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COMMENTARIES

The Origin of Concepts

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Jean Mandler's rich and nuanced feature article (this issue) develops a four-part argument:

1. An adequate characterization of the adult mind must distinguish conceptual representations from perceptual representations.
2. A priori arguments cannot decide the issue of the ontogenetic roots of each type of representation, nor of the relations between them. In particular, there is no convincing a priori argument that infants' representations are first perceptual and only later conceptual. Furthermore, there is no known mechanism through which conceptual representations may be built from perceptual representations.
3. Data from three paradigms-sequential touching, manual habituation, and imitation-provide convergent evidence that conceptual categories exhibit a different course of development than do perceptual categories. Specifically, conceptual categories emerge at the domain level (e.g., animal vs. vehicle) before the basic (dog vs. cat) or subordinate (poodle vs. collie) levels, whereas most available evidence suggests that categories based on visual similarity are formed at the basic level first.
4. A process of attentive perceptual analysis yields conceptual categories.

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It is always easy to quibble with a programmatic statement with the scope of Mandler's lovely feature article, and I am not able to refrain from doing so. But first, I would like to strongly endorse, quibbles aside, the first three parts of her argument. I reserve serious doubts only for the fourth, and offer a friendly amendment to Mandler's project.

1. *Distinguishing perceptual from conceptual representations.* **In distin-**guishing perceptual from conceptual representations, Mandler most often appeals to a difference between what entities look like and what kinds of entities they are. Additionally, she claims that conceptual representations differ from perceptual representations in being consciously accessible, supporting problem solving and inference, and being stored in long-term memory. To quibble, it is not clear that these different properties determine a single type of representation, or whether Mandler considers all of these to be properties of conceptual representations. Each may characterize at least some perceptual representations. For example, some clear cases of perceptual representations, such as a toothache or the experience of redness, may be consciously accessible.

Nonetheless, the distinction between categories based on what entities look like (or sound like or feel like) and categories based on what kind of things entities are can be cashed out in the tradition of the "theory theory" of concepts (Carey, 1985; Gopnik & Meltzoff, 1997; Keil, 1989). In this tradition, concepts such as those discussed in Mandler's feature article (tiger, mammal, animal, bird, duck, vehicle, car, cup, container, etc.) include both core and peripheral features. The core of the concept includes its causally deepest properties, those properties that determine what kind of thing the entity is and its particular properties. In this tradition, conceptual categories are those with cores, those for which adults take the stance Medin and Ortony (1989) called *psychological essentialism*. Core properties, or essential properties, are often not perceptually available. For example, in the adult concept of a tiger, its essence is inherited from its parents, is internal, and is not observable (Keil, 1989).

If concepts' cores include nonobservable causal constructs, then concepts that have cores have a nonperceptual component. The attribution of causality goes beyond spatiotemporal analysis. Even in the case of Michotte-like contact causality, the mind contributes the causal attribution; perception merely gives us contact, simultaneity, and so forth. Similarly, perception gives us aspects of paths and contingency; the mind attributes goals to agents.

This is a subtle point. The fact that we can see a physical event as a causal interaction does not make the concept of causal interaction perceptual any more than the fact that we can see a certain building as a nuclear reactor makes the concept of nuclear reactor perceptual. Perceptual categories, as I and, I believe, Mandler mean them, are formed from observational properties such as red, square, dog-shaped, and spatiotemporally specified aspects of motion.

2. A priori relations between conceptual and perceptual categories. Here I have no quibbles with the points Mandler develops in her feature article and wish only to add the following observation. If causal analysis is at the core of at least some conceptual representations, then a relevant literature as to the origin of conceptual representations is the literature on infants' appreciation of causality (Gergeley, Nadasdy, Csibra, & Biro, 1995; Leslie, 1988; Spelke, Phillips, & Woodward, 1995). As I read this literature, at least by the time infants are 7 to 12 months of age, the earliest ages at which Mandler's studies reveal conceptual representations of domain-level concepts, infants appreciate both Michotte-like contact causality and aspects of agency. Furthermore, both types of causality are attributed to entities on the basis of analysis of their action, not on the basis of what they look like. Gergeley et al. (1995) showed that 12-month-old infants attribute goal directness to dots that appear to chase other dots through gaps in walls or appear to jump over barriers to reach each other. Johnson, Slaughter, and Carey (1998) showed that 12-month-olds follow the focus of attention of faceless, amorphous robots, as long as those robots interact contingently with the baby. Although perceptual information is required for the infant to identify cases of contact causality or intentional goal-directed activity, the causal attributions go beyond the perceptual information.

3. For conceptual categories, domain-level distinctions precede, developmentally, basic-level distinctions. Whether a task reflects perceptual or conceptual categorization is both an empirical and a theoretical matter. It depends on how we draw the perceptual-conceptual distinction, and then it depends on what drives the behavior in question. A minor quibble concerning this part of Mandler's argument is that the tasks in which she and her colleagues have shown domain-level distinctions to precede basic-level distinctions (sequential touching, manual habituation, and imitation) do not transparently reflect conceptual rather than perceptual categorization. It is an open question, for example, whether infants of the age Mandler has studied would habituate to a manually presented class of objects united by a clearly perceptual property. Van de Walle (1999) showed that they will, as 9-month-olds presented with a series of red horses recover interest when allowed to play with a yellow horse, and they generalize habituation when offered a red pig. That the basic-level distinction did not determine recovery of interest is, of course, consistent with Mandler's own data from this age. What is new is that the color distinction did. Manual habituation at 9 months can reveal perceptual categorization.

This is not to say that the domain-level distinctions reflected in these tasks do not reflect categories with conceptual cores. Rather, my point is simply that the nature of the representational distinction subserving some behavioral distinction cannot simply be ascertained by considering the nature of the task itself. That being said, I do agree that the imitation-induction paradigm in particular seems on its

face to reflect conceptual categorization. Affording "keying" or "drinks from a cup" is not an observation property, and the infants' generalization patterns were unaffected by perceptual similarity.

The convergence of developmental pattern from the three paradigms-much earlier evidence of domain-level distinctions before basic-level distinctions-is a very important set of findings in the developmental literature. For the sake of argument, let us accept these findings as reflecting a distinct course of development of perceptual and conceptual categorization. I certainly believe Mandler is right on this point, even though it is difficult to establish this beyond doubt.

4. A process of attentive perceptual analysis yields the first conceptual categories. Mandler does not think that the concept of animal, uniting birds, fish, toads, dogs, horses, snakes, and so forth, is innate. She does think that by 7 to 9 months of age, infants have formed such a category, and this domain-level category has a conceptual core *(self moving agent).* The problem, then, is how the infant goes from the state of not having the domain-level concept of animal to having one. The answer Mandler gives is that the infant produces conceptual categories from perceptual input through a process of active, attentive, perceptual analysis. Visual information is redescribed into a simpler and explicitly realized form, most likely in the format of an image schema, but perhaps in a more abstract format. The content of these explicit conceptual relations includes paths objects take, plus various relations among objects such as containment, support, contact, and contingent relations.

I see several problems with this proposal. Most trivially, Mandler offers no evidence for the "active, attentive" character of the process of perceptual analysis. From adult studies of Michotte (1963) on contact causality, it is clear that some conceptual attributions that go beyond the perceptual input are automatically invoked. Although there is no evidence on this point, I would think this is also likely to be true for infants in the case of contact causality, as well as in the case of the attribution of agency and goal directedness to the interactions of moving entities.

Much more important, for reasons that Mandler clearly lays out in her sections on why there is no known mechanism for deriving conceptual categories from perceptual ones, there is equally no known way that perceptual analysis could do the trick on its own. Where do the categories represented in the image schematic meanings themselves come from? If one cannot derive causality from spatiotemporal descriptions, or agency from spatiotemporal descriptions (even those that provide the necessary input for attributions of each type of causality), then the problem of how these concepts arise has not been solved.

In sum, although endorsing the first three parts of Mandler's argument, I do not believe that perceptual analysis can be the mechanism through which conceptual representations are formed. I offer a friendly amendment to Mandler's story and suggest she look to the literature on core knowledge (cf. Carey & Spelke, 1994, 1996) for the origin of the cores of conceptual categories. By hypothesis, core

knowledge derives from innate learning mechanisms in at least two domains: intuitive mechanics, with the concept of an object and contact causality at its core, and intuitive psychology, with the concept of an agent and intentional causality at its core. Core knowledge is appropriately abstract, takes perceptual information as its input, and outputs the event-level descriptions Mandler needs for her very persuasive account of the distinct developmental course of perceptual and conceptual categorization to fly.

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