Being There Conceptually: Simulating Categories in Preparation for Situated Action

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A constant theme in Jean Mandler’s work is that a child’s developing knowledge is grounded in sensory–motor experiences of events (e.g., Mandler, 1987, 1992). Rather than being detached from events, knowledge remains grounded in them. Rather than being amodal, knowledge retains its sensory–motor origins. The essay to follow arises in the tradition of this work and reflects its influence.

THE SITUATED VIEW OF CONCEPTS

According to the view developed here, people conceptualize a category differently across situations, with each conceptualization embedded in a background situation. A single situation-independent concept does not represent the category; the concept does not represent the category in isolation, independently of the situations in which it occurs. Consider the category of chairs. According to the situated view, different conceptualizations of chairs are represented in their respective situations. Thus, one situated conceptualization might represent...
office chairs in business environments, another might represent easy chairs in homes, another might represent theater chairs in theaters, another might represent airline chairs in jets, and so forth. A single situation-independent concept does not represent chairs across situations, and the conceptualizations do not represent isolated chairs. As the category is encountered in different situations, a situated conceptualization develops for each, linked together in a radial concept, as described later.

**EVIDENCE FOR THE IMPORTANCE OF SITUATIONS**

Findings across diverse areas demonstrate the importance of situations in intelligence and behavior. In developmental psychology, the Vygotskian approach has stressed the importance of situations in acquiring cognitive and social skills (e.g., Vygotsky, 1991). From this perspective, Jean Mandler illustrated the importance of situations in children’s ability to remember stories and events (e.g., Mandler & Johnson, 1977; Mandler, 1987). In the social and personality literatures, situations predict behavior at least as well as traits (e.g., Mischel, 1968). In perception, situations greatly facilitate object recognition when an object occurs in a predicted context (e.g., Biederman, 1981), with Jean Mandler and her collaborators providing some of the earliest demonstrations (e.g., Mandler & Parker, 1976; Mandler & Ritchey, 1977; Mandler & Stein, 1974). In memory, situations play a central role in elaborating perceived scenes (e.g., Intraub, Gottesman, & Bills, 1998) and in retrieving information from memory (e.g., Tulving & Thomson, 1973). In language comprehension, texts can be incomprehensible when the relevant situation is not known (e.g., Bransford & Johnson, 1973). Indeed, language comprehension can be viewed as preparation for situated action (Barsalou, 1999a). In pragmatics, situations are central to establishing common ground between communicators, both human (e.g., Clark, 1992) and nonhuman (e.g., Smith, 1977). In problem solving and reasoning, it may be difficult to draw valid and useful conclusions without the support of a concrete situation (e.g., Cheng & Holyoak, 1985, Gick & Holyoak, 1980; Johnson-Laird, 1983). In linguistics, the importance of situations has motivated the theory of construction grammar, where syntactic structures evolve out of familiar situations (e.g., Goldberg, 1995). In philosophy, the importance of situations has motivated the theory of situation semantics, where logical inference is optimized when performed in the context of specific situations (e.g., Barwise & Perry, 1983). At a more general level, arguments about the central role of situations in cognition can be found in Barsalou, Yeh, Luka, Olseth, Mix, and Wu (1993), Clark (1997), Glenberg (1997), and Greeno (1998).

Across these diverse areas, the common theme is that situations are fundamental to cognition. By incorporating situations into a cognitive task, processing becomes more tractable than when situations are ignored. Because specific entities and events tend to occur in some situations more than others, capitalizing on these correlations constrains and facilitates processing. Knowing the current situation constrains the entities and events likely to occur. Conversely, knowing the current entities and events constrains the situation likely to be unfolding.

By focusing on situations, the cognitive system simplifies many tasks. Rather than having to search everything in memory across all situations, the cognitive system focuses on the knowledge and skills relevant in the current situation. As a result, it becomes easier to recognize objects and events that may be present; it becomes easier to remember relevant information and skills; it becomes easier to resolve the ambiguities of language; it becomes easier to solve problems and perform reasoning; it becomes easier to predict the actions of other agents. For all these reasons, it would not be surprising if situations turned out to be central for concepts.

**CURRENT THEORIES OF CONCEPTS**

Most current views implicitly view concepts as unsituated, assuming that concepts have been abstracted from the situations in which they occur. Although these theories could be readily extended to represent situated concepts, they typically do not.

Consider classical theories, which typically assume that rules describe the objects in a category independently of situations (e.g., Bruner, Goodnow, & Austin, 1956). For example, a rule might attempt to capture the physical properties of chairs that are necessary and sufficient for membership. Although such rules could also attempt to capture situational properties, they typically do not. Instead, classical theories abstract across situations, rather than establishing rules for subsets of chairs within particular situations. Classical theories to date represent the extreme view of unsituated concepts.

Prototype theories similarly tend to assume that unsituated abstractions represent categories (e.g., Hampton, 1979; Rosch & Mervis, 1975). Rather than being definitional, however, these abstractions are statistical, representing the most frequent properties across situations, with situation-specific properties canceling themselves out. Although subprototypes could develop for concepts in particular situations, this possibility has not been explored.

The view that categories are embedded in intuitive theories similarly tends to ignore situations (e.g., Murphy & Medin, 1985). Although in-
tuitive theories constrain the form that concepts take, situations have not played a central role in these accounts. Even when concepts are constrained by intuitive theories, they are nevertheless assumed to remain constant across situations (but see Gelman & Diesendruck, 1999, for an account of intuitive theories that is compatible with situated concepts).

Exemplar models have much potential for implementing situated concepts but typically have not. Many exemplar models assume that the entire set of exemplars stored in memory for a category represents it on each occasion (e.g., Lambergs, 1994; Nosofsky, 1984). Thus, a fixed representation stands for the category on all occasions, not a situation-specific one. Furthermore, exemplar representations typically only include physical properties of exemplars, not properties of associated situations. Notably, some exemplar models have more of a situated character. For example, Nosofsky and Palermi’s (1997) random-walk model assumes that only a subset of exemplars is retrieved in the current context, such that the category representation changes across contexts (also see Barsalou, Huttenlocher, & Lambergs, 1998). Similarly, Medin and Schaffer’s (1978) context model assumes that context is important in categorization, although context is typically implemented as other properties in the objects being categorized, not as their situational properties. As these theories illustrate, exemplar models can implement situated conceptualization if two conditions are met: (a) situational information is represented in exemplars along with object properties, (b) situation-specific subsets of exemplars are retrieved during categorization.

In contrast to the previous four classes of models, connectionist models clearly implement situated conceptualization. Not only do they represent a category differently across situations, they include situational information in these representations. Consider Rumelhart, Smolensky, McClelland, and Hinton’s (1986) account of the room schema. In an auto-associative net, subsets of object properties are linked to subsets of room properties, such that correlated sets of object and situational properties form attractors. When a subset of object properties is activated, related situational properties become active, thereby situating the object. Conversely, when situational properties become active, relevant properties of the object become active, resulting in a situation-specific representation of it. Connectionist models have been explicitly formulated to implement situated conceptualization, and they do so elegantly.

**CONCEPTS AS GROUNDED IN PERCEPTUAL SIMULATION**

The importance of situations for concepts follows from the proposal that people represent concepts with perceptual simulations (Barsalou, 1999b). This next section briefly outlines the theoretical assumptions of perceptual symbol systems, and then reviews some of the empirical evidence for this approach. The following section then illustrates how viewing concepts as grounded in perceptual simulation predicts the importance of situations in concepts.

The first assumption of this view is that selective attention focuses on components of experience. During perception of sensory events, people focus on shapes, colors, sounds, smells, etc.; during perception of proprioceptive events, people focus on movements, facial expressions, vocalizations, etc.; during perception of introspective states, people focus on emotions, cognitive operations, beliefs, etc. Once attention selects a perceived aspect of experience, associative areas in the brain capture the respective pattern of activation in the relevant perceptual, proprioceptive, or introspective area. Later, these associative areas partially reactivate these perceptual representations in the absence of perceptual input, thereby simulating the experience of what an external or internal event was like. Using such simulations, people conceptualize objects, external events, and internal events in their absence.

Barsalou (1999b) illustrated how these simulation mechanisms implement a fully-functional conceptual system, including the type-token distinction, categorical inference, the productive construction of novel simulations, the representation of propositions, and the representation of abstract concepts. Also illustrated are how these simulation mechanisms could underlie the knowledge that supports basic cognitive processes, including perception, categorization, memory, language, and thought. Additional articles extend this theory (Barsalou, 1993, 1999a; Barsalou & Prinz, 1997; Prinz & Barsalou, 2000; Prinz & Barsalou, in press). In one of the earliest articles to champion this theme, Jean Mandler highlighted the importance of sensory-motor knowledge in children’s developing concepts (Mandler, 1992). Glenberg (1997) offered a related proposal.

**Empirical Support for Perceptual Simulation in Conceptual Tasks**

Several lines of empirical inquiry implicate perceptual simulation in the representation and processing of concepts (for a review, see Barsalou, Solomon, & Wu, 1999; also see Goldstone & Barsalou, 1998). Solomon and Barsalou (2001a) demonstrated that when individuals attempt to verify a property of a concept, they search for the property in a perceptual simulation of the respective object. To verify that a house has a roof, for example, individuals simulate a house and a roof, and then search the simulated house for a region that matches the simulated...
PERCEIVED SITUATIONS AND SIMULATED SITUATIONS

If perceptual simulation underlies the representation of concepts, it places an important constraint on them: If a conceptualization attempts to simulate a perceptual experience, then it should typically simulate a situation, because situations are intrinsic parts of perceptual experiences. To make this critical assumption more concrete, consider the nature of perceptual experience. At a given point in time, people perceive the immediate space around them, including any agents, objects, and events within it. Some of these entities and events may be external, whereas others may be internal. Furthermore, this experience is multimodal; it is not just visual, but also auditory, tactile, gustatory, olfactory, proprioceptive, and introspective. Thus, a perceptual situation is a perceived region of space that contains agents, objects, and events, both external and internal. Most importantly, even when people focus attention on a particular entity or event in perception, they continue to perceive the background perceptual situation—the situation does not disappear.

If perceptual experience takes the form of a situation, and if a conceptualization is essentially an attempt to simulate perceptual experience, then the form of a conceptualization should take the form of a situation. When people construct a simulation to represent a category, they should tend to envision it in a relevant perceptual situation, not in isolation. When people conceptualize chair, for example, they should attempt to simulate not only a chair but a more complete perceptual situation, including the surrounding space and any relevant agents, objects, and events. In principle, it is possible to simulate a chair independently of a situation, and indeed, the ability to focus attention on aspects of situations is a central part of perceptual symbol systems (Barsalou, 1999b). When we actually perceive chairs in the world, though, we never perceive them in a vacuum. Although we focus attention on them, we nevertheless continue to perceive the background situation. This observation motivates that claim that conceptualizations are similarly situated, at least much of the time. Although the simulation of a chair may typically focus attention on the simulated object, the background situation nevertheless tends to be simulated along with it.

THEORETICAL FRAMEWORK

Following Yeh and Barsalou (2001), the following assumptions underlie the view that concepts are situated:

1. A conceptualization of a category typically includes a background situation.
2. Each conceptualization represents a category in a way that is relevant to the background situation, such that different conceptualizations represent the category differently.

3. The different conceptualizations of a category become linked by analogy or by an essence (real or imagined) to form a radial concept.

The first assumption is the one just described, namely, conceptualizations do not simulate a category’s members in isolation but simulate them against background situations. For example, people do not simulate chairs in isolation, but tend to simulate them in their background situations (e.g., living rooms, classrooms, jets, theaters, etc.). The second assumption follows naturally from the first: If conceptualizations include background situations, then each simulated form of a category should include information appropriate for the respective situation. For example, the simulation of a chair in a living room should simulate a living room chair, whereas the simulation of a chair on a jet should simulate a jet chair. As a result, the different conceptualizations of a category differ, not just in situational information, but also in information about category members per se. Although some properties may be relatively common across conceptualizations, others are likely to vary (Barsalou, 1982).

The third assumption is necessary to explain how different conceptualizations of the same category become linked together. For example, how do the various conceptualizations of chairs become integrated into a single category? One possibility is by analogy. When a perceived entity accesses a structurally analogous conceptualization in memory, the two become linked (e.g., Brooks, 1978; Gentner & Markman, 1997; Holyoak & Thagard, 1989; Nosofsky, 1984). Perceiving a dining room chair, for example, may activate the conceptualization of an office chair via their shared physical structure, or via the common actions performed on them. As a result, the two conceptualizations become linked in memory. As chairs are increasingly encountered in other situations, the respective conceptualizations become related to similar conceptualizations, thereby forming linked chains. Although core properties could ultimately become established across the various conceptualizations of a concept, they need not be. When they do not, the linked chains of conceptualizations form a radial concept, whereby each conceptualization is closely related to at least one other (Lakoff, 1987; Malt, Sliomacer, Shi, & Wang, 1999).

Essences constitute another possible linking mechanism. If all known conceptualizations of a category are believed to share a common essence, they become linked around the essence, even when their physical appearances differ (e.g., Gelman & Diesendruck, 1999). Depending on the category, the essence could reflect a real essence that actually exists across instances, or it could simply reflect the belief that an essence exists, even when one does not. Regardless, the point is that the situated conceptualizations for a category could become linked in several ways. Following Barsalou (1999b), the result is a simulator capable of producing many situated simulations of a category.

This proposal does not simply boil down to the fact that a category has subordinates; the claim is significantly stronger. A category does not simply take different subordinate forms. Instead, these forms arise to accommodate the constraints of different situations. Conceptualizations of chairs, for example, take different forms because the constraints on having a place to sit vary from situation to situation. Furthermore, the heart of this proposal is that conceptualizations are represented against background situations—they are not simply subordinates represented in isolation. Finally, this framework extends well beyond subordinate categories. Consider cars. This framework predicts that a single subordinate, say sedans, will be conceptualized in a variety of situations, such as driving a sedan, seeing a sedan drive by, repairing a sedan, filling a sedan’s gas tank, and so forth. Rather than conceptualizing sedans in a generic situation-independent manner, people conceptualize them in these various situations, focusing on different perspectives and properties in each. Thus, the theoretical proposal here extends beyond the fact that categories have subordinates.

Barsalou et al. (1993) presented the functional specifications of the aforementioned theory, which remains to be implemented computationally. As described earlier, existing connectionist theories offer one natural approach. Implementing this theory as a perceptual symbol system, however, constitutes a significant challenge that lies considerably beyond existing connectionist models (Barsalou, 1999b).

EMPIRICAL SUPPORT FOR SITUATED CONCEPTS

Yeh and Barsalou (2001) reviewed a wide variety of evidence that concepts are situated. Not only do people represent concepts in background situations, they represent them from subjective perspectives. In representing a concept, it is as if people were being there with one of its instances. Rather than representing a concept in a detached isolated manner, people construct a multimodal simulation of themselves interacting with an instance of the concept. To represent the concept, they prepare for situated action with one of its instances (Barsalou, 1999a). This final section briefly illustrates this point with two empirical findings.
Generating Category Members From Situations

Vallée-Tourangeau, Anthony, and Austin (1998) illustrated how participants imagine themselves in situations to produce exemplars of concepts. These researchers asked participants to generate exemplars from common taxonomic categories, such as furniture and fruit, and from ad hoc categories, such as things dogs chase and reasons for going on a holiday. After participants finished generating exemplars, they were asked to describe the strategies that they had used. Each strategy was classified as one of the following:

1. Experiential mediation—retrieving an autobiographical memory of a situation that contains individuals from the target category, and then reporting the categories to which these individuals belonged. When generating types of fruit, for example, this might involve retrieving a memory of a grocery store, scanning across it, and reporting the types of fruit perceived in the produce section. Similarly, when generating types of furniture, this might involve retrieving a memory of a residence, scanning across it, and reporting the types of furniture perceived in the living room.

2. Semantic mediation—retrieving a detached taxonomy that contains the target category, and then reporting its subcategories. When generating exemplars of fruit, for example, this might involve retrieving the fruit taxonomy and reporting subtypes, such as tropical fruit, dried fruit, and citrus fruit. Similarly, when generating exemplars of furniture, this might involve retrieving the furniture taxonomy and reporting subtypes, such as decorative furniture, storage furniture, and seating furniture.

3. Unmediated retrieval—accessing exemplars unconsciously and not being aware of any obvious strategy. On such occasions, participants often made remarks such as, “I just thought of them.”

Vallée-Tourangeau et al. (1998) reported that their participants used experiential mediation about 3 times as often as semantic mediation for both common taxonomic and ad hoc categories (unmediated retrieval was used even more rarely). Typically, experiential mediation included situations, namely, memories of events in environmental contexts. One might well expect that participants would report situations for ad hoc categories, given that these categories arise out of goal-directed activity in specific contexts (Barsalou, 1983, 1991). Much more surprising is the finding that situations were reported just as often for common taxonomic categories, suggesting that they, too, are organized around situations.

Bucks (1998) reported the same pattern of results as Vallée-Tourangeau et al. (1998), again showing that participants used experiential mediation most often to generate the instances of both common taxonomic and ad hoc categories. Related results have been reported by Walker and Kintsch (1985).

Together, all of these studies show that participants represent concepts in background situations. When participants receive a concept, they do not process its meaning in isolation. Instead, they often activate a background situation, and then establish the concept’s meaning within this context.

Generating Features From Situated Instances of Categories

As the next studies illustrate, participants also situate concepts with respect to subjective perspectives when asked to produce the features of a single concept. Wu and Barsalou (2001) asked participants to list properties for individual concepts, such as apple, and for conceptual combinations, such as sliced apple. The instructions explicitly stated that participants should produce properties of the target objects per se. Nevertheless, participants produced many other properties that described background situations and subjective perspectives on these situations. The importance of situations can be seen in the types of properties that participants produced:

1. Taxonomic concepts—neighboring concepts in a taxonomy that contains the target concept. For example, generating the concepts fruit, banana, and Granny Smith for the target concept apple.

2. Entity properties—properties that describe the target object’s surface properties and components. For example, generating smooth, red, stem, and seeds for apple.

3. Situational properties—properties that describe a physical setting or event in which the target object occurs. For example, generating grocery store, fruit basket, slicing, and picnic for apple.

4. Introspective properties—properties that describe an agent’s subjective perspective on the target object. For example, generating delicious and “I like them” for apple.

It is not surprising that participants generated entity and taxonomic properties in the feature listing task. After all, this is what they were instructed to do. What is surprising is how often they described situational and introspective properties. Participants frequently described the physical settings and events in which the target objects are typically found (i.e., situational properties). Furthermore, participants often de-
scribed these situations from their subjective perspectives (i.e., introspective properties). Across four experiments, the proportion of situational and introspective properties combined ranged from 26% to 50%. In a given study, roughly two thirds of these properties were situational, and about one third was introspective. These findings illustrate that participants did not simply represent the target objects as detached and isolated. Instead, participants typically imagined being there with the objects, situating the objects in the environment, and viewing them from their subjective perspectives. Once participants had constructed these situated simulations, they scanned across them, producing a variety of properties in the process. Although participants were asked to process isolated concepts, they nevertheless represented them in background situations from subjective perspectives. These findings are consistent with the importance of thematic relations in concepts. Not only do people represent a concept's structural properties relevant to a taxonomy, they also represent its thematic relations relevant to related situations. It has long been believed that thematic relations are primarily important for children and not for adults (cf. Inhelder & Piaget, 1964; Lucarelli, Kyarizis, & Nelson, 1992; Markman, 1981, 1989; Nelson, 1977). However, recent work illustrates the central importance of thematic relations in adult concepts as well (Lin & Murphy, 2001). This importance may further reflect people's spontaneous inclination to represent concepts in situations.

SUMMARY

These findings illustrate the importance of situations in the representation of concepts. They also point toward future research that could illuminate the roles of situations in concepts, and the roles of concepts in situations. The human conceptual system probably did not evolve to represent concepts in isolation, or in detached taxonomies. Instead, the human conceptual system probably evolved to support human action in the environment.

REFERENCES


