doi: [10.2307/1562247](https://doi.org/10.2307/1562247).
- Bordalo, Pedro, Nicola Gennaioli, and Andrei Shleifer (2012). “Salience Theory of Choice Under Risk”. In: *The Quarterly Journal of Economics* 127.3, pp. 1243–1285. doi: [10.1093/qje/qjs018](https://doi.org/10.1093/qje/qjs018).
- Bourdieu, Pierre (1977). *Outline of a Theory of Practice*. Trans. by Richard Nice. Cambridge: Cambridge University Press. doi: [10.1017/CB09780511812507](https://doi.org/10.1017/CB09780511812507).
- (1984). *Distinction: A Social Critique of the Judgement of Taste*. Trans. by Richard Nice. Cambridge, MA: Harvard University Press.
 - (1991). *Language and Symbolic Power*. Ed. by John B. Thompson. Cambridge, MA: Harvard University Press.
- Bourdieu, Pierre and Loïc J. D. Wacquant (1992). *An Invitation to Reflexive Sociology*. Chicago: University of Chicago Press.
- Burrell, Jenna (2016). “How the Machine ‘Thinks’: Understanding Opacity in Machine Learning Algorithms”. In: *Big Data & Society* 3.1. doi: [10.1177/2053951715622512](https://doi.org/10.1177/2053951715622512).
- David, Paul A. (1985). “Clio and the Economics of QWERTY”. In: *American Economic Review* 75.2, pp. 332–337.
- Desrosières, Alain (1998). *The Politics of Large Numbers: A History of Statistical Reasoning*. Trans. by Camille Naish. Cambridge, MA: Harvard University Press.
- Dewey, John (1910). *How We Think*. Boston: D. C. Heath & Company.
- (1922). *Human Nature and Conduct: An Introduction to Social Psychology*. New York: Henry Holt and Company.

- (1925). *Experience and Nature*. Chicago: Open Court Publishing Company.
- (1934). *Art as Experience*. New York: Minton, Balch & Company.
- (1939). *Theory of Valuation*. Chicago: University of Chicago Press.
- Duhem, Pierre (1954). *The Aim and Structure of Physical Theory*. Trans. by Philip P. Wiener. Princeton, NJ: Princeton University Press.
- Einav, Liran and Jonathan Levin (2014). “Economics in the Age of Big Data”. In: *Science* 346.6210, p. 1243089. DOI: [10.1126/science.1243089](https://doi.org/10.1126/science.1243089).
- Epstein, Joshua M. and Robert Axtell (1996). *Growing Artificial Societies: Social Science from the Bottom Up*. Cambridge, MA: MIT Press. ISBN: 9780262050531.
- Espeland, Wendy Nelson and Michael Sauder (2007). “Rankings and Reactivity: How Public Measures Recreate Social Worlds”. In: *American Journal of Sociology* 113.1, pp. 1–40. DOI: [10.1086/517897](https://doi.org/10.1086/517897).
- Espeland, Wendy Nelson and Mitchell L. Stevens (1998). “Commensuration as a Social Process”. In: *Annual Review of Sociology* 24, pp. 313–343. DOI: [10.1146/annurev.soc.24.1.313](https://doi.org/10.1146/annurev.soc.24.1.313).
- Fanelli, Daniele (2012). “Negative Results Are Disappearing from Most Disciplines and Countries”. In: *Scientometrics* 90.3, pp. 891–904. DOI: [10.1007/s11192-011-0494-7](https://doi.org/10.1007/s11192-011-0494-7).
- Foucault, Michel (1982). “The Subject and Power”. In: *Critical Inquiry* 8.4, pp. 777–795. DOI: [10.1086/448181](https://doi.org/10.1086/448181).
- Fraassen, Bas C. van (1980). *The Scientific Image*. Oxford: Oxford University Press. DOI: [10.1093/0198244274.001.0001](https://doi.org/10.1093/0198244274.001.0001).
- Franco, Annie, Neil Malhotra, and Gabor Simonovits (2014). “Publication Bias in the Social Sciences: Unlocking the File Drawer”. In: *Science* 345.6203, pp. 1502–1505. DOI: [10.1126/science.1255484](https://doi.org/10.1126/science.1255484).
- Frickel, Scott, Sahra Gibbon, Jeff Howard, Joanna Kempner, Gwen Ottinger, and David J. Hess (2010). “Undone Science: Charting Social Movement and Civil Society Challenges to Research Agenda Setting”. In: *Science, Technology, & Human Values* 35.4, pp. 444–473. DOI: [10.1177/0162243909345836](https://doi.org/10.1177/0162243909345836).
- Fricker, Miranda (2007). *Epistemic Injustice: Power and the Ethics of Knowing*. Oxford: Oxford University Press. DOI: [10.1093/acprof:oso/9780198237907.001.0001](https://doi.org/10.1093/acprof:oso/9780198237907.001.0001).
- Frischmann, Brett M. (2012). *Infrastructure: The Social Value of Shared Resources*. New York: Oxford University Press. DOI: [10.1093/acprof:oso/9780199895656.001.0001](https://doi.org/10.1093/acprof:oso/9780199895656.001.0001).
- Gadamer, Hans-Georg (2004). *Truth and Method*. Trans. by Joel Weinsheimer and Donald G. Marshall. 2nd ed. London: Continuum.
- Gangl, Markus (2010). “Causal Inference in Sociological Research”. In: *Annual Review of Sociology* 36, pp. 21–47. DOI: [10.1146/annurev.soc.012809.102702](https://doi.org/10.1146/annurev.soc.012809.102702).
- Gebru, Timnit, Jamie Morgenstern, Briana Vecchione, Jennifer Wortman Vaughan, Hanna Wallach, Hal Daumé III, and Kate Crawford (2021). “Datasheets for Datasets”. In: *Communications of the ACM* 64.12, pp. 86–92. DOI: [10.1145/3458723](https://doi.org/10.1145/3458723).
- Georgescu-Roegen, Nicholas (1971). *The Entropy Law and the Economic Process*. Cambridge, MA: Harvard University Press.
- Getzels, Jacob W. and Mihaly Csikszentmihalyi (1976). *The Creative Vision: A Longitudinal Study of Problem Finding in Art*. New York: John Wiley & Sons.

- Giddens, Anthony (1984). *The Constitution of Society: Outline of the Theory of Structuration*. Cambridge: Polity Press.
- Giere, Ronald N. (2004). “How Models Are Used to Represent Reality”. In: *Philosophy of Science* 71.5, pp. 742–752. DOI: [10.1086/425063](https://doi.org/10.1086/425063).
- (2006). *Scientific Perspectivism*. Chicago: University of Chicago Press. DOI: [10.7208/chicago/9780226292144.001.0001](https://doi.org/10.7208/chicago/9780226292144.001.0001).
- Gramsci, Antonio (2007). *Prison Notebooks*. Ed. and trans. by Joseph A. Buttigieg. Vol. 3. New York: Columbia University Press.
- Habermas, Jürgen (1971). *Knowledge and Human Interests*. Trans. by Jeremy J. Shapiro. Boston: Beacon Press.
- Hacking, Ian (2002). *Historical Ontology*. Cambridge, MA: Harvard University Press.
- Hansmann, Henry and Reinier Kraakman (2000). “The Essential Role of Organizational Law”. In: *The Yale Law Journal* 110.3, pp. 387–440.
- Hart, H. L. A. (2012). *The Concept of Law*. Ed. by Joseph Raz, Penelope A. Bulloch, and Leslie Green. 3rd ed. Oxford: Oxford University Press.
- Hess, Charlotte and Elinor Ostrom, eds. (2007). *Understanding Knowledge as a Commons: From Theory to Practice*. Cambridge, MA: MIT Press. ISBN: 9780262083577.
- Holme, Petter and Jari Saramäki (2012). “Temporal Networks”. In: *Physics Reports* 519.3, pp. 97–125. DOI: [10.1016/j.physrep.2012.03.001](https://doi.org/10.1016/j.physrep.2012.03.001).
- Husserl, Edmund (2012). *Ideas: General Introduction to Pure Phenomenology*. Trans. by W. R. Boyce Gibson. London: Routledge.
- Hutchins, Edwin (1995). *Cognition in the Wild*. Cambridge, MA: MIT Press. ISBN: 9780262082310.
- IFRS Foundation (2018). *Conceptual Framework for Financial Reporting*. London: IFRS Foundation.
- James, William (1890). *The Principles of Psychology*. 2 vols. New York: Henry Holt and Company.
- Kant, Immanuel (1987). *Critique of Judgment*. Trans. by Werner S. Pluhar. Indianapolis, IN: Hackett Publishing Company.
- Kivelä, Mikko, Alex Arenas, Marc Barthelemy, James P. Gleeson, Yamir Moreno, and Mason A. Porter (2014). “Multilayer Networks”. In: *Journal of Complex Networks* 2.3, pp. 203–271. DOI: [10.1093/comnet/cnu016](https://doi.org/10.1093/comnet/cnu016).
- Kroll, Joshua A., Joanna Huey, Solon Barocas, Edward W. Felten, Joel R. Reidenberg, David G. Robinson, and Harlan Yu (2017). “Accountable Algorithms”. In: *University of Pennsylvania Law Review* 165.3, pp. 633–705.
- Kuhn, Thomas S. (1962). *The Structure of Scientific Revolutions*. Chicago: University of Chicago Press.
- Longino, Helen E. (1990). *Science as Social Knowledge: Values and Objectivity in Scientific Inquiry*. Princeton, NJ: Princeton University Press.
- MacKenzie, Donald (2006). *An Engine, Not a Camera: How Financial Models Shape Markets*. MIT Press. ISBN: 9780262134606.
- Manski, Charles F. (2008). *Identification for Prediction and Decision*. Cambridge, MA: Harvard University Press. ISBN: 9780674026537.
- Mao, Tse-tung (1967). *Selected Works of Mao Tse-tung, Volume I*. Includes “On Contradiction” (August 1937). Peking: Foreign Languages Press.
- Marx, Karl (1859). *Zur Kritik der politischen Ökonomie*. Berlin: Franz Duncker.

- (1994). *Marx: Selected Writings*. Ed. by Lawrence H. Simon. Indianapolis: Hackett Publishing Company.
- Marx, Karl and Friedrich Engels (1970). *The German Ideology*. Ed. by C. J. Arthur. New York: International Publishers.
- McAllister, James W. (1996). *Beauty and Revolution in Science*. Ithaca, NY: Cornell University Press.
- Merleau-Ponty, Maurice (2012). *Phenomenology of Perception*. Trans. by Donald A. Landes. Abingdon, Oxon: Routledge.
- Murmann, Johann Peter (2003). *Knowledge and Competitive Advantage: The Coevolution of Firms, Technology, and National Institutions*. Cambridge: Cambridge University Press. DOI: [10.1017/CB09780511510953](https://doi.org/10.1017/CB09780511510953).
- Nelson, Richard R. (1994). “The Co-evolution of Technology, Industrial Structure, and Supporting Institutions”. In: *Industrial and Corporate Change* 3.1, pp. 47–63. DOI: [10.1093/icc/3.1.47](https://doi.org/10.1093/icc/3.1.47).
- Newman, M. E. J. (2003). “The Structure and Function of Complex Networks”. In: *SIAM Review* 45.2, pp. 167–256. DOI: [10.1137/S003614450342480](https://doi.org/10.1137/S003614450342480).
- North, Douglass C. (1990). *Institutions, Institutional Change and Economic Performance*. Cambridge: Cambridge University Press.
- Nosek, Brian A., George Alter, George C. Banks, et al. (2015). “Promoting an Open Research Culture”. In: *Science* 348.6242, pp. 1422–1425. DOI: [10.1126/science.aab2374](https://doi.org/10.1126/science.aab2374).
- Noy, Shakked and Whitney Zhang (2023). “Experimental Evidence on the Productivity Effects of Generative Artificial Intelligence”. In: *Science* 381.6654, pp. 187–192. DOI: [10.1126/science.adh2586](https://doi.org/10.1126/science.adh2586).
- Open Science Collaboration (2015). “Estimating the Reproducibility of Psychological Science”. In: *Science* 349.6251, aac4716. DOI: [10.1126/science.aac4716](https://doi.org/10.1126/science.aac4716).
- Ostrom, Elinor (1990). *Governing the Commons: The Evolution of Institutions for Collective Action*. Cambridge: Cambridge University Press. DOI: [10.1017/CB09780511807763](https://doi.org/10.1017/CB09780511807763).
- (2005). *Understanding Institutional Diversity*. Princeton, NJ: Princeton University Press. DOI: [10.2307/j.ctt7s7wm](https://doi.org/10.2307/j.ctt7s7wm).
- (2010). “Beyond Markets and States: Polycentric Governance of Complex Economic Systems”. In: *American Economic Review* 100.3, pp. 641–672. DOI: [10.1257/aer.100.3.641](https://doi.org/10.1257/aer.100.3.641).
- Peirce, Charles S. (1877). “The Fixation of Belief”. In: *Popular Science Monthly* 12, pp. 1–15.
- Pierson, Paul (2000). “Increasing Returns, Path Dependence, and the Study of Politics”. In: *American Political Science Review* 94.2, pp. 251–267. DOI: [10.2307/2586011](https://doi.org/10.2307/2586011).
- Popper, Karl R. (2002). *The Logic of Scientific Discovery*. 2nd ed. London: Routledge.
- Porter, Theodore M. (1995). *Trust in Numbers: The Pursuit of Objectivity in Science and Public Life*. Princeton, NJ: Princeton University Press.
- Quine, W. V. (1948). “On What There Is”. In: *The Review of Metaphysics* 2.5, pp. 21–38.
- (1951). “Two Dogmas of Empiricism”. In: *The Philosophical Review* 60.1, pp. 20–43. DOI: [10.2307/2181906](https://doi.org/10.2307/2181906).
- Rawls, John (1999). *A Theory of Justice*. Revised. Cambridge, MA: Harvard University Press.

- Ricoeur, Paul (1991). *From Text to Action: Essays in Hermeneutics, II*. Trans. by Kathleen Blamey and John B. Thompson. Evanston, IL: Northwestern University Press.
- Sen, Amartya (1987). *On Ethics and Economics*. Oxford: Basil Blackwell.
- (1999). *Development as Freedom*. Oxford: Oxford University Press.
- Sewell William H., Jr. (1992). “A Theory of Structure: Duality, Agency, and Transformation”. In: *American Journal of Sociology* 98.1, pp. 1–29. DOI: [10.1086/229967](https://doi.org/10.1086/229967).
- (1996). “Historical Events as Transformations of Structures: Inventing Revolution at the Bastille”. In: *Theory and Society* 25.6, pp. 841–881. DOI: [10.1007/BF00159818](https://doi.org/10.1007/BF00159818).
- Simon, Herbert A. (1971). “Designing Organizations for an Information-Rich World”. In: *Computers, Communications, and the Public Interest*. Ed. by Martin Greenberger. Baltimore, MD: Johns Hopkins Press, pp. 37–72.
- Stanford, Kyle (2023). *Underdetermination of Scientific Theory*. Stanford Encyclopedia of Philosophy, substantive revision 4 April 2023. URL: <https://plato.stanford.edu/entries/scientific-underdetermination/>.
- Stanford Institute for Human-Centered Artificial Intelligence (2026). *AI Index Report 2026*. Stanford, CA: Stanford University. URL: <https://hai.stanford.edu/ai-index/2026-ai-index-report>.
- Tesfatsion, Leigh (2006). “Agent-Based Computational Economics: A Constructive Approach to Economic Theory”. In: *Handbook of Computational Economics, Volume 2: Agent-Based Computational Economics*. Ed. by Leigh Tesfatsion and Kenneth L. Judd. Amsterdam: North-Holland, pp. 831–880.
- Turing, A. M. (1937). “On Computable Numbers, with an Application to the Entscheidungsproblem”. In: *Proceedings of the London Mathematical Society* s2-42.1, pp. 230–265. DOI: [10.1112/plms/s2-42.1.230](https://doi.org/10.1112/plms/s2-42.1.230).
- UNESCO (Nov. 23, 2021). *Recommendation on Open Science*. Paris: United Nations Educational, Scientific and Cultural Organization. URL: <https://www.unesco.org/en/legal-affairs/recommendation-open-science>.
- Veblen, Thorstein (1914). *The Instinct of Workmanship and the State of the Industrial Arts*. New York: The Macmillan Company.
- Wilkinson, Mark D., Michel Dumontier, IJsbrand Jan Aalbersberg, et al. (2016). “The FAIR Guiding Principles for Scientific Data Management and Stewardship”. In: *Scientific Data* 3, p. 160018. DOI: [10.1038/sdata.2016.18](https://doi.org/10.1038/sdata.2016.18).
- Winsberg, Eric (2010). *Science in the Age of Computer Simulation*. Chicago: University of Chicago Press.
- Wittgenstein, Ludwig (2009). *Philosophical Investigations*. Ed. by P. M. S. Hacker and Joachim Schulte. 4th ed. Chichester: Wiley-Blackwell.
- Woodward, James (2003). *Making Things Happen: A Theory of Causal Explanation*. New York: Oxford University Press. ISBN: 9780195155273. DOI: [10.1093/0195155270.001.0001](https://doi.org/10.1093/0195155270.001.0001).