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Communication and Category Structure: The Communicative Process as a Constraint on the Semantic Representation of Information

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CATEGORIZATION

Categorization is the process of dividing the world of experience into groups of entities whose members share one or more characteristics in common. Recognition of similarities across entities and the subsequent aggregation of similar entities into categories lead the individual to discover order in a complex environment that would otherwise consist of a multiplicity of unique entities. Medin (1989) has observed that, in the treatment of patients, the clinical psyhcologist cannot approach each individual as unique precisely because "absolute uniqueness imposes the prohibitive cost of ignorance" (p. 1469). Experience with patients who present common symptoms permit the clinician to cumulate and ysntesize information and thereby to expand professional knowledge of a diagnostic category. By grouping patients based upon observable similarities, the clinician treating an individual patient can apply knowledge accumulated through previous encounters with other patients.

Because categories serve to impose order on experiential information, they are frequently referred to as the building blocks of cognition. By assigning labels to groups of objects with similar characteristics, individuals create cognitive categories that allow them to organize sensory input, to store information efficiently in memory, and to retrieve stored information easily and effectively upon demand. By grouping entities according to observable similarities, the individual is encouraged to form concepts about the environment that allow the generalization to new encounters of information garnered through past experiences, just as the clinician generalizes to the current patient knowledge accrued through encounters with previous patients. Thus categorization provides an effective mechanism for simplifying the individual's interaction with the environment. As Markman (1989) points out, without the ability to recognize the similarities that exist between otherwise dissimilar entities, individuals would be incapable of dealing with the variety and complexity that characterize the individual's interaction with his/her physical surroundings.

THE CLASSICAL THEORY OF CATEGORIES

Traditional approaches to the study of cognitive categories have rejected the notion that categories might be acquired through a process of generation based upon experience and have focused, instead, on the acquisition of categories as a process of recognition. This insistence on category acquisition as the recognition of determinate, or pre-existing, categories proceeded from the

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unquestioning acceptance by many psychologists, linguists, philosophers and anthropologists of what has come to be known as the classical theory of categories.

The classical theory of categories assumes that the membership of a category is itself determinate: Entities that are members of a given category share a set of essential features that is identified by the category label and that can be apprehended by all members of the linguistic community. Thus, within the classical framework, the world of experience consists of fixed classes of entities; and each such class of entities is defined by a set of necessary and sufficient criteria -- a set of essential features -- that is identified by the category label. It is this set of essential features which serves to determine category membership.

Because the classical theory of categories states that an entity is a full and equal member of a category if it exhibits the essential features that are both necessary and sufficient for category membership, it provides an elegant explanation for both the internal structure of cognitive representations and the semantic meanings of words. This simple but powerful theory rests on three basic propositions (Smith and Medin, 1981):

I. The intension, or definition, of a category label is a summary representation of an entire category of entities.
II. The essential features that comprise the intension of a category are individually necessary and jointly sufficient to determine membership within the category.
III. If a category exists as a subset nested within a superordinate category, the essential features that define the superordinate category are contained within the set of features that define the subset.

Proposition I states that the intension, or definition, of a category is the union of those essential features which identify the entire category and not merely a single instantiation or category prototype. Furthermore, because all members of a single category must share the same set of essential features, all members are equally representative of the category. Thus the internal structure of a category is said to be ungraded precisely because, if all members of a category are equally representative, no one member can be more typical of that category than any other member.

Proposition II states that to be a member of a category an entity must exhibit all of the essential features that comprise the intension, or definition, of the category, and that possession of the full set of these essential features is itself sufficient to determine membership in the category. This proposition expresses the fundamental notion that category boundaries are both fixed and rigid: There is a binary, either/or relationship that exists between an entity and a category in that an entity either is, or is not, a member of a particular category. Proposition III simply identifies the essential definitional relationship that must exist between categories that occur within a hierarchical structure: Any member of a category that is a subset of a superordinate category must exhibit both the necessary and sufficient criteria that determinemembership in the subset and the defining features, or necessary and sufficient criteria, that determine membership in the superordinate category.

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At the most basic level, categorization is defined as the process of grouping entities into sets, or categories, whose members bear some logical relation to each other. Within the framework of the classical theory of categories, however, *categorization* is the process of systematically dividing up the world into a formalized and potentially hierarchical ordering of sets of entities that share some essential characteristic or set of characteristics. An entity is any object, event, or property that participates in the individual's experience of the world; and a category is a set of distinguishable entities each of which exhibits all of the essential features that are common to the entire set.

According to the classical theory, then, a category is a logical and bounded set; and an entity is a *member* of a category if it exhibits the full complement of essential features common to the entire set. *Essential features* are the defining characteristics — the necessary and sufficient criteria — that determine category membership. They are both *individually necessary* and *jointly sufficient* for membership in a classical category. Each entity accorded membership within the category must exemplify the full complement of essential features; and the presence of the full complement of essential features is sufficient to determine membership within the category. Obviously, if an entity does not exhibit all of the features necessary for membership in a classical category, it cannot be a member of that category.

The *intension*, or *definition*, of a classical category is a statement of those essential features which are necessary and sufficient for determining category membership. Because the union of necessary and sufficient characteristics is generally thought to provide a mental representation of what it means to be a member of a category, the intension of a category is sometimes referred to as a *concept*. The *extension* of a category identifies, or refers to, those entities which comprise the membership of the category. Because the intension of a category term defines the set of essential features and each entity accorded membership within the category must exhibit the full complement of defining features, the classical theory of categories maintains that intension and extension are synonymous: Membership within a particular category (extension) entails possession of an essential and defining character (intension). Brown (1979) observes that, within this formalized and tightly constrained ordering of reality, the classical theory stipulates that category membership is absolute: "... any given thing is either in or out of the set; there are positive instances, all of which manifest the common characteristic, and noninstances which lack it. Membership is an either-or absolute because sets have clear boundaries" (p. 189).

Recent research, however has undermined the assumptions upon which the classical theory is founded. Based upon empirical evidence, critics have advanced several powerul criticisms of the classical theory. They argue that the inability of subjects to identify a set of essential features that are both individually necessary and jointly sufficient for category membership (Hampton, 1979; Rosch & Mervis, 1975) not only undermines the classical assumption that those essential features which determine category membership are absolute, but controverts the notion that they are available to, and can therefore be specified by, all members of the linguistic community. Evidence of graded typicality effects based upon the observation that subjects judge certain member entities to be more representative of a category than other, less typical members (McCloskey & Glucksberg, 1978; Rips, Shoben, & Smith, 1973; Rosch, 1973, 1975) undercuts the classical assumption that category structure is ungraded. Barsalou (1987) points out that subjects can not only rate member entities for representativeness, or typicality, of a particular category, but that they are able to rate nonmember entities for their unrepresentativeness of that category. The evidence

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that subjects are able to rank category and non-category entities alike on a single continuum of representativeness (Barsalou, 1987), supported by demonstrations of category membership based upon family resemblance structures (Rosch & Mervis, 1975), points to the lack of fixed and determinate boundaries separating members of a category from nonmembers, thereby casting doubt on the classical assumption that there is an explicit, either/or relationship between an entity and a category.

Gardner (1985/1987) observes that, until only recently, the classical theory exemplified "the 'right way' to think about categories, concepts, and classification" (p. 340). Indeed, the fundamental assumptions of the classical theory remained unchallenged until Wittgenstein (1953) argued that category membership was determined, not by the possession of a set of necessary and sufficient features, but by a series of overlapping similarities, or family resemblances, that exist between the members of a category but are not necessarily common to all. To illustrate this principle of overlapping resemblances, Wittgenstein drew an analogy between the networks of similarities that exist between members of a category and the similarities of build, facial features, eye color, etc., that frequently characterize an extended family unit. Rosch and Mervis (1975) interpret their experimental findings as "empirical confirmation" (1975, p. 603) of Wittgenstein's theory of family resemblances. But Smith and Medin (1981) argue that Wittgenstein's thesis is "nothing like a principled disproof of the classical view" (1981, p. 31). They contend that the inability of subjects to provide the set of necessary and sufficient characteristics that determines membership of a category demonstrates only that the defining features for that category have not yet been identified.

PUTNAM AND THE QUEST FOR STABILITY OF REFERENCE

The power of the classical theory resides in its professed ability to constrain the membership of a category. Thus the critical assumption that intension equals extension not only determines the membership of a category but ensures stability of reference for category labels. If the intension of a category is not determinate and its extension is not fixed, as empirical observations have appeared to demonstrate, the stability of reference that is the theoretical centerpiece of the classical theory is jeopardized. If intension does not equal extension, it follows that a category label cannot possess an invariant meaning that exists independent of context. In sharp contrast to Wittgenstein's theory of family resemblances, Putnam's theory of natural-kind terms attempts to ensure the stability of reference by offering a modernized rendition of the classical theory.

Putnam (1973, 1975) argues that extension is not fixed by the individual, but is determined both socially and indexically, by society and by the real world. He contends that natural-kind terms such as "water" and "gold" will have the same extension in all possible worlds in which the term is used to designate an entity. And, because such words have extensions that are consistent across all possible worlds, they must have what Putnam calls "an unnoticed indexical component" (1975, p.234). The attribution of indexicality to natural-kind terms ensures that their extension is fixed independently of any mental concepts that might be associated with a term by the individual speaker. Additionally, the intension of a natural-kind term is determined not by a definition based upon "necessary and sufficient" superficial qualities (Putnam, 1975, p. 238), but by its "'important' properties" (Putnam, 1975, p. 239). These important properties are contingent in that they specify the necessary microstructure of an object or entity, the underlying structure or composition of the

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object which may not in itself be evident, but which nonetheless determines the superficial, observable characteristics of the entity. Water may change its superficial appearance in that, varying with temperature, it may occur as solid, a liquid, or a gas, but it is necessarily water because its underlying microstructure is consistently described as H_2O.

Putnam's contention that, in the absence of a demonstrable microstructural component, superficial characteristics necessarily assume an indexical function as "necessary and sufficient condition[s]" (1975, p. 241), reflects his claim that linguistic terms correspond to a fixed and predetermined reality — that the word can be mapped in a one-to-one, indexical relationship with that entity to which it refers in the real world. And he proceeds to apply this notion of indexicality not only to natural-kind words like "water" and "gold", but to all referring terms in a language — "to the great majority of all nouns, and to other parts of speech as well" (Putnam, 1975, p. 242).

While indexical correspondence with a pre-existing reality is the contribution that, in Putnam's opinion, "the real world" brings to "a better semantic theory" (1973, p. 711), the contribution of society is outlined in his hypothesis of the linguistic division of labor. This hypothesis states that, within a linguistic community, there will be some terms whose determining criteria are known only to a small group of experts; and that use of these linguistic terms by other, non-expert speakers must therefore rely on the assumption that the important criteria can be recognized by this expert group.

The notion of the linguistic division of labor proceeds from Putnam's contention that there exists for each category term a common hidden structure, or intension, that determines extension. It stipulates that individuals within the linguistic community need not be cognizant of the criteria that determine a category term's extension. Indeed, it is not necessary that any one individual be able to identify a category's important properties if all members of the linguistic community share the assumption that, within the community as a whole, there exists at least some one expert who possesses the ability to recognize these determining criteria. Wittgenstein's notion of family resemblance was a product of his observation that individuals were unable to define a core of essential features that would define category membership. In contrast, Putnam's approach is to postulate that the ability to identify a core concept is not necessary as long as the individual assumes that such a set of essential features does exist and can be identified by expert knowledge.

If, as Putnam maintains, the average speaker has no knowledge of the associated criteria — the hidden structure — that fix the extension of a term, how is the extension of a term to be determined by the non-expert speaker? Putnam's solution is to invoke a causal theory of reference whereby the initial identification of the extension is perpetuated through transmission of the association between a word and its referent(s) within the linguistic community. This causal theory of reference stipulates that, once the referent(s) of a particular term are determined, the relationship between term and entity is irrevocably established and transmitted through conventional usage within the linguistic community.

Putnam's hypothesis of the division of linguistic labor would thus offer to the classical theory of categories a new level of authentication: The referents of a natural-kind term and, by extension, of any category term, can be verified by expert opinion emanating from the division of linguistic labor. By relegating the responsibility for determining the extension of a natural-kind term to the

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province of domain experts, Putnam intends to affirm the existence of an internal, determining structure. Thus the role of important properties is highly analogous to the role played by essential features within the classical theory. Just as the possession of a set of essential features is both necessary and sufficient for determining category membership within the classical tradition, the structural properties ascertained by domain expertise are "'important'" — or necessary and sufficient — for determining the referents of natural-kind terms and, by extension of the argument for indexicality, of all referring terms in the language.

Obviously, the stability of reference provided by the classical theory of categories is not easily relinquished. Those who find the classical theory "intuitively compelling" (Medin, 1989) contend that the behavior of individuals actually conforms to the classical view. They argue that, because "People act as if things (e.g., objects) have essences or underlying natures that make them the thing that they are" (Medin, 1989), the classical view may actually serve "as the layperson's metatheory of concepts" (Medin & Smith, 1984). This approach, dubbed "psychological essentialism" by Medin (Medin, 1989; Medin & Ortony, 1989), is closely related to Putnam's division of linguistic labor: It assumes that it is not necessary that any one individual be able to identify the necessary and sufficient criteria that define a category as long as people assume, or "act as if", such a definition could be provided.

Psychological essentialism has, in turn, contributed to the current notion that categorization is a theory-based process. According to proponents of the theory-based approach, category membership is not contingent upon a set of shared attributes or properties but is determined, instead, by the individual's recognition of integral relationships that exist between the observable properties exhibited by a set of category members. Recognition of these relationships leads to the development of a theoretical structure for that particular category. For example, birds lay eggs, have wings, and build nests, usually in high places necessitating flight. Any of these properties alone would not be sufficient to identify an instance of the category bird by matching observable features: Birds lay eggs, but so do turtles, snakes, mosquitos and a myriad of insects; birds have wings and most of them fly, but so do bats; birds build nests, often in high places, but so do squirrels and wasps and hornets. It is the interrelationship between the observable properties of laying eggs, having wings, and building nests that contributes to the production of a theoretical structure — in this case, a "bird structure" — that determines membership in the category "bird".

The theory-based approach emanates in large part from the argument that individuals act as if an entity has an underlying nature or inherent essence that makes it what it is. This essence, resurrected as theory, provides causal linkages from hidden essential properties to perceptual surface properties. Surface properties, in turn, point toward the essential theoretical core of a category while simultaneously permitting identification of category members (Medin, 1989). Obviously, then, the argument for theory-based categories is inherently circular and little more than a restatement of the Aristotelian notion of a determining essence.

Philosophers and psychologists alike are reluctant to relinquish the basic assumptions that underlie the classical theory of categories precisely because these assumptions specify a continuity of mental representations both within and across individuals while simultaneously providing stability of reference for linguistic terms. Putnam's argument for the indexicality of all referring expressions dominates current philosophical approaches to the study of categories. But empirical

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findings indicate that categories are simply not definable by a set of necessary and sufficient criteria that are available to the individual. Putnam's recourse to the authority of subject experts proposed in his division of linguistic labor and Medin's reliance on his personal observation that people seem to "act as if" an object has an underlying nature are both symptomatic of the need to provide a metaphysical foundation that will ensure stability of reference for category labels. If there are no essential features that determine category membership and constitute the definition of a category label; if the membership of a category is not fixed by a set of context-independent criteria, but is dependent solely upon immediate context, goals, and individual experience, then the stability of semantic reference and conceptual representation is undermined and the possibility of effective communication between individuals is without foundation.

COMMUNICATION AND THE COOPERATIVE PRINCIPLE

The classical theory of categories is an elegant and powerful theory. But its power resides ultimately in its ability to constrain the membership of a category. Thus the critical assumption that intension equals extension would not only determine the membership of a category but would ensure stability of reference for linguistic category labels. If the intension of a category were determinate and its extension fixed, as the classical theory maintains, it would follow that a category label would possess an invariant meaning that would exist independent of context. It is just such a premise of correspondence between a category label and its intension — between the linguistic sign and its associated idea, or *signifier* and *signified* — that supports the Saussurean model of communication.

At its most general level, communication can be described as the transmission of a message from a sender to a receiver across a channel. According to the code model of communication (Sperber & Wilson, 1986), a message originates at the information source and is paired with, or encoded by, a signal that is capable of transmission. This signal travels across a channel and is delivered to its destination, where it is paired with a replication of the original message through the process of decoding. The code model of communication is predicated on the assumption that successful transmission of a message is facilitated by a coding system shared by sender and receiver. This shared coding system ensures that the content of the message as decoded by the receiver will approximate the content of the message originally encoded by the transmitter.

This traditional model of communication is exemplified by the general communication system diagrammed by Shannon and Weaver (1949). But Sperber and Wilson (1986) argue that the information-processing device cannot be interpreted as either the information source/destination or the transmitter/receiver if the explanatory power of Shannon's model is to prove generalizable. Rather, the information-processing device must be understood as the functional unit formed by the union of source and transmitter, or destination and receiver. This union of source and transmitter is inherent in the semiotic model of human communication proposed by the linguist Saussure (1915/1959). Saussure depicted both the source of communication and its destination as the union of psychological and physiological factors within the individual. He proposed that a mental fact or concept is associated with a linguistic representation, or sound-image, in the brain of the speaker, triggering the transmission of an impulse to the speech organs, which then initiate the physical production of the appropriate phonation. This sound image travels from the mouth of the

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speaker to the ear of the hearer and is transmitted to the brain of the hearer where it is paired with the appropriate fact or corresponding concept.

The Saussurean model of communication rests on the fundamental assumption that a language is a system of distinct and arbitrary signs, each of which corresponds to a distinct idea. This system of distinct signs is comprised of a set of sound images, or signifiers, which are associated with corresponding abstract concepts, or *signifieds*. Verbal communication between individuals is possible because the meaning of the linguistic unit — the *significant* comprised of *signified* and *signifier* — is determined by collective social usage. In the same way that Shannon andWeaver's schematic model assumes that the transmitter and the receiver share the same code, Sausurre's semiotic model assumes that the code — the system of linguistic units, or significants — is mutual knowledge shared by all speakers in the linguistic community.

But the model of communication proposed by Saussure also shares with Shannon and Weaver's schematic model the unidirectional transmission that typifies most characterizations of communication: Initiated and transmitted by the sender, the signal flows to the receiver, whose participation in the act of communication is that of a passive receptor. Reddy (1979) contends that the conventional conceptualization of communication as a conduit biases both the linguistic description and the conceptual representation of communication: Use of the conduit metaphor to describe communication emphasizes one aspect of the communicative process at the expense of those aspects which do not accord with the imagery suggested by the conduit.

What is lost within this metaphorical representation of communication is the interactive aspect of human communication: Information is depicted as being packed into a word or sentence and shipped across a conduit where it is to be unpacked intact by the recipient. Lakoff and Johnson (1980) point out that the metaphorical representation of communication as a conduit actually entails two basic assumptions: that the word possesses a meaning that is not dependent upon speaker or context; and that this meaning has an existence that is itself independent of speaker or context. Within this metaphorical framework, then, the human component is effectively excised from the communicative process and the message itself becomes the primary and dominant focus. Communication is characterized as successful if the message that is received is the same as, or equivalent to, the message that was originally transmitted. The influence of context or individual experience is viewed as little more than noise on the channel that has the potential to distort the signal and impede successful transmission. Such an interpretation is possible precisely because the conduit metaphor, like the model of communication described by Saussure, assumes that words and meanings exist independent of both the intentions of the communicant and the influence of immediate context.

Grice's (1957/1990; 1969) description of speaker-meaning is a preliminary attempt to account for the human component in communication. He proposes that the statement "*S* means $_{NN}$ something by *x*" entails that the speaker [*S*] must not only intend by his utterance [*x*] that he will produce a certain belief or response in his audience, he must also intend that his utterance is to be recognized by the audience as intended to produce that response and that this recognition will contribute to the actual production of the response (Grice, 1969, p. 151). Although Grice's argument appears to focus on what a particular speaker means on a particular occasion and within a particular context (Grice, 1969), his underlying concern is not with the construction of a theory of meaning *per se* but

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with the development of a theory of communication or, more specifically, of a theory of speaker-meaning within a communicative setting. As Avramides (1989) points out, it is not a sufficient condition that an utterance should produce a response in an audience: "The utterance must be produced with the appropriate intentions to communicate and those intentions must be recognized by the audience for there to be a genuine case of nonnatural [speaker-intended] meaning."

At this level, Grice's characterization of human communicative behavior as the intention to inform remains grounded within the metaphorical framework of a one-way conduit. The assumption that Grice's speaker "must intend to induce by *x* a belief in an audience" (Grice, 1957/1990, p. 75) rules out the possibility of two-way, interactive communication between speaker and audience. Although Grice allows that the intended effect is to be in some small way within the control of the audience — "in some sense of 'reason' the recognition of the intention behind *x* is for the audience a reason and not merely a cause" (Grice, 1957/1990, p. 76) — the role of the audience remains essentially a passive one.

In "Logic and Conversation" (1975/1989), Grice deals more directly with the problems of conversation and the interactive nature of human communication in response to what he characterizes as the "inadequate attention to the nature and importance of the conditions governing conversation" (p. 24). Although Grice's primary emphasis in this essay is on the nature and function of conversational implicature, it is here that he outlines his notion of a cooperative principle underlying communicative exchanges. Grice observes that interactive communication, or discourse, does not usually consist of a series of unidirectional statements, but is generally characterized by what he calls "cooperative transactions" (1975/1989, p. 29). "Our talk exchanges", he writes, "... are characteristically, to some degree at least, cooperative efforts; and each participant recognizes in them, to some extent, a common purpose or set of purposes, or at least a mutually accepted direction" (1975/1989, p. 26). Recognition of this cooperative effort brings with it, Grice claims, the realization that participants in the communicative process are expected to adhere to a general assumption that their "conversational moves" be relevant to the purpose of the communication, a practice that Grice identifies as "the Cooperative Principle" (1975/1989, p. 26). Active participation in a communicative exchange imposes certain communicative responsibilities or standards of discourse with which the participants' behavior must accord for the purpose of the communicative act to be realized. It is these responsibilities which are to be accounted for by the cooperative principle and its associated maxims.

Grice argues that participants in a process of communication observe this cooperative principle "not merely as something that all or most do *in fact* follow but as something that it is *reasonable* for us to follow" (1975/1989, p. 29). Without the assumption that all parties to a communicative exchange are adhering to Grice's cooperative principle, or something like it, any attempt at communication would be little more than an exercise in futility. The ultimate goal in any communicative exchange must be the giving and receiving of information. For this goal to be realized — for the communication to be profitable to its participants — the exchange must be carried out in accordance with the notion of relevance introduced by the cooperative principle.

Grice's cooperative principle is an important contribution to the literature on communication precisely because it recognizes that human communication is an inherently interactive process within which both the speaker and the audience must be seen as full participants. The attempt to

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account for the interactive nature of communicative exchanges — for the cooperation between participants that must characterize any such communicative process if it is to be mutually profitable — is a significant shift in attention away from the conceptualization of communication as a conduit and its attendant emphasis on communication as the mechanical transmission of a message. But while Grice's notion of a cooperative principle would appear, theoretically, to constrain the process of communication by ensuring the relevance of individual contributions to a communicative exchange, it does not address the problem of reference that becomes increasingly more insistent in the wake of growing disillusionment with the power of the classical theory to account for observed phenomena.

THE FUNCTION OF CONTSTRAINTS

While the theoretical void created by this disillusionment with the classical theory has generated the introduction of various competing theories, no one theoretical approach has received unanimous acceptance. The study of categories continues, but within an atmosphere of theoretical flux. One avenue of investigation that may offer fresh insight draws upon research into the nature and function of cognitive constraints. Constraints serve to reduce the complexity of cognitive tasks by placing limits on the hypothesis space within which the individual evaluates possible alternatives.

Although the precise nature and function of constraints is currently of interest to researchers in the areas of developmental psychology and knowledge acquisition, the study of constraints emanates from Chomsky's investigations into the process of language acquisition. Chomsky's notion of a universal grammar is an attempt to describe a system of linguistic constraints that will account for the rapidity and uniformity with which the child acquires language facility. Given the inadequacy of the initial stimulus, the complexity of language, and the infinite variety of possible linguistic strings, Chomsky (1965) contends that language learning is enabled by a system of linguistic universals, or constraints, that provide the child with mechanisms for limiting possible alternatives during the acquisition of a native language .

Thus, within a complex and varied environment, the process of determinants or parameters that serve to limit the range of possibilities from which the learner may choose. An adequate theory of knowledge acquisition must also account for the rapidity with which the child develops concepts that accord with those of his elders within an environment that provides inadequate stimuli. Gelman (1990) observes that the inadequacy of the child's experience — the poverty of the stimulus — is further complicated by the seemingly infinite complexity, or pluri-potentiality, of the child's experiences: Experiences provided for the child by an adult cannot guarantee that the child will produce the particular interpretation that is the adult's didactic intent. Recognition of the complexity and variety of experience has fostered a growing awareness that it is not sufficient for constraints to simply limit the range of possible alternatives; constraints must also function as guiding principles by providing a basis for choosing certain preferred alternatives over others (Chomsky, 1965). Whether they are posited in the form of universal principles (Chomsky, 1965), organizing structures (Gelman, 1990), guiding principles (Medin et al., 1990) or biases and predispositions (Markman, 1989), constraints serve not only to limit the range of possible

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alternatives but to provide a selection procedure that guides the individual to favor the optimal alternative. Medin et al. (1990) point out that, if the individual cannot examine all of the possible products of some cognitive task because of the pluri-potentiality of experience, they must in some way be biased to favor certain inferences before others. These biases serve to direct the individual's attention toward preferred possibilities: "Without guiding principles of some form it simply is unclear how the learning process would ever get off the ground" (Medin et al., 1990, p. 169).

Theoretically, then, constraints provide the individual with both a means of limiting the range of possible alternatives and an evaluation measure for selecting the most probable alternative from among a range of possibilities. Keil (1981) points out that, while formal constraints are frequently characterized not as restrictions on process but as restrictions on structure, such a characterization is not wholly satisfactory. Citing Newell's (1972) objections that structure and process are generally so tightly interrelated that the distinction between the two may boil down to one of terminology, Keil suggests that the characterization of constraints as restrictions on structure may actually reflect an intuitive bias on the part of the individual theorist. The distinction between constraints on structure and constraints on process is further compromised by the more recent distinction between domain-general and domain-specific constraints (Keil, 1990). Domain-general constraints are currently accepted as applying to the general process of knowledge acquisition, while domain-specific constraints are identified as those that apply to the acquisition of knowledge within the conceptual structure of a particular domain, such as language. Despite the current discussion on domain-general and domain-specific constraints, it is highly probable that processes involved in knowledge acquisition and decision-making place constraints on cognitive structure.

FREYD'S SHAREABILITY CONSTRAINT

Freyd (1983) proposes that cognitive representations are impacted by "constraints that the process of sharing puts on the knowledge structures" (p. 209). Arguing from the assumptions that individuals learn from others and that there is a human tendency to minimize information loss through agreement on what it is that is known, she theorizes that the interaction between individuals involved in the process of communication imposes certain constraints, or organizing principles, that are reflected in the observable structure of knowledge These organizing principles, Freyd suggests, do not originate within the individual mind but emanate from the process of communication itself: "the need to communicate, as well as the need to understand, imposes shareability constraints" (p. 199).

As Freyd observes, it is generally assumed that language is composed of discrete, analytic units that reflect the categorial structure proposed by the classical theory. These units are thought to be produced by formal "learnability" constraints that are activated during the process of language acquisition (Newport, 1981). But Freyd argues that the apparently discrete nature of these units may actually be produced by the attempt to facilitate communication through language: While the definition of a category may begin as non-analytic, personalized knowledge, a significant part of language learning may involve continual revision and modification of this definition through communicative interaction with other members of the linguistic community. Those category terms whose definitions, or intensions, are shared with other members of the community will be more

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highly constrained than those that are not held in common. And because individuals strive to share a common intension for a category to facilitate the process of communication, those terms whose definitions are shared, and thus highly constrained, will appear to approximate discrete linguistic units.

Although Freyd does not cite research conducted by Krauss, Vivekananthan, and Weinheimer (1968), this earlier study provides empirical support for her thesis. Krauss et al. asked subjects to code color chips either for identification by others (the social coding condition) or for identification by the encoder (the nonsocial encoding condition). When these same subjects were asked to match color terms to color chips two weeks later, there were significant differences in accuracy based upon the interaction between encoding and decoding conditions: While subjects were most accurate in their identification of color terms supplied by themselves regardless of the original coding condition, they were more accurate in their identification of color terms supplied by others under the social coding condition than of color erms supplied by others under the nonsocial coding condition.

More recently, work by Clark and Wilkes-Gibbs (1986), and Fussell and Krauss (1989a, 1989b) supports the earlier findings of Krauss et al. (1968) and indicates that the intent to communicate with another individual is an integral component in both the production and the comprehension of linguistic exchange. Based upon their own research, Clark and Wilkes-Gibbs (1986) conclude that successful communication between individuals appears to proceed from the underlying assumption, reminiscent of Grice's cooperative principle, that communication is a collaborative process in which all participants are responsible for establishing the speaker's meaning. Similarly, Fussell and Krauss have demonstrated that the intended addressee of a communicative act influences the comprehensibility of communication. When these researchers (Fussell & Krauss,1989a) asked subjects to provide referring expressions describing abstract figures either for themselves (the nonsocial condition) or for another (the social condition), the intended recipient of the communication significantly affected the ability to identify these same figures at a later date: Subjects were able to correctly identify a greater number of the descriptions produced under the social condition than those produced under a nonsocial condition. In a variation on the first experiment, Fussell and Krauss (1989b) asked subjects to write descriptions of abstract stimuli that would identify them for a friend. When presented with descriptions they had created, descriptions created by a friend, and descriptions intended by a stranger for his/her own friend, individual subjects were most accurate in identifying the stimuli using their own descriptions, but were more accurate in identifying the stimuli when the description was created by a friend than when it was created by a stranger for his/her friend.

These studies indicate that both the intent to communicate and the intended recipient influence the individual's cognitive organization of information. The fact that subjects were better able to identify color terms, referring expressions, and descriptions created by another with the intent to communicate (the social condition) than those created by another for personal use (the nonsocial condition) offers support for Freyd's contention that the process of communication imposes constraints that are reflected in cognitive knowledge structures.

Based upon empirical research conducted by Krauss, Vivekananthan, and Weinheimer (1968) and the "shareability constraint" proposed by Freyd (1983), Keil (1987) theorizes that participation in

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a communicative process with the intent to share information may impose constraints on the cognitive structure of a category that will cause participants to act as if the coategory conformed to the classical theory. The need to share information across potentially idiosyncratic representational structures may predispose individuals to adopt a categorial structure that reflects a consensus of opinion across the linguistic community — a definition that emanates from characteristics that the individual believes are shared by other participants in the communicative exchange.

Obviously, the classical theory of categories is an elegant and potentially powerful theory. Because it tightly constrains category membership by specifying a set of defining features that every member must exhibit, it provides for stability of semantic reference across individuals. It is this stability of reference that makes the classical theory so intuitively compelling. Indeed, it is just such stability of reference that Putnam seeks to establish through the notions of indexicality and the division of linguistic labor.

But the power of the classical theory has been undermined by its inability to account for empirical observations of individual behavior. The inability of subjects to produce a set of essential characteristics that define a category undercuts the assumption that such a set exists and is available to the individual. Furthermore, the classical theory assumes that all category members are equal because they must exhibit the same set of defining features; but subjects have repeatedly demonstrated the ability to provide typicality ratings for both members and non-members of a given category. Instability of the resulting graded typicality effects, which vary both between subjects and within subjects across observations, further undermines the assumption of the classical theory that each category possesses an invariant and ungraded structure. Empirical observation demonstrates that the individual's cognitive representation of a category is neither ungraded nor determinate: Category structure is not constrained by an invariant set of defining criteria, as the classical theory supposes, but appears to be dynamic and flexible, within the boundaries of individual experience, immediate context, and individual goals and ideals.

Immediate context and past experiences serve as dynamic constraints on category structure that function both to limit the possible alternatives from which the individual must choose and to provide selection procedures that predispose the individual to favor the most probable alternative. For example, context may function as a constraint to limit the range of possible alternatives and to predispose the individual to select the most probable referent for the term "pig" in the statement "He saw a whole lot of pigs today." Within the context of a drive in the country, "pigs" will refer to barnyard animals; within the context of participating in a 1960s-style peace rally, "pigs" will refer to policemen; but, within the context of attending a high school dance, the same term might indicate yet another set of referents. In this example, context serves as an external constraint on the membership of the category label "pigs" by providing a criterial measure for selecting the most appropriate group of referents.

Freyd's (1983) shareability constraint suggests that interaction between individuals involved in the exchange of information are subject to constraints that determine the cognitive organization of a category. When the shareability constraint and the findings of Krauss et al. (1968), Clark and Wilkes-Gibbs (1986) and Fussell and Krauss (1989a, 1989b) are reviewed in light of the current dilemma in category research, there emerges a potentially valuable line of research for the

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investigation of category structure. This research would build upon the suggestion that the process of communication may actually precipitate the restructuring of cognitive representations of categories to approximate a set of values that is shared across members of the linguistic community.

The notion that participation in the exchange of information predisposes the individual to seek commonality of reference through the adoption of a knowledge structure that is shared by all participants in the communicative process suggests that stability of reference — the theoretical heart of the classical theory — may indeed be reconciled with empirical observations of graded typicality effects, as suggested by Medin and Smith (1984; see also Smith & Medin, 1981). They argue that the individual may actually rely upon his/her intuitive assumption of an underlying set of essential features as a means for justifying categorizations based on typicality. And they suggest that, because individuals "approach the world as if it conformed to the classical view," the classical theory may actually serve "as the layperson's metatheory of concepts" (Medin & Smith, 1984, p.123). In the face of research indicating that individuals are unable to define those essential features (Hampton, 1979; Rosch & Mervis, 1975), Medin and Smith (1984) advance Putnam's (1975) hypothesis of the division of linguistic labor as support for their notion of a metatheory of concepts: Individuals might reconcile their inability to define the essential properties of a category by assuming that these features were present, but hidden from view, and that they could be ascertained by domain experts who possessed the specialized knowledge requisite to apprehend them.

But the shareability constraint proposed by Freyd (1983) and research conducted by Fussell and Krauss (1989a, 1989b) indicates that it may not be necessary to propose such a metatheory of concepts. Given findings of instability of graded typicality judgments both between subjects and within subjects over time, the process of communication may predispose the individual to represent categories generated at the individual, idiosyncratic level with a cognitive structure that functions at a more universal or shared level. Thus, categories employed in the process of communication, and therefore subject to Freyd's proposed shareability constraint, would be predicted to exhibit a more discrete and analytic structure — a structure that would more closely approximate the bounded and ungraded structure proposed by the classical theory of categories.

IN SEARCH OF A COMMUNICATIVE CONSTRAINT

Empirical observation indicates that individual representations of a category generally demonstrate considerable instability. Under the influence of individual experience and the immediate context, typicality judgments vary both between individuals and within the same individual across situations. Barsalou (1989) argues that this instability in category representation is substantial and that intuitions of stable and invariant knowledge structures are little more than "analytic fictions" (1989, p. 86) that obscure the dynamic and flexible nature of human cognitive representation.

Barsalou observes that the concept representing a category and serving as the individual's basis for typicality judgments on any given occasion is composed of context-independent information that is present within all instances of a category; context-dependent-information associated with, or

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cued by, the immediate context; and context-dependent information produced by the individual's recent experiences. He concludes that within-subject stability of representation across contexts is produced by context-independent information that is incorporated into all representations of a single category. This context-independent information is similarly responsible for between-subject stability when such information consists of category properties that are shared across a population. When context-dependent information cued by the immediate context is culturally determined within a population, it, too, will contribute to stability of category representation.

The apprehension of stability between any two representations of the same category, whether between subjects or within the same subject across observations, is dependent upon the amount of overlap that exists between the context-independent and context-dependent information that forms the conceptual basis for each such representation: If category representations draw on information that is shared either within the individual across contexts or across members of a population within the same context, the resulting typicality judgments should demonstrate increased stability (Barsalou, 1989).

By defining stability of representations not as a sameness of concepts but as the similarity of conceptual information determining the representation of a category within a given context, Smith, Medin and Rips (1984) contend that it is this similarity or "communality" (p. 268) of category properties that serves to facilitate what they call "everyday comprehension" (p. 269). The notion of communality proposed by Smith et al. (1984) echoes the fundamental premise behind Freyd's shareability constraint: The need to share knowledge through communication — to convey information and to comprehend information provided by others — causes the individuals involved in such a communicative process to minimize information loss through agreement on what it is that is known. Borrowing from the terminology employed by Barsalou (1987, 1989), any such agreement would attempt to achieve consensus on the semantic meaning of a category label through maximum overlap, or sharing, of the context-independent and context-dependent information that underlies category representation.

Barsalou (1989) asks "When are category representations stable, and what purpose does this stability serve?" (p. 93). Given the fundamental assumption that the goal of communication is to promote the exchange of information between individuals, the need to minimize information loss will require stability of semantic reference. It follows, then, that, if the intent to communicate does serve to constrain the cognitive representation of a category, involvement in a process of communication will promote increased stability of category representation. Any attempt to demonstrate that communication functions as a constraint on knowledge structures, as Freyd proposes, must first produce findings of increased stability in the cognitive representation of categories. Without such a finding of increased stability beyond that produced by the context-independent and context-dependent information that is shared across a population, the proposal that communication functions as a constraint on the variability of category representations to promote shared meaning cannot be supported.

A research program is presently underway that will investigate the power of the communicative process to constrain cognitive representation of categories. To determine whether there exist certain organizing principles that are generated within the context of interpersonal communication and serve to constrain the observed structure of categories, the current study addresses the specific

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question "Does the individual, under constraints imposed during participation in a process of communication, restructure his/her internalized ordering of category members to reflect a more fixed and arbitrary external ordering that is shared across members of the linguistic community?"

To ascertain the presence of a communicative constraint on the structure of cognitive categories, the present study will test the null hypothesis that the variability, or instability, of the cognitive structure of a category is unaffected by a context of interpersonal communication. Subjects are randomly assigned to one of three stimulus conditions: no context (Group One); general context (Group Two); and general context plus communication (Group Three). For each of twelve category labels, subjects are asked to read a brief introductory paragraph, or vignette, and then to rate the representativeness of eight category terms. This exercise is then repeated twice, at intervals of ten to fourteen days, for a total of three separate observations for each subject. Findings of a significant increase in the stability of category structure for the experimental group receiving the general-context-plus-communication stimulus will provide initial support for the notion that the intent to participate in a process of communication functions to constrain the cognitive representation of a category by biasing the individual to restructure internalized representations of reality — those flexible and potentially idiosyncratic categories generated through experience — to reflect a more discrete and analytic ordering of category structure that is shared across members of the linguistic community.

CONCLUSION

The classical theory of categories is an elegant and powerful theory. But the assumption that all members are equally representative of a category cannot account for the effects of graded typicality that appear to characterize the individual's cognitive representations of categories. Observations of a continuum of typicality judgments ranging from the most representative members at one extreme to the most unrepresentative non-members at the other (Barsalou, 1987) undermines the explanatory power of the classical theory. Furthermore, the inability of subjects to provide a set of essential features that determine category membership contradicts the basic assumption that categories are mutually exclusive classes determined by fixed sets of essential features that are readily available to the individual.

If the intension of a category is not determinate and its extension is not fixed, how is shared meaning achieved across individuals during the process of linguistic communication? Is there a mechanism similar, perhaps, to Grice's Cooperative Principle, that emerges during the process of communication to facilitate shared meaning by constraining the graded typicality effects that characterize the individual's cognitive representation of a category? And can such a mechanism promote a reorganization of the graded structure observed in the individual's representation of a category by emphasizing the features which are more likely to be shared across individuals, such that the resulting cognitive organization of a category approximates the ungraded structure proposed in the classical theory of categories?

While understanding how the individual generates categories to structure his or her own experiential and potentially idiosyncratic knowledge is of fundamental importance to a coherent theory of cognition (Barsalou, 1987), it is equally important to understand how these categories

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may be affected by the individual's intention to participate in a communicative exchange. A satisfactory theory of cognition must include an explanation of how participation in a process of linguistic communication impacts the individual's internal representations of knowledge, if only to distinguish externally imposed constraints from those generated internally.

The possibility that categories function in accordance with the classical theory at one level (that of communication through linguistic expression) while exemplifying aspects of instability, graded structure, and fuzzy boundaries at another (the flexible and potentially idiosyncratic structuring of individual knowledge) focuses attention on the role of constraints in determining the internal organization of categories. Keil's suggestion that the need to communicate information may force individuals to restructure their mental representations in accordance with a set of "common values or dimensions" (1987, p. 193) may point toward an enhanced understanding of how the idiosyncratic, personalized categories produced by the individual interact with the universal, analytical categories presupposed by the classical theory of categories.

The immediate question, then, is not "What is the structure of categories?" but "What are the organizing principles that constrain category structure?" And "Does the individual, given the possible influence of constraints imposed by the intent to communicate, restructure internalized representations of reality — those idiosyncratic cognitive categories — to reflect a fixed and arbitrary external ordering of knowledge?" Answers to these complex question can only enhance understanding of the functional relationships that exist between communication, cognition, and the representation of categories.

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