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EDITORIAL

THE DEVELOPMENT OF CATEGORIZATION

Categorization is indubitably an important cognitive process for humans (as well as other animals, Murai, Kosugi, Tomonaga, Tanaka, Matsuzawa, & Itakura, 2005), one that we constantly engage in to adapt to a very rich environment. We have a powerful impulse to interpret our world. This act of interpretation is fundamentally an act of categorization. We can go back in history at least to Aristotle (see his work on Categories, 350 B.C.E.) and along this way we find discussions of categories often appearing in philosophers' books. The issue of categorization is also an historically early topic in psychology (see Hull's experiment in 1920), and a considerable amount of research has been continuously dedicated to it up until the present. One could ask then: Why a special issue on categorization at this point in time?

Although the general topic of categorization is venerable, relatively recently we cognitive scientists have changed our view about categorization. We have moved from considering taxonomies (or categories based in logic) as the "real," mature kind of categorization to understanding that there are multiple kinds of similarities that are taken into account when one groups items (Barsalou, 1993, 2003; Medin, Goldstone, & Gentner, 1993; Ross & Murphy, 1999). More than this, we know now that children, like adults, are able to take into account multiple types of similarity in categorization (e.g., Deak & Bauer, 1995; Waxman & Namy, 1997). We do not know, though, the precise course along which this ability develops: what triggers it; whether internal mechanisms or external cues are more powerful in shaping it; how concepts are "born" in our heads; or how do we end up, as adults, to flexibly shift between several possible interpretations for one stimulus in accordance with contextual demands. This is why we have endeavored to gather some of the leading researchers who struggle to solve these problems, and to put together a special issue on the development of categorization.

A timely topic in research on the development of categorization is the debate over perceptual versus conceptual influences on categorization. Are our categories based on perceptual features that cumulatively ground concepts? Or, are our categories based on some underlying conceptual knowledge? Some authors consider that it is mainly through perceptual learning that we end up with abstract concepts, and that we need to look at categorization as a dynamic process that takes place in the physical world (Goldstone, 2004; Smith, 2005). Others argue that our categories have at their core some kind of hidden, essential knowledge which goes beyond the perceptual information that is extracted from the interaction with stimuli (Gelman, 2003). The first group of articles in this issue offer answers to this question. Many of the articles argue that the influence of perceptual and attentional processes on conceptual development has been underemphasized. For example, Fisher argues for the importance of considering attentional and perceptional factors in conceptual development. Her argument is that views in which children's categories are constructed on the basis of their theories place implausibly high demands on children's very limited executive control of attention. Similarly, Namy, Gentner, and Clepper underline the role that comparing perceptually similar items has for observing the conceptual relations they have, and develop systematic experiments to show how much perceptual similarity is needed for this. Oakes and Kovack-Lesh describe the role that memory and perceptual processes (such as presenting items in pairs or singly) play in infants' categorization. Also, Quinn, Lee, Pascalis, and Slater use inverted human stimuli to show that infants' pattern of categorization is well explained in terms of perceptual expertise rather than humans being an apriori specialized domain. All of these articles bring evidence that perception is an important process that influences categorization, which may ultimately lead to conceptual knowledge. Also arguing for the importance of perceptual grounding of children's concepts, Samuelson, Perry, and Warrington argue that perceptual and conceptual influences cannot be separated, and that approaches that attempt to experimentally disentangle theory-laden factors such as "artist's intention" from perceptual shape information overestimate children's ability to ignore the perceptual information. They even argue that separating these two streams of influences can lead us to dangerous avenues on the path of unfalsifiable theories. This is a promising new approach to understanding the complex relations between the perceptual and conceptual aspects of our categories.

The second group of articles involve the organization of categories into taxonomies, natural kinds, and artifacts. For long, taxonomies were considered as the desirable end-point in conceptual development. Even though the last several years of research have brought evidence that other types of relations are important too (see for example the work of Barsalou), taxonomies remains one of the essential types of categories we have. Regarding the development of taxonomies, Piaget considered that little children cannot form taxonomies, but rely on extracting thematic relations among objects. Recent research has showed, however, that in certain conditions children as young as 3 years can give taxonomic answers in categorization tasks. The articles grouped around this theme offer multiple perspectives about this ability. Bonthoux and Kalenine synthesize theories that consider either perceptual similarity or contextual relations as leading to concept formation, and marshal evidence that both are in fact used by children. Folkbiology is represented by the article of Coley, which offers evidence for the development of the distinction between humans and non-human animals. The article of Gliga and Mareschal focuses more on neuroimaging as a tool in answering questions about taxonomies and argue for the major role these tools can have in answering our questions about cognitive development. Finally, Rakison argues for the relationship between induction and categorization in infancy when dealing with animals and vehicles. Although this group of articles is heterogeneous in their topics of coverage, all of them reach one way or the other the important issue of the development of kinds.

The last two articles focus on an issue that has relatively recently entered the stage of research in the development of categorization, namely flexible categorization. Blaye, Chevalier, and Paour investigate the role of intentional control for relational flexibility. This is important as we need to understand when do children's responses become intentionally flexible. Finally, Ionescu sketches a picture of the factors that can influence flexible categorization at preschool age. In a way, we can say that this small group of articles summarizes several aspects outlined by all the above mentioned articles, such as the role of perception, memory, and the manipulation of the task for flexible switching among the relevant categories for an item.

One overarching theme that cuts across all three of the sections concerns the importance of domain-general and domain-specific reasoning processes in the construction of categories. There is a long tradition in cognitive science of arguing that different domains have their own special structure which should be exploited for learning. To efficiently exploit these kinds of structure, different kinds of constraints are needed for different domains. This view has been associated with distinguished researchers such as Elizabeth Spelke, Ellen Markman, Rochel Gelman, and Susan Carey. Some of the specialized domains of knowledge that have been suggested include number, physics, space, psychology and biology (Spelke & Kinzler, 2007). These core domains serve as the fundamental structures that organize our more particular knowledge. The claim is that children come to their world already having broken it down into kinds of things, and this is critical because in order to know how something will behave, even a child needs to know what kind of thing it is. As Rochel Gelman writes, "When I say that core domains benefit from the presence of innate structures, I find it helpful to use the metaphor of a skeleton. Were there is no skeletons to dictate the shape and contents of the bodies of the pertinent mental structures, then the acquired representations would not cohere (Gelman, 1996, p. 560).

Gelman has in mind skeletons as an apriori structure on which to hang knowledge. However, several of the articles in this special issue take issue with this perspective, from two vantage points. First, several of the articles point toward domain-general processes that require no pre-structuration into preset domains. Rakison's article explicitly argues for general associative learning processes that explain how children come to expect different kinds of objects to have different features. These kinds of domain-general processes are similarly implicated in Fisher's argument for "knowledge light" categorization processes, Namy et al.'s argument for a domain-general process of comparison that yields specific abstract relations, Samuelson et al.'s argument for general perceptual cues rather than only specialized intentional reasoning as guides for children's identification judgments, and Oakes and Kovack-Lesh's argument that general memory constraints govern children's categorization of land and sea animals. The second argument against apriori mental skeletons raises the exciting possibility that skeletons are themselves formed via development rather than existing apriori. This notion is seen in the book "Rethinking innateness" (Elman et al., 1996), where one of the primary ideas is that the existence of modularity does not necessarily implicate innateness. Modules can be learned because systems can self-organize, with the help of a structured environment, so as to increase their own structure over time. The articles by Coley, Quinn et al., Rakison, and Namy et al. can all be construed as providing evidence for the position that domains are the result of learning, not simply the foundations without which learning could not occur. Clearly, domains are critical for learning. Without domains, our learning would be insufficiently constrained. However, one important line for future research will be to study the bidirectional relation between domains and learning. Domains allow for efficient learning, but one of the things that humans learn is how to structure their world into domains.

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REFERENCES

Barsalou, L. W. (1993). Flexibility, Structure, and Linguistic Vagary in Concepts: Manifestations of a Compositional Symbols. In A .F. Collins, S. E Gathercole, M. A.Conway, & P. E Morris, *Theories of Memory.* Lawrence Erlbaum Associates Ltd., East Sussex, UK.

Barsalou, L. W. (2003). Situated Simulation in the Human Conceptual System. *Language and Cognitive Processes, 18*, 513-562.

Deak, G., & Bauer, P. (1995). The Effects of Task Comprehension on Preschoolers' and Adults Categorization Choice. *Journal of Experimental Child Psychology*, *60,* 393-427.

Elman, J. L., Bates, E. A., Johnson, M. H., Karmiloff-Smith, A., Parisi, D., & Plunkett, K. (1996). *Rethinking innateness.* Cambridge, MA: MIT Press.

Gelman (1996) Domain specificity in cognitive development: Universals and nonuniversals. In Sabourin, M., Craik, F. and Robert, M. (Eds.) *Advances in psychological science* Psychology Press Ltd., Vol.2, (25), 567-579.

Gelman, S. A. (2003). *The Essential Child – Origins of Essentialism in Everyday Thought.* Oxford University Press, Inc., New York.

Goldstone, R. L. (2004). Believing is seeing. *American Psychological Society Observer*, *17*, 23-26.

Medin, D., Goldstone, R., Gentner, D. (1993). Respects for Similarity. *Psychological Review, 100*, 254-278.

Murai, C., Kosugi, D., Tomonaga, M., Tanaka, M., Matsuzawa, T., & Itakura, S. (2005). Can chimpanzee infants (*Pan troglodytes)* form categorical representations in the same manner as human infants (*Homo sapiens)*? *Developmental Science, 8,* 240-254.

Ross, B. H., & Murphy, G. L. (1999). Food for Thought: Cross-Classification and Category Organization in a Complex Real-World Domain. *Cognitive Psychology*, *38*, 495-553.

Smith, L. B. (2005). Emerging Ideas About Categories. In L. Gershkoff-Stowe & D. H. Rakison (Eds.), *Building Object Categories in Developmental Time.* Malwah, NJ: Lawrence Erlbaum Associates.

Spelke, E. S., & Kinzler, K. D. (2007). Core knowledge. *Developmental Science, 10,* 89-96.

Waxman, S.R., & Namy, L.L. (1997). Challenging the Notion of a Thematic Preference in Young Children. *Developmental Psychology*, *33,* 555-567.