Sabina Pauen & Birgit Träuble
Department of Psychology, University of Heidelberg

How to Investigate the Concept of Concepts

(Commentary to Osman Kingo: The Concept of Concepts)

Trying to understand the nature of conceptual thinking is certainly a timeless challenge for philosophers as well as psychologists and anthropologists. Osman Kingo provides the reader with a well-structured and thoughtful review of the current debate on the beginnings of concept formation, written from a developmental perspective. The major messages of his outline can be summarized as follows: Humans form concepts because this is a highly efficient way to structure experiences. Adults form concepts at different levels of abstraction and based on different kinds of criteria. According to Kingo, a fruitful way to understand the nature of conceptual thinking is to look how perceptual and conceptual categories develop. Children start naming things towards the end of their first year of life. These names typically refer to categories of objects (e.g. "dogs" or "cars") which have been acquired before. But what type of information is crucial for category formation at a preverbal age? Are these early categories already meaning-based? Developmental psychologists have not yet formed a consensus on this issue. As pointed out by Kingo, the difference between perceptual and conceptual information plays a key role in this debate.

Perceptual information is often interpreted as consistently available information in the sensory array, referring to aspects like shape, colour, or texture. The assumption is that *perceptual categories* result from automatic processes which do not require conscious acts. By analyzing the co-occurrence of specific combinations of different attributes, our perceptual system forms prototype categories from very early on. In contrast, *conceptual information* is assumed to refer to meaningful information about functional and/or causal properties of a given entity (e.g. self-propulsion, contingency). This information may be non-obvious, or non-observable (e.g. beliefs, goals, self-propulsion). Hence, *conceptual categories* result from conscious acts. Based on this distinction between perceptual and conceptual categories, an important question emerges: How are both related in human development?

According to the *enrichment view*, conceptual categories emerge out of perceptual ones (Eimas, Quinn 1994; Rakison, 2005; Quinn & Eimas, 1996, 2000; Quinn & Oates, 2004). Alternatively, categories may always be constructed from both: perceptual and conceptual features at the same time. The *microanalytic approach* shifts the focus from analyzing the content of categories to investigating the process of category formation at different ages and in different task contexts (Madole & Oakes, 1999; Oakes & Madole, 2003). According to yet a third theory, the *dynamic system approach*, human cognition permanently organizes itself in a new way, hence leaving no space for stable thoughts or ideas in terms of concepts (Gershkoff-Stowe, 2005; Smith, 2005; Smith & Thelen, 2003; Thelen & Smith, 1994). All three approaches differ in terms of the status they credit to concepts, but they all have in common that category formation is viewed as one unique mechanism. This so-called *One-Process-Theory* is contrasted with the *Dual-Process Account* (Mandler, 2001) which suggests that perceptual and conceptual categories are both grounded in perception and exist in parallel, but are formed in different ways and develop along separate lines (the former starting some time earlier than the latter).

Based on this analysis, Kingo states that existing evidence does not allow any final conclusion about the nature of concepts and their development. According to him, this inconclusiveness results partly from the fact that empirical findings supporting perception-based accounts and conception-based accounts systematically vary with the methods applied to test each model. Following Kingo, it does not make sense to abolish or ignore concepts altogether, simply because it is difficult to test their existence and to distinguish them from percepts. After all, there would be no way to communicate about categories if there were only percepts or highly unstable categories. Rather than trying to decide whether human thinking is perception or conception-based, we should accept that both views complement each other. By talking about the *concept of concepts*, we give credit to the fact that concepts are important mental products which can be subject to empirical investigations, while making it explicit at the same time that the term concept remains a psychological construct without any a-priori correct definition.

So far, so good. Kingo's summary provides the reader with an adequate and well-balanced picture of where we stand right now. But how could research on category development make further progress? How can we come to a better understanding of what concepts are and how they first emerge? At the end, the author points out that the impact of social influences on category formation should be studied more extensively. This is certainly true, but since Kingo does not explain how knowledge about social influences could possibly help us to define the nature of concepts, we prefer to discuss in more detail Kingo's other claim that methodological pluralism would lead to a better understanding of the distinction between perceptual and conceptual categories.

As will be elaborated further in the following paragraphs, we think that a careful analysis of task demands might be very helpful to interpret existing findings and to design new promising experimental procedures, but we also want to make the point that the target question (i.e. how do we best conceptualize concepts?) is a theoretical one and thus requires a better distinction between perceptual and conceptual representations at the theoretical level (see also Pauen, 2000).

Will new methods bring new hope?

Kingo prefers the object individuation task over the habituation-dishabituation method in order to clarify whether the perceptual or the conceptual view is correct. Indeed, results obtained with the habituation-dishabituation procedure can't tell us with any certainty whether an observed categorization effect is based on the formation of an on-line category via the abstraction of visual similarities among the objects presented during the familiarization phase, or rather on knowledge about real-world exemplars acquired before the start of the experiment. Hence, it is almost impossible to prove the application of conceptual knowledge by presenting pictures or 3-D miniature models in a task following the habituation-dishabituation paradigm. By systematically varying perceptual within- and between-category similarity of the exemplars presented, and testing the implications of this variation for categorization performance, it may be possible, though, to show that a perception-based account alone can not provide a plausible explanation for performance in tasks of this kind (e.g. Pauen, 2002), but this does not explain in any detail the thought processes underlying the observed effects.

Would the object-individuation paradigm fix this problem? Unfortunately not!

The lack of a habituation phase rules out the possibility that on-line category formation takes place. If only one exemplar of each category is being presented, on-line category formation via forming visual abstractions cannot take place. This helps on one front, but it leaves us with the question of what kind of information infants use to individuate the two objects presented. Do they refer to features related to their appearance, or to features related to the meaning associated with the exemplars presented? As noted by Kingo, earlier studies have shown that shape information seems to be crucial for object individuation in the Xu and Carey paradigm (Xu & Carey, 1996). Kingo wants to build up on this finding by presenting stimuli of different conceptual domains (i.e. animate, inanimate) that look highly similar in terms of their shape, thus pitting similarity in appearance against similarity in meaning. In short, he plans to combine the advantages of using perceptually controlled material of different domains (designed by Pauen, 2002) with the advantages of the object individuation paradigm (developed by Xu and her colleagues). Following his line of arguments, infants' success in such a task would support the conception-based view. Of course a corresponding finding would be consistent with the conception-view, but it would still be very indirect support for this position. Why is this? The identification of a given stimulus as an exemplar of a certain category is always perception-based – no matter whether we use the habituation-dishabituation paradigm, whether we follow the procedure described by Xu and Carey (1996), or whether we use a manual search task (Xu & Baker, 2005). We always have to analyse features related to the appearance of objects involved in the scene and to look out for perceptual similarities or differences. For that reason, there is no way to rule out the possibility that infants rely on visual information alone in order to solve the task at hand. In the case of the visual object-individuation task, they may pay attention to other features but shape. In the case of the manual search task following the procedure of Xu and Baker (2005), they may pay attention to the noise produced by the given objects. Any positive finding obtained with the methods described so far would be inconclusive with respect to the question of whether or not conceptual processing has been involved. How about a negative finding? Can one conclude that infants who fail to individuate objects in either a visual or a manual object individuation task have no conceptual knowledge? Certainly not! Unfortunately, we are still facing the old problem….

One way to further weaken the purely perception-based account (without ruling it out completely) might indeed be to use the object individuation task with two objects of high overall similarity (in terms of general shape, colour, part-configuration), as suggested by Kingo. Differing from his idea, one would have to combine two studies, and a training session. In a first study, one would have to show that infants do not show an individuation effect when the two highly similar objects are presented under control conditions. In a second study, infants would participate in one of two different training conditions involving the very same objects. In Group A, the training would involve demonstrating that a very subtle feature which has not been used to discriminate between the target objects under control conditions, is highly relevant for producing an interesting effect, hence differentiating between both objects in functional terms. In Group B, the same kind of actions should be performed with both objects, but not resulting in any effect. Since infants would have equal opportunities to analyse the visual properties of the two objects in both training groups, any difference in performance between both experimental groups could be attributed to the encoding of functional meaning of the critical feature during the training phase (see Träuble & Pauen, 2007 for a similar approach). Data collection for a corresponding study is already under way in our laboratory. Hence, we are thinking along similar lines as Kingo, but we want to create meaning under controlled experimental conditions, rather than referring to meaning assumed to be present already (e.g. a conceptual animate-inanimate distinction). Furthermore, we think that it is necessary to demonstrate that perceptual differences alone can not account for object individuation.

Inducing learning experiences in a laboratory setting and testing their impact on performance in categorization or individuation tasks may be a promising way to study knowledge acquisition and concept formation in preverbal infants, but it can't resolve the theoretical debate on perceptual and conceptual categorization. The only way to solve this theoretical problem is to think more deeply about the meaning associated with the term "concept". If we do not meet this challenge, we will never be able to communicate effectively about the processes underlying knowledge formation and memory activation in the infants' mind.

Can we increase the clarity of the term "concept"?

As will be shown in the following paragraphs, neuropsychological research can help us to identify those aspects that may be relevant for differentiating between perceptual and conceptual representations.

(1) First of all, we should distinguish between two kinds of perceptual information that are processed differently in our brain: *static information*, and *dynamic information*. Static information refers to features of the object that do not change over time (e.g. colour), whereas dynamic information refers to features describing changes over time (e.g. movement). Both kinds of information refer to multiple sensory domains. In the case of visual perception which has been studied most extensively (see Kandel, Schwartz & Jessell, 2000, for an overview), we know that information about static and dynamic features enters the sensory system via different kinds of receptors (rods and cones respectively), is sent along different neural pathways (magnocellular and parvocellular pathways), and processed by different neural circuits (ventral and dorsal stream) located in different parts of the brain (temporal and parietal regions). It thus seems plausible to assume that category formation related to static features involves different forms of abstraction than category formation related to dynamic attributes. After all, dynamic information requires us to abstract patterns of neural activation changing over time, whereas static information requires us to abstract patterns of activation remaining constant over time.

(2) Second, we should distinguish between *information directly available in a given experimental setting*, and *information activated from long-term memory* (see also Pauen, 2002). Structures like the hippocampus and the inferior temporal lobe are known to be highly active when information has to be retrieved and activated from long-term storage, whereas this seems to be less the case when we are engaged in immediate perception (see Rosenzweig, Leiman & Breedlove, 1999 for an overview).

In the literature, the term "conceptual category" typically refers to representations that are somehow stored in long-term memory and get activated in a given experimental situation. Furthermore, it has been argued that this information is typically dynamic (e.g. knowledge about self-propulsion belongs to the concept of animate; see Gelman, Durgin, & Kaufman, 1995; Gelman & Spelke, 1981; Mandler, 1992; Premack, 1990; Rakison & Poulin-Dubois, 2001; Spelke, Phillips, & Woodward, 1995). Hence, the current debate on the nature of concepts reflects some confusion of two related questions: (a) Does any given mental representation refer to direct or to past perceptual experiences? and (b) What is the content of that representation? As long as this situation remains, we will keep on producing contradictory and evidence that is ambiguous in terms of its interpretation, leaving open the debate on the nature of concepts.

(3) We should be clear whether we want to study the process of *category formation* or the process of *category identification*. Whenever humans are looking out for similarities between different exemplars presented either in sequence or at once (being involved in the formation of a category), complex processes of on-line comparisons are involved, eventually resulting in the formation of a new category of either short- or long-term stability. Comparing a given exemplar to some kind categorical representation already stored in long-term memory (being involved in category identification) is a different process and might hence also involve different neural activities in the brain.

Some experimental settings, such as tasks based on the habituation-dishabituation procedure, are likely to involve both types of processes. Every time, we see a new exemplar we may try to match our immediate percept to some representation already stored in memory, and we may also be involved in abstracting visual similarities between subsequently presented exemplars. Hence, category formation and category identification go on in parallel, making the interpretation of performance ambiguous. Other tasks, such as the object-individuation task, are less problematic in that sense because on-line processes of similarity comparisons are minimized. The first paradigm may be more useful for studying either the process of category formation, or for exploring the complex interplay between object identification and category formation, whereas the latter may be more useful for studying the process of category identification.

Concluding remarks

What are the implications of this attempt to identify various aspects of the discussion about percepts and concepts in empirical as well as theoretical terms? One reason why it has been so difficult to design good studies exploring the very beginnings of human thinking in infancy is the lack of clarity about the nature of concepts. Kingo suggests that we should talk about the concept of concepts and make it the target of further empirical and theoretical analyses. Following this suggestion, we identified three research questions that have often been confounded in the literature: (1) What is the content of a given representation? (2) Are we talking about representations referring to immediate or to past perceptions? (3) Does the task at hand induce processes of category formation or processes of category identification? As already explained before, we need to decide whether we want to distinguish perceptual from conceptual categories primarily based on the content or the temporal stability of a given representation. Combining both aspects leads to confusion.

If we take content as the defining characteristic and look at the existing literature, "perceptual categories" would refer to static attributes whereas "conceptual categories" would refer to dynamic attributes. But this clearly contradicts our general intuition that static and dynamic attributes are often combined in direct perception as well as in memory representations. Even though it makes a lot of sense to further explore the differences between processes of category formation based on information about static attributes (as has been done in most studies following the visual habituation-dishabituation paradigm), as well as dynamic attributes (see Mandler, 1992;

2004), content may not be the best criterion to distinguish between perceptual and conceptual categories at the theoretical level.

The second possibility would be to focus on temporal stability. In that case, "perceptual categories" would refer to representations of ongoing events or objects perceived directly, whereas "conceptual categories" would refer to a mental entity, structuring past experiences in memory. This distinction seems to fit better with our intuitions because the term "percept" keeps its common meaning of referring to something present, and the term "concept" fits to its everyday understanding of being a mental construct based on, but not necessarily identical with, a percept.

In the light of recent neuropsychological evidence, we may consider to talk about a continuum rather than a dichotomy between perceptual and conceptual representations, because the temporal stability of a given representation is always relative. Take the process of category formation itself: Whenever objects or scenes are presented sequentially (as is case in any task following the habituation-dishabituation paradigm) and compared to each other, the percept of the exemplar presented at a given moment is compared to previously presented exemplars, thus crossing the line between immediate perception and memory activation. Depending on how long ago the previously encountered objects or scenes have been perceived, we would talk about either category formation (if the time interval has been short), or category identification (if the time interval has been comparably long). Furthermore, the newly formed category may be more or less stable over time, depending on its relevance for a given individual. Taken together, it seems impossible to draw any clear line between perceptual and conceptual processes even though they are not the same.

A major advantage of emphasizing that conceptual categories are closely tied to processes of memory formation or memory activation is that any pre-specification in terms of the content of the representation can be avoided. Hence, we could explore without any prejudices whether preverbal infants have a spontaneous bias in the sense that they refer more often to specific static attributes (such as shape) or to dynamic attributes (such as motion patterns), and to basic features (such as colour), or complex features (such as body configuration), when forming a categorical representation in memory. We could also study when and how they come to combine static with dynamic information in a given concept, and / or how the process of concept formation can be influenced by other factors.

In sum, being more precise in defining what it means to talk about a conceptual representation seems to have no disadvantage, but could help us to know better what we are talking about. Future studies would avoid any confusion of content with stability of categorical representations, and could focus more clearly on either one or the other.

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