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Labels constructively shape object categories in 10-month-old infants



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ABSTRACT

How do infants' emerging language abilities affect their organization of objects into categories? The question of whether labels can shape the early perceptual categories formed by young infants has received considerable attention, but evidence has remained inconclusive. Here, 10-month-old infants ($N = 80$) were familiarized with a series of morphed stimuli along a continuum that can be seen as either one category or two categories. Infants formed one category when the stimuli were presented in silence or paired with the same label, but they divided the stimulus set into two categories when half of the stimuli were paired with one label and half with another label. Pairing the stimuli with two different non-linguistic sounds did not lead to the same result. In this case, infants showed evidence for the formation of a single category, indicating that nonlinguistic sounds do not cause infants to divide a category. These results suggest that labels and visual perceptual information interact in category formation, with labels having the potential to constructively shape category structures already in preverbal infants, and that nonlinguistic sounds do not have the same effect.

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Introduction

One of the central questions in early language and cognitive development is how the emergence of language affects infants' preverbal understanding of the world. During the past 20 years, many studies have shown that even very young infants can rapidly form categories on the basis of the static perceptual features of objects (Behl-Chadha, 1996; French, Mareschal, Mermillod, & Quinn, 2004; Mareschal & Quinn, 2001; Oakes, Coppage, & Dingel, 1997; Quinn, 2002, 2004; Quinn & Eimas, 1996) and that during the first year of life these early categories are gradually enhanced with more sophisticated knowledge such as feature correlations, sounds, motion, function, and animacy cues (Baumgartner & Oakes, 2011; Burnham, Vignes, & Ihsen, 1988; Pauen & Träuble, 2009; Perone & Oakes, 2006; Younger & Cohen, 1986). Other research has shown that in older children language can shape object categories by enabling the grouping together of perceptually dissimilar objects (e.g., dogs and whales as mammals) and the separation of similar objects (e.g., bats and birds) into different categories as well as forming the basis for inferences about hidden object properties (Graham, Kilbreath, & Welder, 2004; Welder & Graham, 2001). There is also evidence that labeling aids object individuation by 12 months of age (Xu, Cote, & Baker, 2005), and even younger infants at 9 or 10 months expect different labels to refer to different kinds of object (Dewar & Xu, 2007, 2009). However, although several studies have investigated the emerging effect of language on categorization during the first year of life, they have yielded little agreement and it is not yet clear how linguistic information interacts with object representations that have developed preverbally.

Two separate questions have been asked about the role of language in infants' object categorization during the first year of life. The first is whether labels can facilitate object categorization, that is, whether the labeling of objects enables infants to form categories that they would not form without labels. The second question is whether, like in older children, labels can override nonverbal perceptual information and change the structure of perceptual categories when visual similarity and category labels are in conflict with each other.

Much of the work exploring early categorization is based on the familiarization/novelty preference procedure (Fantz, 1964), which relies on the fact that infants tend to spend more time looking toward novel objects than toward familiar objects. In a typical study, infants are familiarized with a sequence of objects from one category and are then tested with two new objects—one a novel member of the familiarized category and one from a different category. If infants show a looking preference to the object from the new category, it can be concluded that they have formed a category that includes the novel within-category object but excludes the object from the different category. The emerging ability of language to shape categories has been studied in variants of this paradigm in which the objects presented during familiarization are accompanied by auditory labels or other sounds and the effect on infants' looking preferences during test are investigated.

The question of whether labels facilitate category formation has been addressed in several studies by Waxman and colleagues (Balaban & Waxman, 1997; Booth & Waxman, 2002; Ferry, Hespos, & Waxman, 2010; Fulkerson & Waxman, 2007; Waxman & Braun, 2005; Waxman & Markow, 1995). For example, in a seminal study, Balaban and Waxman (1997) showed that infants who were familiarized with a sequence of pig drawings exhibited at test a looking preference for a rabbit over a novel pig only when the familiarization items were accompanied by a labeling phrase ("A pig!") but not a tone sequence. Unsystematic labeling with different novel words did not lead to category formation in 12-month-olds (Waxman & Braun, 2005). Other studies have aimed to provide evidence that consistent novel labels facilitate categorization in infants at 6 months of age and even at 3 or 4 months (Ferry et al., 2010; Fulkerson & Waxman, 2007). This and other work has led to the claim that words serve as "invitations to form categories," enabling category formation by highlighting commonalities between objects with the same label (Waxman & Markow, 1995).

However, two considerations appear to weaken this claim. First, as described, many studies have shown that preverbal infants as young as 3 months can form perceptual categories in the absence of any auditory input, and these early categories can be at the basic or superordinate levels (Behl-Chadha, 1996; Quinn & Eimas, 1996). On this basis, it seems plausible that, in silence, 9-month-olds may be able to form a perceptual category of the stimuli used in the studies described above (e.g., a

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