Do Simple Objects Facilitate Infants’ Formation of a Spatial Category?

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The present study investigated infants’ ability to form a category of a support relation (i.e., “on”) when the objects depicting the relation were perceptually simple versus more complex. Twenty Korean infants of 14 months were habituated to dynamic support events with objects that were either simple or more complex in appearance. They were then tested with events that differed from the habituation events in the specific objects, spatial relation, or both. Infants formed a support category whether familiarized to simple or complex objects, looking significantly longer at test events with a novel than familiar relation. The results indicate that at 14 months of age, object features do not impact infants’ ability to form a categorical representation of support.

Key words: categorization, simplicity, generalization, object features, spatial cognition

Categorization is an essential cognitive ability that enables us to generalize our experiences from a set of exemplars to novel exemplars. In the domain of relations, a categorizer generalizes a relation among known objects or elements to novel ones responding to the familiarized relation as familiar despite the novelty of the elements depicting it. In the present study, we examine infants’ ability to form a categorical representation of a small-scale spatial relation, namely, support (i.e., one object placed on another object). Research on infants’ ability to categorize spatial relations thus far has mainly focused on what spatial categories infants form at different points in development (e.g., Behl-Chadha & Eimas, 1995; Casasola, Cohen, & Chiarello, 2003; Gava, Valenza, & Turati, 2009; Quinn, 1994; Quinn, Adams, Kennedy, Shettler, & Wasnik, 2003; for a review, see Casasola, 2008), while only a few studies have examined how infants form a spatial category (e.g., Casasola, 2005; Quinn, Cummins, Kase, Martin, & Weissman, 1996; Quinn, Polly, Furer, Dobson, & Narter, 2002). To fill this empirical gap and provide insights into the ideal conditions for infants’ spatial learning, we test infants’ ability to categorize a support relation under two learning conditions: when infants viewed the spatial relation with perceptually simple objects versus more complex objects. Our goal was to explore whether the simplicity of objects enhances infants’ formation of a category of support.

Recently, researchers have begun to explore how the perceptual simplicity of learning materials influences category learning and generalization (e.g., Kaminski, Sloutsky, & Heckler, 2006, 2008; Kaminski & Sloutsky, Quinn, 1994; Quinn, Adams, Kennedy, Shettler, & Wasnik, 2003; for a review, see Casasola, 2008), while only a few studies have examined how infants form a spatial category (e.g., Casasola, 2005; Quinn, Cummins, Kase, Martin, & Weissman, 1996; Quinn, Polly, Furer, Dobson, & Narter, 2002). To fill this empirical gap and provide insights into the ideal conditions for infants’ spatial learning, we test infants’ ability to categorize a support relation under two learning conditions: when infants viewed the spatial relation with perceptually simple objects versus more complex objects. Our goal was to explore whether the simplicity of objects enhances infants’ formation of a category of support.

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Several studies have documented an advantage of simple objects over complex ones in generalization tasks. For example, in a word learning study, Son, Smith, and Goldstone (2008) found that toddlers demonstrated more robust generalization of an object label from a single instance to new examples when the single instance (i.e., the training object) was perceptually sparse and had only the overall geometric shape of the target object. In contrast, toddlers had more difficulty generalizing the object label when the training instance was complex, with rich details. These researchers proposed that simplified objects shortcut the category learning process and foster generalization because they omit category-relevant elements and depict only category-relevant information, thereby providing already-abstracted instances. In contrast, more perceptually complex objects contain category-relevant details and these details seem to hinder learners’ formation of an abstract categorical representation (Son, Smith, & Goldstone, 2008).

Similar advantages of perceptually simple objects have been found in studies examining the learning of relational categories (Amaya, Uttal, O’Doherty, Liu, & DeLoache, 2008; Kaminski & Sloutsky, 2010; Kaminski, Sloutsky, & Heckler, 2006, 2008; Rattermann, Gentner, & DeLoache, 1990; Son, Smith, & Goldstone, 2011; Welling, 2011). First, Rattermann, Gentner, and DeLoache (1990) found that, in a relational mapping task where the relation match was pitted against the object match, young children made more relational choices when the objects were perceptually sparse than when they were perceptually rich. Similarly, Kaminski and colleagues demonstrated that both adults (Kaminski, Sloutsky, & Heckler, 2008) and children (Kaminski & Sloutsky, 2010; Kaminski, Sloutsky, & Heckler, 2006) generalized relational rules to new instances with greater ease when the rules were demonstrated by abstract symbols than concrete objects. Moreover, Amaya and colleagues (2008) investigated elementary school children’s use of manipulatives in mathematical problem solving, and found an effect of the object features in children’s ability to focus on the relevant mathematical task. Specifically, children who were given more attractive blocks that were patterned with bright colors were more likely to play with the blocks and be diverted from the relevant mathematical concepts than children who were given less exciting monochromatic blocks. Together, these researchers have argued that perceptually simple objects are more beneficial because they are less interesting in their own right as objects. Thus, they do not detract attention away from the relational information. In contrast, perceptually rich objects draw more attention to themselves and consequently may hinder relational thinking (Kaminski, Sloutsky, & Heckler, 2006, 2008; Rattermann et al., 1990).

In sum, studies that have examined generalization of objects and relational information suggest that there are benefits to perceptually simple exemplars. One advantage is providing a ready-made abstraction through the removal of irrelevant information. The other advantage is more specific to relational categories, namely, the ability to look beyond the component objects and focus on the relation. Because simple objects, more than perceptually rich object, are less likely to overshadow the relations, they may play a critical role in promoting attention to relations and consequently generalization.

Despite findings pointing to the merits of simple objects in fostering generalization, there are studies that outline a more nuanced picture and suggest that simple objects may not always provide an advantage over complex objects (Paik & Mix, 2006; Petersen & McNeil, 2008; Son, Smith, & Goldstone, 2011; Welling, 2011). For instance, Petersen and McNeil (2008) reported that the beneficial effect of simplicity occurs only when the complex objects have established meanings as objects. More specifically, they found that preschoolers’ counting performance was significantly hampered by complex objects that had established meanings (e.g., animal