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The role of representational strength in verbal updating: Evidence from 19- and 24-month-olds

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ABSTRACT

The current research investigated the role of object familiarity in children's ability to update the representation of an absent object via language. In Study 1, the degree of object familiarity was manipulated by the amount of time children were exposed to an object. The results showed that when 19- and 24-month-olds were minimally exposed to the object, only the 24-month-olds were able to incorporate newly heard information about it by selecting the new version of the object. Studies 2 and 3 demonstrated that the younger children's failure to update is due to their failure to activate an object's weak representation in working memory. When the object's weak representation was reactivated (by seeing a depiction of the object) prior to the language input, the younger children successfully updated their representation of the object. The findings are discussed in light of the graded representation account.

Introduction

Children, like adults, must often rely on other people to acquire information about things that are not perceptually available. Once they master language, much of children's learning is based on what they are told, and often new information concerns things that they have not directly experienced such as the existence of bacteria and a novel event that occurred across the world (Harris, 2007, 2012). Until recently cognitive development research has focused on how children learn from first-hand

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observation, with relatively little attention to how children structure and adjust their knowledge on the basis of others' verbal input (Gelman, 2009).

The ability to integrate new information about things that are absent is, above all, based on our capacity to retrieve and maintain the memory representation of the object while the new information is received. In this sense, object memory representation is a mental depiction of an object that was created when the object was initially perceived and that can be retrieved from long-term memory when not directly observed (Kosslyn, Thompson, & Ganis, 2006). Stronger representations of objects are more likely to support these processes than weaker representations (Munakata, 2001; Munakata, McClelland, Johnson, & Siegler, 1997). One way to strengthen an object's representation is through repeated exposure to the object in question, which changes the pattern of neural activity representing that stimulus (Munakata et al., 1997). Research on object search has shown that infants are better at maintaining object representations when repeatedly presented objects are hidden. For example, 7.5-month-olds search more frequently for a familiar object when it is hidden even though they show a distinct preference for a novel object when it is visible (Shinskey & Munakata, 2005).

Research on infants' ability to respond to *names* referring to absent objects has shown a similar effect of representational strength on the ability to bring the representation of the object to mind upon hearing its name. One-year-old infants can respond to the name of an absent object, indicating that they can retrieve the object's representation from memory and maintain it active to initiate a response (searching or looking for the object) (Ganea, 2005; Saylor, 2004). However, factors that determine the strength of a representation (e.g., familiarity with the referent) affect whether infants respond to such references. For example, 1-year-old infants gesture significantly more toward the door after hearing the name of a familiar person, such as the child's father, who recently left the room (Ganea & Saylor, 2013a). But when such references are made about a recently met person, for example one of the research assistants, infants do not react in the same way. Nevertheless, infants respond to the name of the person when he or she is in view, indicating that they had learned the person's name. These findings suggest that familiarity with the referent plays a critical role in child's ability to activate its representation when the referent is absent. With age, infants are better able to build stronger representations of objects and they are better able to maintain such representations in working memory under higher task demands (when they have not seen the object for a long time before hearing its name again or when the object is mentioned in a novel context) (Ganea & Saylor, 2013a, 2013b). For example, 16-month-olds can respond to both new and familiar people when mentioned in their absence, and they can do so even when the test is delayed after the person's departure (Ganea & Saylor, 2013a).

Activating an object's representation on hearing its name is a critical step enabling children to learn new things through language. Recent research has shown that the ability to update an absent object's representation following new verbal input emerges during the second year of life (Ganea & Harris, 2010, 2013; Ganea, Shutts, Spelke, & DeLoache, 2007). In one study, 19- and 22-month-olds learned the proper name ("Lucy") for a target object ("frog"), which was then removed from children's view (Ganea et al., 2007). While the target object was in another room, children were told about a change in a property of the object (i.e., that Lucy had become wet). To test whether children revised their representation of Lucy based on newly received information, children were asked to indicate Lucy from three test choices: a wet frog, a dry frog, and a wet pig. The 22-month-olds successfully picked out the wet frog, whereas the 19-month-olds did not. Instead, the 19-month-olds were more likely to update when the new information was given to them in the presence of the toy.

One unexplored possibility, which resonates with the previous findings on absent object reference, is that younger children may be able to update their representation, but only when their initial representation of the referent is strong. The role of representational strength has been illustrated for infants' ability to update on the basis of *visual* information. In some versions of the A-not-B task (Piaget, 1954), strong object representations are necessary for children to correctly search for the object; however, when task demands are lessened (e.g., by using gaze measures), weaker object representations suffice for correct performance (Hofstadter & Reznick, 1996; Munakata et al., 1997; Wellman, Cross, & Bartsch, 1986). Similarly, when updating requires a change in the quantity of objects represented, stronger representations may be required. By 5 months of age, infants can use visual information about a change in quantity to update their representation of occluded objects (Koechlin, Dehaene, & Mehler, 1997; Wynn, 1992). If they see a bunny become hidden behind a screen and then see a second