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Effects of causal information on the early word learning: Efficiency and longevity

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ABSTRACT

This study examines two accounts of why causal information facilitates early learning, one focusing on its attracting attention at the time of encoding and the other on its enhancing memory through coherent elaboration. Three-year-olds were taught novel words along with either causally-rich or causally-weak descriptions of their referents until each child reached a specific learning criterion. Children reached this criterion in fewer trials in the causally-rich than in the causally-weak condition. However, when children's memory for the newly learned words was subsequently tested after a lengthy delay, no differences in performance were detected. Causal information therefore appears to support early word learning primarily by enhancing the efficiency of initial encoding, rather than by enhancing the longevity of lexical-semantic representations. These results provide greater support for the attention-based than the coherent elaboration-account and further suggest that encoding may be a principal limiting factor in children's word learning.

1. Introduction

Ample evidence demonstrates that causal information (i.e., information that reveals the effective powers of an object or the nature of its contingent interactions) plays a prominent role in structuring

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and supporting early cognitive development. Not only are young children sensitive to physical causality, but they also actively seek out causal explanations for object interactions and functions (Cohen & Oakes, 1993; Gopnik, Sobel, Schulz, & Glymour, 2001; Leslie & Keeble, 1987; Schulz & Bonawitz, 2007). Moreover, recent evidence suggests that preschoolers, like older children and adults, are more likely to investigate causal than non-causal properties of novel objects (Alvarez & Booth, 2014). These early emerging propensities toward causal information have implications for learning and memory. Not only do children remember causally coherent information particularly well (Barr & Hayne, 1996; Bauer & Mandler, 1989; Copple & Coon, 1977), but this information facilitates acquisition of new categories and words to refer to them (Booth, 2008, 2009; Gopnik & Sobel, 2000; Kemler Nelson, O'Neill, & Asher, 2008; Träuble & Pauen, 2007). Important questions remain, however, regarding why causal information has this facilitative effect.

Consider, for example, the effects of causal information on early word learning. Booth (2009) taught three-year-olds novel words along with descriptions of either a causal (e.g., Sooples wrap their wings around their body to stay warm) or a non-causal (e.g., Sooples have wings with orange stars on the back) property of their referents. Several days later, children revealed better memory for the words learned with causal descriptions.

One possible explanation for this facilitative effect is that, by virtue of its inherent interest, causal information enhanced attention during training. As a result, causal information and associated words were more readily and fully encoded (Craik, Govoni, Naveh-Benjamin, & Anderson, 1996; Uncapher & Rugg, 2005). This possibility is consistent with evidence that infants attend more to causal than non-causal events (Mascalzoni, Regolin, Vallortigara, & Simion, 2013). Young children are also particularly interested in learning about causal properties of objects. In one study (Alvarez & Booth, submitted for publication) three-year-olds were introduced to two puppets, one of which always described novel items in terms of their causal properties (this is used to squirt out paint in squiggly designs) while the other always described them in terms of their non-causal properties (this has squiggly designs painted on the back). Children had to indicate which puppet they wanted to hear describe a different novel item. Children chose to hear from the 'causal' puppet far more often than the 'non-causal' puppet. Although this study did not explicitly measure attention, it reveals preferences for causal information that could influence attention and learning.

A second possible explanation for the facilitative effect of causal information on early word learning is that it provides a framework for coherent elaboration of semantic representations. Indeed, the functions that instantiated 'causal' information in Booth's (2009) study are notable for the explanatory links they provided between intentional actions, goals, object part structure, and outcomes (e.g., knowing that a novel animal wraps its wings around its body to stay warm not only describes a goal-directed behavior in and of itself, but it provides a causal explanation for *why* the creature's wings are so large and thick). As a result of this type of coherent elaboration, representations formed with the benefit of causal information might be more readily retrieved or more robustly maintained in the face of decay over time (Craik & Tulving, 1975; Craik, 2002; Duffy, Shinjo, & Myers, 1990; Eysenck, 1979; McDaniel, Dunay, Lyman, & Kerwin, 1988).

These two explanations for the facilitative effect of causal information on word learning focus on distinct phases of the memory process. The heightened-attention account attributes the effect of causal information solely to its influence on initial encoding, while the coherent-elaboration account attributes the effects to influences that extend into the subsequent period of memory consolidation and retention. Thus, a potential way to shed light on whether one or both of these mechanisms is involved is to trace the time-course of acquisition and memory for novel words taught with information varying in its causal richness (Bauer, Evren Guler, Starr, & Pathman, 2011; Wojcik, 2013). If the heightened-attention account is correct, children should initially learn novel words more readily with the support of causally-rich than causally-weak descriptions of their referents. Subsequent retention, however, should be equivalent across conditions if initial encoding is equalized with additional training. If the coherent-elaboration account is correct, even after equalizing initial encoding, representations formed in the causally-rich condition should be more robust, leading to greater long-term retention of words than in the causally-weak condition.