Historical Difference Under Symbolic Equivalence

A Generative-Relational Position

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Abstract

In some classificatory practices, symbolic designations make distinctions communicable and actionable by gathering selected differences under a local criterion of equivalence. This position paper examines the limits of that operation from a generative-relational perspective. Its central claim is that symbolic equivalence can obscure differences in historically formed concepts, realized relational trajectories, and the generative conditions through which trajectories become possible. The equivalence criterion itself develops within particular histories and practices, giving symbolic sameness a purpose-relative scope. The paper proposes a deliberately local quotient-based formalization to identify the conditions under which a symbolic record suffices for a specified inference, while maintaining openness about wider generative-relational existence. It also considers cross-context interpretation, the practical feedback of classifications, and the revision of representational domains. Ontological openness provides a constructive methodological commitment while keeping questions about wider generative conditions available for inquiry. The result is a bounded philosophical argument for using symbols while preserving the limits of their interpretive authority.

Keywords: symbolic equivalence; generative-relational inquiry; historical difference; generative underdetermination; ontological openness.

Notice On The Local Scope Of Definitions. The definitions, formal distinctions, and mathematical constructions introduced in this paper are local to the present inquiry. They clarify particular arguments within this manuscript. Applications to other works, including related generative-relational research, require separate consideration of their assumptions, conceptual purposes, and historical-relational conditions. Propositions and corollaries are understood within their stated premises, and any future conjectures would require independent assessment. Formal domains and equivalence classes specify analytical boundaries while leaving the ontology of generative-relational existence open to further inquiry.

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1 Introduction

Two practices may be recorded under the same institutional category while having emerged through substantially different relations. A decision described as voluntary, a contribution registered as collaborative, or a body of work classified under a disciplinary label may acquire a common symbolic identity amid differing histories, dependencies, and possibilities of action. Such classifications can be informative and practically indispensable. They nevertheless preserve some distinctions while leaving others inaccessible at the level of the resulting label. The epistemic difficulty concerns the scope of the judgments licensed by a classification: a category suited to one purpose may conceal distinctions relevant to another. A shared symbol can support a warranted equivalence for a specified task while remaining insufficient to establish a more extensive sameness.

This paper considers that difficulty through a generative-relational (GR) perspective. Its central proposal extends the problem of representational compression to the historical formation of the domain and equivalence criterion themselves. The concepts available for classification, the relations by which equivalence is established, and the practices through which classifications acquire significance may themselves have histories of formation and change. A symbolic category is therefore intelligible partly in relation to the conditions under which certain differences became salient, comparable, or dispensable. Where a classification gathers historically differentiated cases, its shared designation alone leaves those distinctions unavailable to an observer. Where different generative arrangements yield similar recorded histories, even an apparently exhaustive account of past events may leave open differences in the capacities, dependencies, and conditional possibilities through which further events could arise.

The term *symbolization* is used here in a deliberately limited sense. The paper investigates those episodes of representation in which a plurality of concepts, trajectories, or generative descriptions is treated as equivalent under a locally specified criterion. The quotient construction familiar from mathematics provides a useful idealization of this operation: distinct elements may be mapped to a common equivalence class once a relation of equivalence is fixed. The analogy isolates a selected classificatory operation within the wider practices of language, semiosis, and conceptual thought. Symbols can also be ambiguous, compositional, productive, and open to reinterpretation, introducing distinctions that earlier practices had yet to articulate.

A further restriction concerns the relation between concepts and symbols. The expression *pre-symbolic concepts* designates a distinction internal to this analysis: conceptual positions available when a selected classification operates. Their broader histories may intertwine with language. Conceptual discrimination and symbol use may develop together, and inherited symbols can transform the distinctions that later become available to thought. The problem at issue is accordingly recursive: historical and relational conditions shape conceptual differentiations; a local act of symbolization organizes those differentiations according to an equivalence criterion; and the circulation of the resulting symbols may alter the conditions of subsequent conceptual formation. The history of a conceptual domain and its equivalence criterion thus becomes part of the evidence relevant to interpreting symbolic sameness.

The proposed distinction between *relational trajectory* and *generativity* is particularly consequential. A trajectory concerns an actually realized course of relations at an appropriate scale of description. Generativity concerns the capacities, constraints, enabling conditions, and processes relevant to the possible production or transformation of such courses. The relation between the two may be many-to-many. Different generative arrangements can sustain similar observed trajectories, and one arrangement can admit different trajectories under different conditions. Recovering a history can therefore motivate further inquiry into the conditions that enabled it and into unrealized alternatives. The paper uses *generative difference* to mark this additional question while keeping measures and inventories of generativity local

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to the relevant inquiry.

The inquiry enters a well-established philosophical conversation. Cassirer's account of symbolic forms locates language and other symbolic activities within the formation of meaningful human experience (Cassirer 1965). Bowker and Star's analysis of classification examines how categories and standards are embedded in infrastructures and social interaction (Bowker and Star 1999). Hacking's account of looping effects shows, for certain classifications of people, how the application of a category can contribute to changes in the subjects classified (Hacking 1996). These works provide resources for understanding symbols as historically active within the formation of experience, classifications, and subjects. Within this established conversation, the present paper connects three questions: how an equivalence criterion acquires local historical conditions, how it can obscure both realized relational differences and unrealized generative alternatives, and how the resulting symbolic determinacy can inform judgments while retaining openness about ontology.

This position is compatible with rigorous formalization, provided its scope remains explicit. Once a domain, an equivalence relation, and a target judgment are specified, one can ask whether information retained by a symbolic classification is sufficient for that judgment. A precise answer may be available within the chosen model. The legitimacy of extending that answer beyond the model is a further philosophical and evidential matter. The definitions and formal statements introduced below are therefore local constructions for this paper. Their interpretive authority is local to their stated domains; related GR inquiries require independent conceptual justification. In particular, observational underdetermination specifies an epistemic limitation; ontic indeterminacy requires its own argument.

Representational omission becomes philosophically consequential when differences suppressed by a classification matter for a subsequent inference, comparison, intervention, or normative judgment. The crucial issue is how the conditions licensing a classification support its later uses. A category suited to tabulation and a judgment about responsibility may require different evidence; a record of past patterns may leave future dispositions open. A constructive response specifies the conditions under which a local equivalence remains warranted, the differences relevant to further judgments, and the avenues through which inquiry can revise the classification.

Ontological openness has a positive methodological role in this account. Inquiry into generative conditions may extend recursively. Such extension remains compatible with rigorous local explanations and multiple possibilities concerning wider ontological structure. Ontological suspension here means calibrating claims of completeness to the concepts and evidence presently available. This stance keeps emergent relational and generative distinctions available for investigation as explanatory tools develop.

The paper develops this position in a bounded sequence. It first examines the historical formation of conceptual distinctions and then formulates contextual symbolic equivalence. Subsequent sections distinguish relational from generative residues, address translation between differently constituted contexts, and consider ontological openness amid continuing inquiries into generative origins. The final discussion traces the practical return of classifications into social relations and assesses their consequences for epistemic and normative judgment. Throughout, formal statements are placed where they clarify a specific inference, while the philosophical question remains the same: how far the determinacy afforded by symbols can legitimately extend into judgments about historically developing, generatively open relations.

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2 Historical Formation Of Concepts

An inquiry into symbolic equivalence begins by examining the conceptual domain to which a criterion of equivalence will be applied. A quotient construction can show how a given distinction disappears when two descriptions are assigned to a common class. Historical inquiry further examines the availability of descriptions, the practical grounds of comparison, and the formation of distinctions selected for omission. The conceptual domain therefore requires its own examination. In a generative-relational (GR) inquiry, conceptual articulation is approached through historically developing relations among subjects, practices, materials, inherited descriptions, and modes of attention. This approach makes the formation of conceptual distinctions an object of investigation while leaving open the ontological constitution of what those distinctions address.

A concept may provisionally be understood by its role in a field of discriminations, inferences, and practical engagements. An observer learns to distinguish a relevant occurrence from its surroundings, to associate it with possible explanations, and to anticipate which differences would alter an appropriate response. Such operations depend upon circumstances that extend beyond a private act of naming. Training establishes habits of attention; instruments make previously inaccessible variations available; cooperative activities stabilize criteria of relevance; institutions determine which classifications may circulate with authority. A history of concept formation can therefore contain changes in the possibilities of distinguishing, testing, and acting, even where the eventual verbal label remains unchanged. Conversely, a change of vocabulary may preserve substantial continuity in the underlying practices. Claims about conceptual continuity therefore require attention to the underlying practices alongside linguistic identity and variation.

The historical character of concepts has significant precedents. Fleck's account of the formation of a scientific fact expressly concerns the cultural conditioning and historical development of scientific concepts (Fleck 1979). Vygotsky's investigation of thought and language treats verbal thought as developmentally related to social speech, complicating an account in which words merely attach to independently completed concepts (Vygotsky 1986). Cassirer's inquiry into symbolic forms similarly directs attention to the contribution of symbolic activity to meaningful experience (Cassirer 1965). These projects approach the historical formation of meaning through distinct commitments. The present formal argument proceeds on its own stated premises. The particular proposal pursued below is to examine how historically formed conceptual distinctions become inputs to a subsequent, locally specified operation of symbolic equivalence.

For this purpose, the paper adopts one limited analytical convention. Let κ designate a context of inquiry, with its relevant historical and relational conditions left open to further specification. An investigator may provisionally identify a domain of conceptual positions and the distinctions supported by that context. The word *position* emphasizes the place of a concept within a field of historically developing relations. Its practical identity may depend on relations to other distinctions, customary applications, material supports, and inferential consequences. These features may evolve as the surrounding practices evolve. The following definition specifies a deliberately bounded analytical vocabulary.

Definition 2.1 (Local Conceptual Configuration). Relative to an inquiry context κ, a *local conceptual configuration* is a triple $\mathsf{C}_\kappa = (C_\kappa, D_\kappa, P_\kappa)$, where C_κ is a provisionally distinguished domain of conceptual positions, $D_\kappa \subseteq \{(c, c') \in C_\kappa \times C_\kappa : c \neq c'\}$ records ordered pairs of positions distinguished on grounds supported by the inquiry, and P_κ designates the relevant interpretive and practical operations through which some of these distinctions acquire consequences. Both D_κ and P_κ record the available scope of this inquiry and remain open to extension.

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The components of this construction have deliberately modest roles. The irreflexive relation D_κ records supported discriminations, including directed ones; further formal properties depend on their specification. The operations P_κ indicate why a distinction matters within the particular inquiry and its specified practical scope. Moreover, C_κ is indexed to a context and captures the conceptual positions currently admitted to analysis. The chosen domain of positions specifies an analytical boundary, whatever its admitted cardinality. The prospect of further conceptual development remains open beyond that representational boundary.

This distinction between a currently articulated configuration and its possible development is especially important when examining the relation of history to generativity. One may reconstruct how a community came to distinguish a signal from an artifact by tracing its instruments, calibration practices, inferential standards, and recurrent disputes. That reconstruction identifies an achieved pattern of conceptual differentiation. Yet the community's future ability to discover new sources of variation, revise a calibration method, or establish a novel evidential practice depends on generative conditions that the recovered classification may leave unspecified. A relational trajectory of conceptual change supplies evidence about how distinctions emerged, leaving further generative possibilities available for inquiry. The analysis therefore attends to realized developments and the conditions of further conceptual transformation.

Consider a laboratory in which a recorded fluctuation is assigned to the category *noise*. At one stage, the classification may be adequate for an instrument with known operating characteristics and for the decision then at hand. Subsequent changes in sensors, experimental protocols, or theoretical expectations could render part of that fluctuation scientifically informative. This schematic example illustrates a possible classificatory revision within laboratory practice. Its point is that the relation between an observed variation and a conceptual distinction depends partly on an evolving practice of inquiry. The original classification may have been well warranted locally even when later work uncovers a consequential difference within what it grouped together. Historical revision can preserve the warranted uses of an earlier classification, clarify their conditions, and identify further discriminations relevant to new purposes.

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The account treats conceptual formation as historically situated and materially constrained. Material recalcitrance, interpersonal disagreement, failed predictions, and successful interventions can all constrain a community's available distinctions. Different contexts may converge on practically robust concepts, and historical reconstruction can reveal enduring continuities beneath divergent vocabularies. Likewise, historically formed criteria of relevance can retain strong evidential validity. The more exact implication is that any inference from local conceptual agreement to comprehensive sameness needs additional grounds. Such grounds may be supplied by shared experimental constraints, reproducible interventions, negotiated interpretive correspondences, or other methods appropriate to the case. GR calls attention to their formation and revision, leaving adequacy to case-specific evaluation.

A conceptual complication concerns the proposed order of analysis: concept formation may itself depend on language and other symbolic practices. Here *before* signifies a logical distinction within a specified representational operation. A researcher can ask which conceptual differences are available at the moment a coding scheme assigns them to categories, even though those differences may already have been articulated in speech, notation, or inherited classifications. The inquiry accommodates symbolic practices within the histories of concept formation. Indeed, an established symbol can become part of P_κ and influence the emergence of later positions in C_κ. The conceptual configuration and its subsequent classification can form moments within a potentially recursive history.

The upshot is a precise restriction on the argument to follow. An assessment of symbolic equivalence accordingly specifies the historical domain of classification and the practices in which its distinctions

matter. Even that specification remains provisional and revisable. It can guide a legitimate formal construction while leaving further relational and generative differences available for investigation. The following section will take this local configuration as a starting point and examine the additional decision through which distinct conceptual positions become symbolically equivalent.

3 Contextual Formation Of Symbolic Equivalence

A historically formed conceptual configuration permits distinctions that a subsequent classification may preserve, reorganize, or set aside. This section isolates one such operation: the assignment of distinct conceptual positions to a common symbolic category under a criterion of equivalence. The resulting formalization makes the scope of a classificatory judgment explicit. It also permits a separate inquiry into the formation of the equivalence criterion itself. Both tasks gain precision through their connection. A quotient can establish precisely which distinctions are collapsed once a criterion has been chosen, while the reasons for choosing that criterion belong to a historical and practical account of the relations in which it is used.

A designation of sameness gains determinate meaning by specifying the respect in which cases are compared. Two activities may count as instances of the same occupation for an administrative register, as different practices for an inquiry into professional training, and as differently situated forms of labor for an inquiry into institutional dependence. Each classification can be appropriately constrained by its task. The presence of multiple defensible criteria nevertheless makes comprehensive identity a separate claim requiring additional argument. This dependence on classificatory purposes has been explored in studies of information infrastructures and standards, notably by Bowker and Star (1999). The local proposal here concerns a more narrowly formal question: which differences become indistinguishable when a selected category is treated as sufficient evidence of sameness?

Recall the conceptual configuration $\mathsf{C}_\kappa = (C_\kappa, D_\kappa, P_\kappa)$ from Definition 2.1. The domain C_κ records positions available to an inquiry, D_κ records supported discriminations between positions, and P_κ identifies the relevant interpretive or practical operations. Each component records the available scope of the present inquiry. Within this configuration, let S_κ denote a set of symbolic categories admitted by a particular classificatory procedure. The categories may be words, register entries, codes, or other repeatable designations. The present construction focuses on the assignment procedure and leaves material forms for context-specific analysis.

Definition 3.1 (Contextual Symbolic Equivalence). For a fixed inquiry context κ, a *local symbolic classification* is a map $s_\kappa : C_\kappa \to S_\kappa$ on the positions admitted to that classification. It induces a relation $\sim_\kappa$ on C_κ by

$$c \sim_\kappa c' \quad \Longleftrightarrow \quad s_\kappa(c) = s_\kappa(c'). \tag{1}$$

The corresponding *contextual symbolic quotient* is $q_\kappa : C_\kappa \to C_\kappa/\!\sim_\kappa$, which assigns each position to its equivalence class. The original classification factors through the quotient by a one-to-one labeling of the resulting classes into S_κ. These definitions concern the selected operation and its specified domain.

Because equality of category assignments is reflexive, symmetric, and transitive, the induced relation is an equivalence relation. This property follows from the specified classification map, while historical relations among the positions retain their own formal character. In particular, D_κ retains the meaning given to it in Section 2, with formal properties determined by the supported discriminations it records. The quotient is a representation of what the classification identifies together. The labels attached to its classes can vary while the partition remains fixed; conversely, a partition can change while

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its displayed category names remain stable.

It is useful to distinguish an equivalence criterion from its apparent naturalness. The procedure s_κ might be adopted because a practical decision requires a finite set of records, because instruments can discriminate only within a certain resolution, because a discipline inherits a taxonomy, or because an institution makes specific distinctions administratively consequential. The criterion's history can include contestation, calibration, negotiated conventions, and material constraints. A historically situated criterion can be rigorous and well warranted. Its validity is assessed relative to the claims and practices for which it is employed. Its authority in another practice depends on the evidential and practical requirements of that new setting.

The definition also makes an important distinction available between a suppressed discrimination and a vanished relation. Suppose the inquiry has grounds to distinguish two conceptual positions, so that $(c, c') \in D_\kappa$. When the classification assigns them the same category, that assignment supplies identical information about the two positions. Other records, situated observers, or later practices may continue to distinguish them, subject to the availability and reliability of evidence. The limitation thus concerns the information supplied by the selected symbolic representation and the inferences it licenses. Recoverability of the underlying relational difference depends on surviving evidence and the possibilities of further inquiry.

Definition 3.2 (Suppressed Supported Discrimination). Relative to C_κ and a local classification s_κ, the set of *suppressed supported discriminations* is

$$L_\kappa(s_\kappa) = \big\{(c, c') \in D_\kappa : s_\kappa(c) = s_\kappa(c')\big\}. \tag{2}$$

Membership in $L_\kappa(s_\kappa)$ means that a distinction supported within the selected inquiry is unexpressed by the category assignment alone. Its relevance to later judgments and its accessibility through other evidence remain questions for separate assessment.

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This second definition deliberately limits the sense in which a difference has been "lost." The set $L_\kappa(s_\kappa)$ captures supported distinctions within the current inquiry, while further distinctions may become articulable later. Moreover, an unexpressed distinction may be immaterial to a particular decision. Recording two procedures under the same equipment category may be entirely adequate for inventory management, even when their calibration histories differ. Those histories can become consequential when the record is later used to evaluate reproducibility or experimental transfer. Extension of a classification's warranted scope requires examining the differences relevant to the new inference. Section 4 will formulate this requirement more precisely, including cases in which different generative conditions support similar observed trajectories.

A further point concerns the temporal and relational development of the equivalence criterion. As practices, available instruments, and obligations change, both the conceptual configuration C_κ and the assignment s_κ may be revised. A pair of positions previously grouped together can become distinguishable within a new procedure, while a previously consequential distinction can cease to be relevant to the task at hand. These changes can follow divergent paths of revision. Some revisions split categories, others merge them, and still others reorganize the domain of conceptual positions itself. Comparing successive partitions therefore calls for the criteria of precision, relevant practices, and inferential aims of each classification.

Symbolization can also create distinctions, support novel combinations, and make previously inaccessible relations intelligible. The quotient model captures a specific classificatory operation within this broader creative activity. A term may acquire different uses across contexts, while a complex expression may support a discrimination emerging through composition. Such processes often require richer

models involving evolving conceptual domains and classificatory operations. The present construction applies to an identifiable act of class assignment. Its account of language, meaning, and semiosis remains deliberately limited to this operation. In the wider process, symbolic activity can itself participate in the formation of later conceptual positions and criteria, so that a subsequent classification begins from a transformed configuration.

Remark 3.3 (Locality Of The Quotient Construction). The specification of C_κ, D_κ, and s_κ identifies an analytical boundary within a particular inquiry. Exactness of the induced quotient is conditional on that boundary and the chosen assignment. The conceptual domain remains open to extension, while broader forms of symbolization may require different formal tools. The construction is local to this paper; its use elsewhere requires a distinct interpretive justification.

A further distinction concerns ordering. One familiar construction starts from a reflexive and transitive preorder, identifies positions related in both directions, and equips the quotient with a partial order. Definition 3.1 takes a different starting point: equality of selected category assignments directly induces equivalence classes. The two constructions illuminate different relations between equivalence and order. Claims concerning the ontological priority of either relation require separate philosophical and empirical justification.

The generative-relational significance of this formalization is therefore twofold. First, symbolic equivalence can make historically supported differences invisible at the level of the resulting designation, with consequences that vary according to the task for which that designation is used. Second, the very decision to treat certain differences as irrelevant has a history and can enter subsequent histories through its practical use. The first point calls for an analysis of what a category assignment can establish; the second calls for an analysis of the relations in which the assignment acquires authority. Both can be investigated while the ontology of concepts and the question of ultimate generative origins remain open. The next section examines the remaining inferential difficulty: even a detailed recovery of realized relational histories may leave the generative conditions of those histories underdetermined.

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4 Residual Relational And Generative Difference

The quotient construction in Section 3 locates a limitation within a selected conceptual classification: differences supported by an inquiry can be unavailable in the category assigned to its positions. A further limitation emerges when the positions under comparison are reconstructed through their histories. Two activities might share a designation while differing in how their participants, obligations, and resources developed. Recovering those trajectories can improve the comparison. Yet the recovery of a realized history and the identification of its generative conditions remain distinguishable achievements. The present section specifies the relation between those achievements and establishes the conditions under which a symbolic record can support a proposed judgment.

A *relational trajectory* will mean an achieved sequence or organization of relational changes at a resolution available to an inquiry. Records may involve partial temporal orders, overlapping processes, or descriptions at several scales; a universal clock is one optional modeling choice. *Generativity*, by contrast, concerns the capacities, constraints, dependencies, and conditions implicated in the production and transformation of possible trajectories. A generative specification may describe rules of change, material and institutional supports, or the susceptibility of a process to altered circumstances. It is an explanatory proposal with a stated scope, open to other descriptions and generative possibilities. At one scale, the realization of a trajectory can modify the generative capacities available at another. Accordingly, the following analytical separation is compatible with reciprocal development.

For a fixed context κ, let T_κ denote a domain of described relational trajectories, G_κ a domain of candidate generative specifications, and U_κ a set of conditions admitted to comparison. A reconstruction map $e_\kappa : T_\kappa \to C_\kappa$ places trajectories in the conceptual configuration from Definition 2.1, while the classification s_κ from Definition 3.1 assigns symbolic categories. Their composition is the *symbolic record* $F_\kappa = s_\kappa \circ e_\kappa : T_\kappa \to S_\kappa$. The map e_κ can already omit historical detail before symbolic classification occurs; its scope therefore remains bounded by the historical information available to the inquiry. The domains and mappings here are local choices of description. In particular, G_κ records proposed mechanisms or conditions within a locally specified analytical domain.

Consider first a judgment about a trajectory, such as whether a documented form of participation satisfies a specified evidential criterion. Let $J : T_\kappa \to Y$ assign its result in a nonempty judgment space Y. A category-only judgment has the form $j(F_\kappa(\tau))$, with j defined on the attained categories $F_\kappa(T_\kappa)$. This yields an exact criterion for when the symbolic record is sufficient to determine the stipulated J within the admitted trajectory domain.

Proposition 4.1 (Symbolic Sufficiency For A Specified Judgment). For fixed κ, $F_\kappa : T_\kappa \to S_\kappa$, and $J : T_\kappa \to Y$, a function $j : F_\kappa(T_\kappa) \to Y$ satisfying $J = j \circ F_\kappa$ exists if and only if

$$F_\kappa(\tau) = F_\kappa(\tau') \quad \Longrightarrow \quad J(\tau) = J(\tau') \qquad (\tau, \tau' \in T_\kappa). \tag{3}$$

This criterion establishes judgment sufficiency for the stipulated target within the stated domain; its application requires substantive justification for that target and domain.

Proof Sketch. If $J = j \circ F_\kappa$, equal records necessarily yield equal judgments. Conversely, if the implication holds, define $j(s) = J(\tau)$ for any τ with $F_\kappa(\tau) = s$. The implication makes this definition independent of the chosen representative. Thus j is well defined on the attained symbolic categories.

Corollary 4.2 (Residual Difference Relevant To Judgment). If some $\tau, \tau' \in T_\kappa$ have $F_\kappa(\tau) = F_\kappa(\tau')$ but $J(\tau) \neq J(\tau')$, every category-only rule assigns those trajectories an identical result and therefore disagrees with J on at least one of them. This insufficiency concerns the specified judgment; other judgments may remain fully supported by the same categories.

The proposition applies a familiar mathematical factorization condition to the present philosophical inquiry. Its philosophical force is the obligation to name the intended judgment before pronouncing a classification sufficient. A register that treats two participants as *collaborators* may support a count of registered participants, provided that counting is its defined task. The same entry alone may be inadequate for judging the participants' opportunities to refuse, their dependence on institutional resources, or their respective contributions. These latter judgments also require defensible normative and evidential criteria; assessment of particular cases depends on suitable evidence and substantive normative criteria. A more informative record may support additional judgments while remaining a situated description of the persons or relations concerned.

The residual problem extends beyond distinctions among achieved histories. Suppose two generative specifications yield the same recorded trajectory under the conditions actually encountered. Their descriptions of dependence, adaptive capacity, or response to altered circumstances may nevertheless diverge. For example, two organizations might exhibit the same documented pattern of cooperation during a period of stable support, while one relies on continuing external authorization and the other has a capacity to renegotiate its commitments independently. This hypothetical contrast illustrates distinct generative conditions compatible with similar observed cooperation. The trajectory provides evidence about realized cooperation, but an inference concerning cooperation under changed conditions requires further assumptions, observations, or interventions. A detailed historical reconstruction may therefore

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admit several explanations of unrealized possibilities.

The point admits a probabilistic formulation accommodating both deterministic and stochastic cases. For a probabilistic local model, let each $g \in G_\kappa$ and $u \in U_\kappa$ specify a probability distribution $P_{g,u}$ on T_κ. Treat the trajectory and symbolic spaces as measurable and F_κ as measurable. The pushforward $(F_\kappa)_\# P_{g,u}$ is then the distribution of symbolic records expected under g and u. A deterministic model is covered when these distributions are concentrated on single trajectories.

Definition 4.3 (Contextual Generative Observational Equivalence). Within the probabilistic local specification just stated, two candidate descriptions $g, g' \in G_\kappa$ are *symbolically observationally equivalent* relative to the admitted conditions U_κ when

$$g \approx_\kappa g' \quad \Longleftrightarrow \quad (F_\kappa)_\# P_{g,u} = (F_\kappa)_\# P_{g',u} \quad \text{for every } u \in U_\kappa. \tag{4}$$

The equality concerns distributions of selected records under specified conditions and allows distinct candidate generative descriptions.

Remark 4.4 (Limits Of Generative Identification). For $g \approx_\kappa g'$, any rule measurable with respect to a single symbolic record has the same output distribution under either candidate. The result extends to independent repeated records generated under the same stated conditions. Such evidence supports the same observation distributions for both candidates, leaving their identification underdetermined. Additional conditions, finer records, or independently warranted structural assumptions may separate them. The ontological interpretation of distinct candidate descriptions requires additional argument.

Observational equivalence and identifiability are familiar issues in statistical modeling; the definition above adapts their general structure to the paper's restricted representational problem (compare van der Linden and Barrett (2016)). Its relevance to GR is that the scope of admitted conditions and the choice of record are themselves historically situated. Expanding U_κ may distinguish specifications previously equivalent; refining F_κ may expose differences suppressed by a coarser classification. Such improvements enlarge the horizon of discrimination, while leaving further generative possibilities open. Moreover, apparently different specifications can be alternative parameterizations of the same modeled capacity. Formal distinctions among candidate descriptions acquire substantive meaning through their intended interpretation and supporting evidence.

The argument supports a calibrated conclusion. Symbolic categories can omit differences among reconstructed trajectories, while relational reconstruction can itself leave generative alternatives underdetermined. Both limitations invite a calibrated use of symbols: their authority depends on the particular judgment, the historical constitution of the record, and the observations and conditions admitted to inquiry. Since those admissions can change across communities and histories, the adequacy of an equivalence relation also raises a question of translation between contexts. The next section examines the conditions for such translation across conceptual domains with potentially partial correspondences.

5 Compatibility Across Historical Contexts

A symbolic classification gains meaning through the distinctions and practices of a particular inquiry. When a designation moves between communities, institutions, or historical periods, its apparent continuity can conceal changes in the equivalence criterion that governs its use. Section 3 described such criteria within one conceptual configuration; Section 4 explained their significance for particular judgments. The present section considers a further question: under which conditions can the categories

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produced in one context support a well-defined correspondence with those produced in another? This is a question about the compatibility of specified classificatory operations. A wider inquiry into translation also involves reference, interpretation, practical uptake, and the historically developed conditions of communication.

Let contexts κ_A and κ_B have admitted conceptual domains C_A and C_B, with local category assignments $s_A : C_A \to S_A$ and $s_B : C_B \to S_B$ of the kind specified in Definition 3.1. Their associated equivalence relations are $\sim_A$ and $\sim_B$. The spaces may differ in their available discriminations, historical records, and practical purposes. To study a correspondence, choose a domain $D \subseteq C_A$ and an interpretive assignment $T : D \to C_B$. The map T expresses a proposed comparison of conceptual positions, supported by whichever historical, contextual, or practical evidence is available. Its choice forms part of the inquiry and remains open to revision, supplementation, and comparison with alternative interpretations.

A particularly strong correspondence would allow a source category by itself to determine the corresponding target category. This requires a single target designation for each source equivalence class represented in D after interpretation by T. The condition is elementary, yet it exposes a recurrent limitation of symbolic transfer.

Proposition 5.1 (Factorization Of Cross-Context Category Correspondence). Let $D \subseteq C_A$ and $T : D \to C_B$ be fixed, with s_A and s_B as above. A unique function

$$U : s_A(D) \longrightarrow S_B \quad \text{such that} \quad U \circ (s_A|_D) = s_B \circ T \tag{5}$$

exists precisely when

$$s_A(c) = s_A(c') \implies s_B(T(c)) = s_B(T(c')) \qquad (c, c' \in D). \tag{6}$$

The result concerns a category-level correspondence relative to the selected domain and interpretive assignment. Its satisfaction warrants the stated factorization; equivalence of meanings or practices calls for additional interpretive evidence.

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Proof Sketch. If U satisfies Equation (5), equal source categories necessarily receive equal target categories, yielding Equation (6). Conversely, when Equation (6) holds, define $U(s_A(c)) = s_B(T(c))$ for $c \in D$. The condition makes this definition well defined across representatives, while every element of $s_A(D)$ has a representative. The resulting U is therefore well defined and unique on the attained source categories.

Suppose, as a constructed illustration, that an earlier institutional register treats two forms of participation as members of one category. A later research setting distinguishes them because one form involves independent authorization and the other involves delegated participation. If the proposed interpretation T sends the earlier conceptual positions to positions separated by the later classification, the earlier register category alone leaves their later category unsettled. Equation (6) fails for that pair. The difficulty is specific: the later distinction is finer along a dimension grouped together by the earlier record. A historian with access to agreements, interviews, or procedural records may still reconstruct the relevant difference. The category-level factorization then becomes available through an enriched record or a restricted comparison domain. This hypothetical arrangement isolates a classificatory possibility for analysis.

The converse case is also informative. A target classification may group several source categories together. Under a suitable T, the condition can hold, so that a function U exists even when the two systems preserve different amounts of detail. Such a correspondence may support administrative aggre-

gation or a narrow comparison of reported outcomes. Recovering the source distinctions from the target categories then requires further information. Correspondence is directional: an admissible assignment from A to B supplies its own inferential affordances, while the reverse direction requires independent examination. This asymmetry is especially important when a later classification is treated as the natural translation of an earlier one.

There are also more fundamental challenges at the stage of specifying T. Some conceptual positions draw their practical meaning from relations among several terms or from institutional operations available in one setting. The resulting correspondence may cover a restricted source domain, with several interpretations still available for other positions. A useful comparison might be constructed through shared cases, joint observations, or situated explanatory work, with new distinctions introduced during the encounter. Such practices can make understanding possible through interpretation and learning even where category-by-category transfer is unstable. The literature on scientific incommensurability offers a point of comparison: discussions of Kuhn's thesis address historically variable taxonomies and local translation difficulties alongside rational theory comparison (Oberheim and Hoyningen-Huene (2025)). Davidson's critique of the conceptual-scheme idea offers a complementary warning against treating failures of translation as decisive evidence for wholly separate worlds (Davidson (1974)). These debates concern broader philosophical theses than the present factorization criterion, which makes a limited statement about selected maps.

Remark 5.2 (Partial Correspondence And Interpretive Scope). Cross-context compatibility is assessed relative to the admitted domain D, the interpretive assignment T, and the two classification procedures. Restricting D, refining source records, or revising T can alter whether Equation (6) holds. A successful category correspondence supplies a warranted relation for the purposes under examination; its extension to other concepts, subjects, and judgments calls for renewed historical and practical assessment.

The generative-relational perspective adds a further consideration. Historical contexts can develop through interaction, so that the act of translation participates in changing the conceptual spaces being compared. A bilingual practice, a negotiated research taxonomy, or an institutional agreement may establish discriminations that were previously unavailable in either register. The aim of comparison can accordingly expand from finding correspondences between fixed classes to understanding how new possibilities of classification arise. For this position paper, the central result remains modest: symbolically identical categories provide determinate cross-context judgments under identifiable compatibility conditions, and their authority extends with the evidence supporting those conditions. The wider question of what any local classification can claim about generative-relational existence itself leads to the next section's account of ontological openness.

6 Ontological Openness And Symbolic Limitation

The preceding sections establish the inferential reach of symbolic equivalence under specified conceptual, historical, and observational conditions. A quotient yields an exact relation among positions within its domain; a factorization criterion identifies the judgments supported by those positions' symbolic records; and cross-context compatibility specifies when category correspondences can be constructed. These results supply precision to inquiry. Their philosophical interpretation requires attention to a further distinction: exactness within a formal description and the extent to which that description captures generative-relational existence are different achievements. This section articulates an ontologically open stance toward that distinction while retaining the practical value of classification.

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A local quotient is specified by an admitted domain and an equivalence criterion. In the present construction, C_κ is the conceptual space presently available to an inquiry, while s_κ determines the classifications made within it. Equation (1) settles the identity of category assignments for pairs of positions in that domain. Yet the historical formation of C_κ, the adequacy of its distinctions, and the scope of its possible extensions remain substantive matters of investigation. An exact partition can be revised when new evidence discloses previously unrepresented positions or when a different practical judgment requires finer discriminations. The mathematical validity of the earlier partition remains intact within its earlier specification, even as the warranted uses of that partition change.

The relation between mathematical representation and its target has long been a subject of philosophical debate. Accounts of scientific representation examine how models enable inference about their targets, how accuracy is assessed in relation to an intended purpose, and how formal structure acquires an interpretation in a particular inquiry (Frigg and Nguyen (2026)). The present argument addresses a narrower operation within that larger discussion. Its quotient formalism specifies an identifiable mode of category assignment, while the referents, histories, and practical uses of the categories call for additional evidence. Formal precision and representational adequacy can therefore develop together through critical comparison, with each assessed according to its distinctive evidential role.

Two senses of openness deserve particular care. First, *epistemic underdetermination* arises when available records support more than one candidate account of a trajectory or its generative conditions. Definition 4.3 gives a local illustration: distinct generative specifications can agree on the distributions of admitted symbolic observations. Refining the observation protocol or expanding the admitted conditions can change the resulting evidential situation. Second, *ontic indeterminacy* would concern the determinacy of the processes or structures themselves. Evidence that permits several descriptions establishes an epistemic limitation under the stated protocol; claims about the determinacy of reality call for independent philosophical or empirical grounds. Maintaining this distinction allows inquiry to be open in its interpretation while remaining exact in its conditional conclusions.

A similar restraint concerns generativity. Describing a process through one generative specification can explain aspects of the trajectories it realizes, including how altered conditions may affect future possibilities. Such a specification also introduces an explanatory vocabulary and criteria for separating mechanisms. An inquiry may reasonably investigate how those conditions arose, and subsequent inquiries may develop further descriptions of their formation. Local explanations can retain their evidential force as generative inquiry extends. Questions concerning a final generative ground belong to wider ontological investigations. The generativity attributed within a model can accordingly be investigated alongside the evidential scope in which that attribution is warranted.

Remark 6.1 (Ontological Openness And Representational Scope). For any locally specified symbolic classification, its quotient, factorization results, and observational equivalences establish relations within the admitted domains and conditions. Their application to additional entities, historical contexts, or generative possibilities depends on further interpretation and evidence. Ontological openness denotes a methodological readiness to reassess those domains and interpretations while preserving the validity of warranted local results. Assessment of ontological completeness remains a separate, open inquiry.

This stance suggests two complementary commitments: retaining classifications that demonstrably support their intended uses, and reopening their criteria when new inquiries require further distinctions. Categories can support coordination, communication, and comparison while remaining open to contextual adjustment. A generative-relational approach can specify a category's purposes, preserve records of relevant within-class differences, and revise its criteria as shared practices develop. In this sense ontological openness contributes directly to epistemic accountability. It encourages a community to

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distinguish evidence presently expressible through a classification from further differences that inquiry may make articulable.

The argument also applies reflexively. Terms such as *trajectory*, *generativity*, and *equivalence* are themselves conceptual selections within this paper. Their definitions establish a limited language for presenting its claims, with the local-scope notice in the front matter expressing that commitment. The formal apparatus gains its philosophical usefulness through interpretive discipline, including the possibility of revising the apparatus itself. This reflexivity bears on the next stage of the argument: classifications enter social life through records, standards, and decisions, where their carefully bounded inferential authority can acquire broader practical consequences. The following section examines how representation enters relational transformation.

7 Symbolic Classification In Social Practice

Symbolic categories acquire consequences when they become elements of social practice. A classification can first be introduced to record a distinction, then serve as a condition for access, an instruction for an institution, or a criterion by which people interpret their own positions. In these settings, the category becomes part of the relational environment it describes. This section considers that transition while preserving the paper's central distinction between the equivalence asserted by a symbol and the heterogeneous histories gathered under its designation.

The study of classification infrastructures supplies an important starting point. Bowker and Star (1999) investigate how categories and standards enter organized work and shape social interactions. Their account directs attention to the material and institutional maintenance of classifications, including the practices through which a seemingly routine category becomes consequential. The present generative-relational position examines a particular further process: a selected equivalence criterion can alter the relations that will later be classified through historically situated practices, capacities, and constraints.

Consider a hypothetical institution that records varied contributors to a research project under a single designation, *participant*. For maintaining a list of involved persons, the designation may be appropriate. If the institution subsequently uses the same entry to allocate access to equipment, recognize contributions, or assign obligations, an initially modest category gains further practical authority. Distinctions among participants' work, dependency on resources, and freedom to decline additional tasks can become relevant to the new decisions. Records available outside the category may help assess those distinctions. The example illustrates a transfer of classification across uses: the requirement of evidential adequacy changes when the category begins to guide actions with different consequences.

Classification can also affect future conduct. A person identified as eligible may gain access to opportunities; a person assigned a particular role may acquire expectations and obligations; an organization classified within a regulatory category may revise its procedures in response. Each consequence depends on the surrounding rules, resources, interpretations, and responses. In his discussion of the *looping effects of human kinds*, Hacking (1996) analyzes how classifications of people can interact with those classified, changing the human phenomena subsequently investigated. The present argument adopts the more modest possibility of a mediated feedback process, with the mechanisms and degree of feedback established locally. Some categories remain relatively stable, and some applications chiefly reorganize records; others alter the practices and subjects they concern.

Recall the conceptual configuration $\mathsf{C}_\kappa = (C_\kappa, D_\kappa, P_\kappa)$ and the classification $s_\kappa : C_\kappa \to S_\kappa$. A use of this classification may inform a decision a, whose enactment is situated among further relations,

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histories, and institutional constraints. A resulting inquiry context κ' may contain revised conceptual positions, supported discriminations, or practical operations. The following expression records a possible relation among these locally specified descriptions:

$$(\mathsf{C}_{\kappa}, s_{\kappa}) \xrightarrow{\text{classification, action, response}} (\mathsf{C}_{\kappa'}, s_{\kappa'}). \tag{7}$$

The arrow schematically describes practical mediation within the stated local contexts. Its interpretation requires evidence identifying the intervention, the participating agents, and the conditions of the observed changes. The prime distinguishes an ensuing inquiry context at the level of description; time coordinates and generative ordering require their own context-specific interpretation. It also leaves room for classifications that persist while their applications change, as well as practices that revise the categories themselves.

Remark 7.1 (Classification And Relational Feedback). A symbolic classification can participate in transforming the relations to which its categories are applied. Where such feedback occurs, an inquiry into the adequacy of the classification may consider both its original evidential purpose and the subsequent practices in which its categories acquire consequences. The existence, direction, and significance of feedback depend on the specified historical and institutional conditions.

Feedback also raises an interpretive issue. A later record of changed participation or compliance may reflect interactions among the classified agents, the classification procedure, and the resources governed through it. A historically adequate explanation identifies the category's causal contribution alongside other mediating conditions, including the effects of institutional decisions and participants' responses. Such an account traces the category's entry into practice, the evidence connecting it to later outcomes, and plausible alternative influences. The generative-relational vocabulary keeps these relationships visible and complements detailed causal analysis.

There is also a constructive role for stable classification. Shared categories can coordinate distributed activity, make records interoperable, and support fair administration when the criteria and their applications are well specified. The concern developed in this paper is one of interpretive fit: a category's practical authority is strongest when it matches the distinctions required by its particular use. Where new practices make further differences salient, a community can preserve auxiliary records, refine the classification, or establish additional procedures for review. Such adjustments can improve the legibility of relational histories while retaining the benefits of common symbols.

Symbolic equivalence thus has a double practical significance. It organizes relations into usable categories, and its deployment can participate in the historical development of the very relations that later inquiry seeks to understand. This conditional feedback deepens the earlier factorization result: the sufficiency of a symbolic record is judged relative to the decision it supports and the consequences of its application. The next section considers the implications for epistemic judgment and normative responsibility, where criteria of factual discrimination and justified treatment require related but distinct forms of assessment.

8 Implications For Epistemic And Normative Judgment

The preceding analysis has identified a specific limit of symbolic equivalence: classifications preserve selected distinctions while gathering heterogeneous conceptual positions, relational trajectories, and possible generative conditions under common designations. The practical significance of this limit depends on the judgment the classification is asked to support. This section develops a modest account

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of responsible judgment that separates evidential sufficiency from normative warrant and locates both within revisable historical practices.

An epistemic judgment concerns what available evidence justifies concluding about a specified subject. Proposition 4.1 offers a narrow formal test: a judgment factors through a symbolic record exactly when its result remains constant among the trajectories represented by each attained category. The condition clarifies the informational demands of a judgment under a fixed local description. Actual inquiry adds questions about the credibility of records, the appropriateness of the selected judgment function, and the domain of cases to which the rule is applied. A formally adequate classification can serve a well-specified evidential purpose, with calibration, provenance, and sensitivity to changing conditions assessed separately.

Normative judgment introduces a distinct task. Decisions about recognition, obligations, rights, access, or permissible treatment require reasons concerning the relevant interests, responsibilities, and standards of justification. Equality of symbolic records establishes a descriptive relationship under the adopted classification criterion. Normative equivalence requires an independently defensible criterion for treating the cases alike in the decision at hand. Conversely, the presence of historical or generative differences supplies material for ethical consideration, with their significance determined through substantive normative argument. The distinction protects both legitimate equal treatment and attention to differences that bear on agency, dependence, or vulnerability.

Consider again a hypothetical register designating several persons as *contributors* to a research initiative. For calculating participation totals, the designation may suffice. For allocating authorship credit, assigning obligations, or determining access to subsequent opportunities, decision makers may need evidence of intellectual contribution, agreed responsibilities, relevant dependency, and the circumstances under which participation was possible. A further record can distinguish these dimensions while retaining the shared category for its administrative use. The example illustrates a general requirement of fit between a classification's evidence and the reasons governing its particular application; the content of a fair decision still calls for independent assessment.

Work on epistemic injustice offers a related ethical perspective. Fricker (2007) examines ways in which persons may be wronged in their capacities as knowers, drawing attention to the interaction of epistemic evaluation and social power. The present inquiry makes a narrower contribution: a classification that compresses different histories of participation may become consequential for the assessment of someone's testimony, contribution, or credibility when institutional decisions rely on it. Evaluating such cases requires evidence of the relevant practice and a substantive standard of justice. This connection concerns the treatment of persons within epistemic institutions; it leaves wider debates about the status of heterogeneous nonhuman subjects for a separate inquiry.

Remark 8.1 (Judgment-Specific Adequacy And Normative Warrant). The adequacy of a symbolic category for a specified inference and the justification of an action informed by that category are distinct evaluative matters. Responsible application identifies the intended judgment, examines the discriminations and evidence available for it, and supplies an independently warranted account of the action's normative criteria. These assessments remain sensitive to their historical and institutional conditions.

The remark supports a practical orientation toward classification. Institutions can state the purpose for which a category was introduced, preserve records pertinent to consequential decisions, make room for contextual explanation, and provide routes for reconsidering judgments when newly relevant differences become visible. Such practices allow shared symbols to coordinate activity while keeping important relational information available for further interpretation. Their appropriateness will vary with the costs of recording, the risks of error, privacy considerations, and the consequences of particular

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decisions. Design choices require context-specific institutional and legal assessment.

A further implication concerns the scope of confidence. When two trajectories remain symbolically indistinguishable under the admitted observations, the evidence warrants conclusions common to the equivalence class. Additional inference calls for additional records, justified assumptions, or new opportunities for inquiry. The same discipline applies to generative descriptions: a successful account of observed conduct can coexist with several candidate explanations of the capacities and conditions that made it possible. Ontological openness here encourages care in assigning explanatory authority, while maintaining room for precise conclusions wherever their premises are satisfied.

The generative-relational position therefore invites two complementary habits: using classifications for the distinctions they reliably preserve, and remaining attentive to historically situated differences relevant to further judgments. This position preserves the practical value of symbolic coordination and the revisability of the criteria that guide it. The concluding section draws together these bounded claims concerning historical formation, symbolic equivalence, and the conditions of warranted interpretation.

9 Conclusion

Symbolic equivalence enables communication, comparison, and coordinated judgment by gathering selected conceptual positions under shared designations. This paper has examined the conditions and limits of that achievement from a generative-relational perspective. Concepts and criteria of equivalence develop within historical relations and practices, while the same symbolic category can gather distinct relational trajectories and generative arrangements. Accordingly, the significance of a common designation depends on the differences retained by its classification procedure and the purpose for which it is employed.

The local formal constructions clarify this dependence. A symbolic record suffices for a specified judgment precisely when that judgment remains constant across the trajectories assigned the same record. A category correspondence between historical contexts likewise becomes well defined under a specified compatibility condition. These results provide conditional tests of representational adequacy. They also make visible the importance of the inquiry domain, the distinctions admitted to it, and the interpretation attached to each classification. Historical reconstruction can recover additional differences among realized trajectories, while further examination of generative conditions may reveal possibilities that the reconstructed histories leave open.

Symbolic categories also participate in the practices through which relations continue to develop. Institutions can employ a category to coordinate activity, distribute opportunities, and recognize contributions; the resulting decisions may alter the circumstances represented by subsequent records. This feedback depends on concrete participants, actions, and constraints. An epistemically warranted classification consequently calls for attention to provenance and intended inference, while a normatively justified application requires reasons appropriate to the treatment or obligation at issue. Preserving relevant contextual evidence and permitting revisions can support both forms of responsibility.

Ontological openness gives these conclusions their methodological orientation. Exact equivalence within an admitted formal domain remains compatible with further distinctions in relational histories, generative conditions, and possible conceptual descriptions. The terms and mathematical devices used here are situated selections and remain revisable as inquiry develops. Their contribution lies in specifying defensible local relations and sustaining further investigation.

The resulting position affirms the practical value of symbols together with the historical and relational conditions of their authority. Symbolic sameness can be reliable for one purpose and invite finer

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discrimination for another. Attending to that variability supports an inquiry in which shared representations remain useful, their limits remain legible, and emerging differences can become grounds for better understanding and judgment.

References

Bowker, Geoffrey C. and Susan Leigh Star (1999). *Sorting Things Out. Classification and Its Consequences*. MIT Press. DOI: 10.7551/mitpress/6352.001.0001.

Cassirer, Ernst (1965). *The Philosophy of Symbolic Forms. Volume One: Language*. Trans. by Ralph Manheim. English-language edition; original German first volume appeared in 1923. Yale University Press.

Davidson, Donald (1974). "On the Very Idea of a Conceptual Scheme". In: *Proceedings and Addresses of the American Philosophical Association* 47. Presidential address delivered 28 December 1973, pp. 5–20.

Fleck, Ludwik (1979). *Genesis and Development of a Scientific Fact*. Ed. by Thaddeus J. Trenn and Robert K. Merton. Trans. by Frederick Bradley and Thaddeus J. Trenn. English translation of the 1935 German original; publisher page lists the 1981 paperback. University of Chicago Press.

Fricker, Miranda (2007). *Epistemic Injustice. Power and the Ethics of Knowing*. Oxford University Press. DOI: 10.1093/acprof:oso/9780198237907.001.0001.

Frigg, Roman and James Nguyen (2026). "Scientific Representation". In: *The Stanford Encyclopedia of Philosophy*. Ed. by Edward N. Zalta and Uri Nodelman. Entry first published 2016; substantively revised 20 May 2026; online entry checked 29 October 2026. Metaphysics Research Lab, Stanford University.

Hacking, Ian (1996). "The Looping Effects of Human Kinds". In: *Causal Cognition: A Multidisciplinary Debate*. Ed. by Dan Sperber, David Premack, and Ann James Premack. Oxford University Press, pp. 351–394. DOI: 10.1093/acprof:oso/9780198524021.003.0012.

Oberheim, Eric and Paul Hoyningen-Huene (2025). "The Incommensurability of Scientific Theories". In: *The Stanford Encyclopedia of Philosophy*. Ed. by Edward N. Zalta and Uri Nodelman. Spring 2025. Archived entry; substantial revision 7 May 2024. Metaphysics Research Lab, Stanford University.

van der Linden, Wim J. and Michelle D. Barrett (2016). "Linking Item Response Model Parameters". In: *Psychometrika* 81. Published online 9 July 2015; erratum published in Psychometrika 82 (2017), p. 273, pp. 650–673. DOI: 10.1007/s11336-015-9469-6.

Vygotsky, Lev S. (1986). *Thought and Language*. Ed. by Alex Kozulin. Trans. by Eugenia Hanfmann and Gertrude Vakar. Revised edition. MIT Press.

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