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When a word is worth more than a picture: Words lower the threshold for object identification in 3-year-old children



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ABSTRACT

A large literature shows strong developmental links between early language abilities and later cognitive abilities. We present evidence for one pathway by which language may influence cognition and development: by influencing how visual information is momentarily processed. Children were asked to identify a target in clutter and either saw a visual preview of the target or heard the basic-level name of the target. We hypothesized that the name of the target should activate category-relevant information and, thus, facilitate more rapid detection of the target amid distractors. Children who heard the name of the target before search were more likely to correctly identify the target at faster speeds of response, a result that supports the idea that words lower the threshold for target identification. This finding has significant implication for understanding the source of vocabulary-mediated individual differences in cognitive achievement and, more generally, for the relation between language and thought.

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Introduction

Many traditional theories of cognitive development regard language as a transformative force on cognition, enabling children to think abstractly, to control their cognitive processes, and to reason about instances that cannot be directly perceived. As [Vygotsky \(1980\)](#) famously noted, “The child

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begins to perceive the world not only through his eyes but also through his speech. As a result, the immediacy of ‘natural’ perception is supplanted by a complex mediated process.” Here we show evidence consistent with the idea that language changes other cognitive abilities, and we provide one mechanism by which words may do so in children as young as 3 years — by changing in-the-moment processing of visual information.

A large literature shows that children’s language proficiency is related to their cognitive skills. Early individual differences in vocabulary size and semantic knowledge predict *later* intelligence (Marchman & Fernald, 2008), school readiness (Morgan, Farkas, Hillemeier, Hammer, & Maczuga, 2015), and behavior regulation (Petersen et al., 2013). Although these relations have been established, the developmental pathways through which language influences other cognitive abilities are not known. In the laboratory, heard words have been shown to influence how long children sustain attention on an object (Baldwin & Markman, 1989), how children compare and categorize visual objects (Ferry, Hespos, & Waxman, 2010; Yoshida & Smith, 2003), and how children reason about relations within and among objects (Dessalegn & Landau, 2013; Loewenstein & Gentner, 2005). Although these results suggest that language influences foundational cognitive processes, they do not elucidate the specific mechanisms by which language learning affects so many aspects of cognition.

One pathway through which language and language learning could influence performance in different domains is by influencing how visual information is momentarily processed. This idea has been considered in the context of traditional debates on whether language can influence perception or whether human cognition is based on nonmalleable percepts (Gleitman & Papafragou, 2012). Although we consider these classic questions in the Discussion section, our hypothesis about how language influences the online processing of visual information is based on findings from adults suggesting that words have direct effects on visual processes (Lupyan & Spivey, 2010; Ostarek & Huettig, 2017). Most human learning and performance has substantial visual components (Ahissar & Hochstein, 2004). Thus, if words can influence how children momentarily process visual information, this would constitute a plausible mechanism for how language could have pervasive effects on other cognitive abilities. We investigated this question by examining how children identify a target object in clutter, one domain in which words have been shown to affect visual processing in adults.

When presented with a cluttered array of objects and the goal of finding a particular target, the perceiver needs to compare the incoming visual information and the array with a memory or representation of the target (Hout & Goldinger, 2015). Adult performance in these tasks depends on the information provided *before* the search array is presented (Vickery, King, & Jiang, 2005), with naming the target being positively related to target identification (Lupyan & Spivey, 2010). This is thought to reflect a process whereby words activate visual memories about the categories of objects to which they refer (Lupyan, 2008; Lupyan & Thompson-Schill, 2012; see also Jonides & Gleitman, 1972), including relevant low-level visual information that lowers the threshold to identify an object (Ostarek & Huettig, 2017). Here we asked whether words have similar effects on 3-year-old children’s identification of objects in clutter. On the one hand, these young children are at the beginning of the long developmental trajectory of word learning and visual object recognition (Smith, 2003) and differ from older children and adults in how they process visual objects (e.g., Mash, 2006). Thus, it is possible that words will not influence how such young children visually identify objects. The alternative possibility, that words do influence how children identify objects in clutter, would constitute a potential causal explanation for the power of language in cognitive development.

In the current experiment, 3-year-old children searched for a target that was an instance of a category (e.g., ice cream) among distractors that were instances of other visually similar categories (e.g., balloons, lamps). In the Label condition, children heard the spoken name of the target object prior to search; in the Visual Preview condition, children saw a visual preview of the target object prior to search. The experimental question was this: When identifying a target in an array of visually similar distractors, does hearing the basic-level name of the target object lower the threshold to identify the target *relative to* seeing a visual preview of the actual target? Both hearing the name and seeing a preview of the target have been shown to facilitate target identification in adults (Lupyan & Spivey, 2010; Vickery et al., 2005), and the combination of a label and a visual preview has been shown to increase the speed with which 3-year-old children identified a target object relative to a visual preview (Vales & Smith, 2015). Here we tested the more consequential prediction that the name of

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