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Sixteen-month-olds can use language to update their expectations about the visual world



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ABSTRACT

The capacity to use language to form new representations and to revise existing knowledge is a crucial aspect of human cognition. Here we examined whether infants can use language to adjust their representation of a recently encoded scene. Using an eye-tracking paradigm, we asked whether 16-month-old infants ($N = 26$; mean age = 16;0 [months;days], range = 14;15–17;15) can use language about an occluded event to inform their expectation about what the world will look like when the occluder is removed. We compared looking time to outcome scenes that matched the language input with looking time to those that did not. Infants looked significantly longer at the event outcome when the outcome did not match the language input, suggesting that they generated an expectation of the outcome based on that input alone. This effect was unrelated to infants' vocabulary size. Thus, using language to adjust expectations about the visual world is present at an early developmental stage even when language skills are rudimentary.

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Introduction

Much of the information that we have about the world is based on testimony provided by other people. Thus, on the basis of other people's testimony, we can acquire knowledge about events that

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we would otherwise know little or nothing about—for example, events in the distant past. In addition, however, other people's testimony can help us to update our knowledge of the current state of the world (Harris, 2012). Indeed, we often rely on such testimony to provide us with information about changes that have occurred with respect to people or objects that are already known to us. For example, via testimony, friends and family members often provide us with updates about their lives. They can tell us about changes in their love lives, their jobs, their kitchen appliances, and so forth. By implication, updating based on verbal testimony has a broad scope.

Developmental research has provided a wealth of information on infants' ability to update object representations on the basis of visual information (e.g., Feigenson & Yamaguchi, 2009; Koechlin, Dehaene, & Mehler, 1997; Uller, Carey, Huntley-Fenner, & Klatt, 1999; Wellman, Cross, & Bartsch, 1986; Wynn, 1992) such as when changes are being made to the number of objects in a scene or to an object's location in the scene. However, only recently have we begun to learn information about children's ability to update their knowledge of an object through language. Ganea and Harris (2010, 2013) showed that when toddlers aged 30 months were told that an object they had put in one container had been moved to a different container during their temporary absence, they searched for the object in the new container, not where they had originally put it. By implication, using the testimony provided by another person, they updated their own prior representation of the state of the world and searched correctly.

However, in those same studies, younger toddlers—aged approximately 24 months—were much less accurate in making such location updates. They often searched for the object on the basis of their earlier firsthand observation of its whereabouts—an error that did not occur in a control condition where they saw the object moved to a new location rather than learning about its movement via verbal testimony. Alternatively, they first searched in the original container and only subsequently went on to search at the object's new location. Thus, these younger infants were less likely than older infants to give priority to what they had been told.

One possible interpretation of this age change is that younger infants have difficulty in updating their representation of the world on the basis of verbal input. To the extent that a great deal of conversational input to young children is concerned with objects, events, and outcomes that are present and potentially observable within the immediate situation (Morford & Goldin-Meadow, 1997), such a restriction might not create any obvious cognitive difficulty. According to this hypothesis, we might expect children's updating ability to improve as their early language becomes increasingly displaced from the here and now.

However, despite the above findings, updating may emerge considerably earlier in development. There are several reasons for considering this alternative possibility. First, task demands may have underestimated the ability of younger toddlers in the studies of Ganea and Harris (2010, 2013). They may have understood what they were told and updated their representation of the object's location but failed to inhibit a prepotent response of searching in the place where they had last seen the object. Under this interpretation, infants can engage in language-based updating but have difficulty in using the updated representation of location to guide voluntary actions such as search. Similar gaps between the representation of location and the execution of a response have been well established in studies of infants' ability to search for a hidden object (Diamond, 1985).

Second, by the beginning of the second year of life, infants are adept at incorporating testimony into their expectations about new unseen referents. For example, infants are able to reason about the quantities of unseen objects and nonobvious functions of objects through information provided via language alone (Graham, Kilbreath, & Welder, 2004; Xu, Cote, & Baker, 2005).

Third, studies of infants' ability to engage in updating with respect to an object's properties—as opposed to its location—have yielded encouraging results. For example, in one study infants left a stuffed animal in a room and went next door. They were subsequently told that the stuffed animal had been accidentally made wet. When they went back to retrieve it, 22-month-olds picked out a wet version of the stuffed animal rather than a dry version (Ganea, Shutts, Spelke, & DeLoache, 2007). Furthermore, follow-up studies on property updating demonstrated that reducing task demands by strengthening the working memory representation of the to-be-updated object and increasing its familiarity promoted updating in even younger toddlers, with 19-month-olds succeeding in updating object properties (Galazka & Ganea, 2014).

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