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Contextual repetition facilitates word learning via fast mapping

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ABSTRACT

The current study explores whether contextual repetition during fast mapping facilitates word learning. Three-year-old children completed fast mapping and test trials using a touchscreen computer. For half of the children, the non-targets (competitors) repeated across learning trials and for other children there was no repetition. All children received the same test trials. Children who experienced contextual repetition, that is, children for whom the competitors repeated during the initial fast mapping task, demonstrated word learning. These data demonstrate that children's word learning is facilitated by the presence of extraneous yet predictable information in the initial fast mapping task.

1. Introduction

Children are frequently bombarded with new words and learning to comprehend these new words is a difficult task. When children hear a new word and see a novel referent in an array of familiar objects (items already associated with a known word), they appear to determine the referent via a process of elimination (Halberda, 2003), often described as fast mapping (Carey, 1978). That is, children use their prior knowledge (i.e., known vocabulary) to rule out objects already associated with a name and select the most novel object as the likely referent of the novel name (even in the context of other nameless, novel objects, Horst, Samuelson, Kucker, & McMurray, 2011; Mather & Plunkett, 2012).

However, fast mapping is only an initial step in the word learning process (Carey, 1978; Horst & Samuelson, 2008). Although fast mapping appears to be relatively easy, learning to remember the name–object associations is more difficult. Indeed, without pre-exposure to the objects (Kucker & Samuelson, 2012), explicit naming (Axelsson, Churchley, & Horst, 2012), or multiple trials per referent category (Smith & Yu, 2008; Twomey, Ranson, & Horst, 2014), young children fail to recall name–object associations after as little as 5 min (see also Bion, Borovsky, & Fernald, 2013; Gurteen, Horne, & Erjavac, 2011). Children also struggle to learn new words via fast mapping if they encounter referents among arrays with more than three familiar objects (Horst, Scott, & Pollard, 2010; see also Zosh, Brinster, & Halberda, 2013), or among arrays that include other novel objects for which they are also trying to learn new names (Axelsson & Horst, 2013; Wilkinson, Ross, & Diamond, 2003). Taken together, these studies demonstrate that children learn words via fast mapping best when the context is highly supportive, specifically when it helps them to shift the focus of their attention from the other, extraneous objects present (competitors) to the target object.

Recently, Horst (2013) argued that introducing contextual repetition during the initial learning phase helps children focus on and encode novel target objects. For example, when 3-year-old children learned names for novel objects by listening to illustrated storybooks, children who repeatedly heard the same storybooks successfully retained the new name–object associations; whereas children who heard different storybooks performed at chance levels (see also Horst, Parsons, & Bryan, 2011; Williams & Horst, 2014). The critical difference was whether children encountered the objects in the same context repeatedly or in different contexts. Horst (2013) argued that children who encountered objects in repeated contexts were at an advantage because they had less information to process because the extraneous information in the storybooks became increasingly predictable. By "extraneous

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information" we mean information in the learning context that is not the target information to-be-learned. These are the non-target information such as the color of the background (Goldenberg & Sandhofer, 2013), or decorations in a classroom (Fisher, Godwin, & Seltman, 2014). Extraneous information in the learning context might facilitate detection of a target as predictability helps speed up visual processing (for a review see Smith, Colunga, & Yoshida, 2010). In repeated contexts, children might get faster at learning which information to ignore and focus attention more rapidly on the target information. What remains to be seen is how the repetition of extraneous information influences children's ability to learn multiple novel word–object associations. The findings from Horst, Parsons, et al. (2011) suggest that contextual repetition aids word learning by increasing predictability thereby limiting the extraneous information that learners need to process.

However, several studies demonstrate that a greater variety of extraneous information facilitates various aspects of learning. For example, Gómez (2002) found that 18-month-old infants (and adults) were better at acquiring links between two sets of non-adjacent novel words (e.g., *pel*-wadim-*jic*, analogous to learning *is* eat*ing*), if they were trained in hearing those words presented with a large variety of extraneous words (i.e., the middle words), suggesting that attentional systems search for elements of statistical regularity in highly variable contexts. Similarly, Thiessen (2011) found that 15- to 16-month-old infants were better at discriminating two phonemes in novel word forms if they previously heard the phonemes in a variety of forms. More recently, Sloutsky and Robinson (2013) also found that increasing the number of correlated, redundant cues (e.g., background color, size, location) helped 14- to 22-month-old infants form two categories simultaneously.

A critical aspect of these studies is that they largely focused on either auditory or visual processing (but see Smith & Yu, 2008), although word learning requires encoding both the auditory and the visual input as well as learning and recalling the association between the two forms (Horst & Samuelson, 2008). Additionally, robust tests of word learning also require testing children's ability to learn *multiple* word–object associations (Axelsson & Horst, 2013). Young children have difficulties with both retaining cross-modal information (see Sloutsky, 2010 for a review) and learning multiple novel words (Horst & Samuelson, 2008), so it is important to identify aspects of the word learning task that can be used to help children learn. Given that the predictability of contextual repetition supports word learning in storybook reading (Horst, Parsons, et al., 2011; Williams & Horst, 2014), it is likely that contextual repetition also supports word learning in other situations.

The current study examines the effect of contextual repetition, i.e., repeating extraneous information, during fast mapping on word learning (cf. McMurray, Horst, & Samuelson, 2012; Yu & Smith, 2007). In all cases children could learn the statistical regularity of the target name–object co-occurrences via associative learning. However, children encountered targets with either the same or different competitors across learning trials. That is, children either encountered the novel object in the same context (with the same competitors) repeatedly or encountered the novel object in different contexts (with different competitors). Importantly, all children received the same test trials. As in the storybook studies (e.g., Horst, Parsons, et al., 2011), those presented with repeated contexts (competitors) during fast mapping were predicted to perform better at test.

2. Method

2.1. Participants

Forty-eight 3-year-old children (M = 36.43 months, SD = 2.44 months, range 33.00–41.99 months; 24 girls) were included in the final sample. Data from 1 additional child were excluded because she consistently touched the screen before waiting to hear the instructions. Children were from predominantly white, middle class homes recruited from southern England.

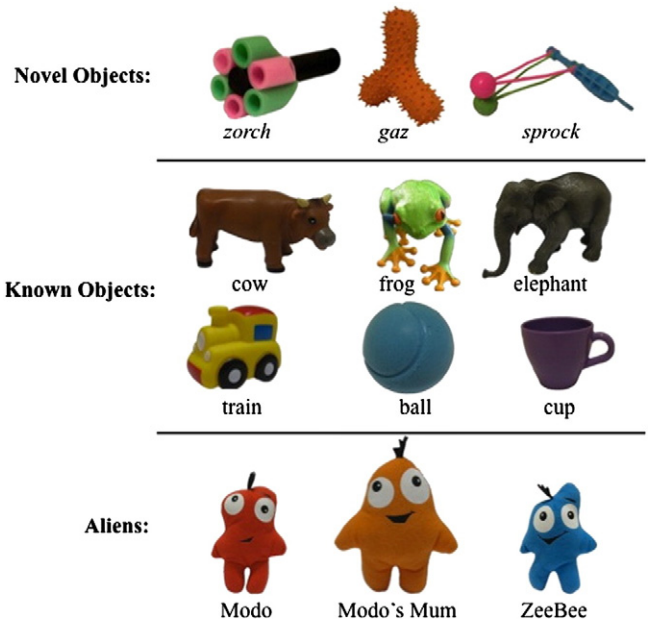

Fig. 1. Target stimuli (both novel and known) and aliens used in the current experiment.

2.2. Stimuli

Children were shown digital photographs of novel and known (familiar) objects (see Fig. 1). Novel objects included the end of a foam arrow/*zorch*, a y-shaped rubber dog-toy/*gaz*, and a clacker/*sprock*, which were chosen because most 3-year-old children do not know the names for these objects. Name–object pairs were held constant to minimize experimenter error (see also Capone & McGregor, 2005). Additional photographs of three aliens, a bed, and a dresser were used during the experiment. A female, native British English speaker narrated the procedure for the child (henceforth the narrator).

2.3. Design

Children received three practice trials, 18 learning trials (fast mapping/referent selection), a reengagement trial, and three test trials (retention). Learning trials included 9 novel name trials—3 trials for each novel name (e.g., 3 *sprock* trials)—and 9 known name trials to ensure children were listening to the requested name and not just choosing the most novel object (Horst, Samuelson, et al., 2011). Children were tested on every novel name. Importantly, test trials were identical for all children and each novel target also served as a non-target competitor to ensure children were demonstrating word learning and not simply fast mapping again (McMurray, Horst, Toscano, & Samuelson, 2009).

The procedure was identical for all children. The critical difference was which objects were presented together on the learning trials (see Fig. 2). For half of the children, the same competitors were repeated across all three trials for a given novel name (e.g., when they were asked for the *sprock* (clacker), the elephant and cup were always present). For the other children, the competitors did not repeat across the three trials for a given novel name (e.g., they saw the *sprock* once with the elephant and cup, once with the train and frog, and once with the ball and cow). Likewise, competitors repeated or did not repeat across known name trials. Note, in previous studies, presenting more