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Cross-situational statistical word learning in young children



Sumarga H. Suanda^{a,b,*}, Nassali Mugwanya^b, Laura L. Namy^b

^a Department of Psychological and Brain Sciences, Indiana University, Bloomington, IN 47405, USA

^b Department of Psychology, Emory University, Atlanta, GA 30322, USA

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ABSTRACT

Recent empirical work has highlighted the potential role of cross-situational statistical word learning in children's early vocabulary development. In the current study, we tested 5- to 7-year-old children's cross-situational learning by presenting children with a series of ambiguous naming events containing multiple words and multiple referents. Children rapidly learned word-to-object mappings by attending to the co-occurrence regularities across these ambiguous naming events. The current study begins to address the mechanisms underlying children's learning by demonstrating that the diversity of learning contexts affects performance. The implications of the current findings for the role of cross-situational word learning at different points in development are discussed along with the methodological implications of employing school-aged children to test hypotheses regarding the mechanisms supporting early word learning.

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Introduction

According to one estimate, by 6 years of age, children have amassed a vocabulary of 14,000 words (Carey, 1978). One central goal in the study of children's language acquisition is to better understand the processes that underlie such impressive word learning. Based on their influential investigation into these processes, Carey and Bartlett (1978) demonstrated one learning mechanism, *fast mapping*,

* Corresponding author at: Department of Psychological and Brain Sciences, Indiana University, Bloomington, IN 47405, USA.

E-mail address: ssuanda@indiana.edu (S.H. Suanda).

a learning process that occurs after a single exposure or a few exposures to a novel word and involves the acquisition of an initial link between a word and its referent. Much of the ensuing research on children's word learning over the past three and a half decades has been devoted to understanding the basis for fast mapping (for a discussion, see [Swingley, 2010](#)), including the nature of the constraints on the mapping process (see [Woodward & Markman, 1998](#)), whether fast mapping is specific to the domain of word learning ([Markson & Bloom, 1997](#)), and how the mapping processes change with development ([Hollich et al., 2000](#)).

Recently, a growing body of research has aimed to understand a different word learning process, one that *extends* over multiple encounters. In one such study employing adults as model word learners, [Yu and Smith \(2007\)](#) presented participants with a series of learning trials, each involving ambiguous reference. In each trial, participants viewed multiple pictures of objects simultaneously on a computer screen and heard multiple spoken words played sequentially in a random order. In each trial, it was unclear which words referred to which objects. However, over trials, every time participants heard a particular word, its corresponding referent object was present. Importantly, word–object pairs did not always appear with the same set of accompanying words and objects. Thus, participants could learn the words if they attended to the cross-situational regularities with which particular words and objects co-occurred. Yu and Smith found that adult learners were remarkably sensitive to these cross-situational co-occurrence patterns between words and objects (i.e., their co-occurrence statistics) and could use this knowledge to acquire the word-to-object mappings. Yu and Smith's data, as well as other results (e.g., [Akhtar & Montague, 1999](#); [Gillette, Gleitman, Gleitman, & Lederer, 1999](#); [Vouloumanos, 2008](#)), have highlighted the likely role of processes other than fast mapping in children's lexical acquisition.

Two lines of research have been inspired by Yu and Smith's initial work on cross-situational learning. First, a number of investigations have been devoted to extending the empirical phenomenon of cross-situational word learning to developmental populations. Toward this end, [Smith and Yu \(2008\)](#) designed a version of their adult cross-situational learning paradigm suitable for testing infant learners. Employing a simplified looking-based version of the task, Smith and Yu found that 12- to 14-month-old infants successfully associated words and their corresponding objects in a task that, like its adult precursor, required them to attend to the co-occurrence statistics across situations (see also [Scott & Fisher, 2012](#); [Smith & Yu, 2013](#); [Vlach & Johnson, 2013](#); [Vouloumanos & Werker, 2009](#); [Yu & Smith, 2011](#)). This finding—that even young word learners possess the capacity for cross-situational word learning—is important because it is an existence proof for the claim that a process such as cross-situational word learning can facilitate early lexical acquisition.

A second line of research has been devoted to understanding the underlying mechanisms that make cross-situational word learning possible. Toward this broad goal, a number of researchers have employed adult learners, as Yu and Smith originally did, to test the nature of the underlying learning algorithms that could explain successful cross-situational word learning (e.g., [Kachergis, Yu, & Shiffrin, 2012](#); [Smith, Smith, & Blythe, 2011](#); [Trueswell, Medina, Hafri, & Gleitman, 2013](#); [Yu, Zong, & Fricker, 2012](#); [Yurovsky, Yu, & Smith, 2013](#)). Extant computational and experimental work suggests that multiple mechanisms could explain cross-situational word learning findings, including hypothesis testing ([Medina, Snedeker, Trueswell, & Gleitman, 2011](#); [Trueswell et al., 2013](#)), associative learning ([Kachergis et al., 2012](#); [Yu, 2008](#)), and single-trial learning ([Smith, Smith, & Blythe, 2009](#)). Other researchers have examined the constellation of factors that influence adults' cross-situational word learning performance, demonstrating that the diversity of learning environments ([Kachergis, Yu, & Shiffrin, 2009](#); [Suanda & Namy, 2012](#)), attention to competitors ([Fitneva & Christiansen, 2011](#)), the adoption of exclusion constraints ([Yoshida, Rhemtulla, & Vouloumanos, 2012](#); [Yurovsky et al., 2013](#)), and the presence of grammatical cues ([Monaghan & Mattock, 2012](#)) all help in cross-situational word learning. Finally, researchers have also begun to examine the extent to which adult learners can acquire word-to-referent mappings through cross-situational learning while also solving other language-related tasks to better mimic the multitasking likely involved in young children's early language learning. Experimental research along these lines has revealed that adult learners can successfully learn words cross-situationally even when the words are presented in continuous speech and thus require learners to segment speech into the relevant units ([Cunillera, Laine, Camara, & Rodriguez-Fornells, 2010](#); [Yurovsky, Yu, & Smith, 2012](#)).

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