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Effects of delays on 6-year-old children's self-generation and retention of knowledge through integration

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ABSTRACT

The current research was an investigation of the effect of delay on self-generation and retention of knowledge derived through integration by 6-year-old children. Children were presented with novel facts from passages read aloud to them (i.e., "stem" facts) and tested for self-generation of new knowledge through integration of the facts. In Experiment 1, children integrated the stem facts at Session 1 and retained the self-generated memory traces over 1 week. In Experiment 2, 1-week delays were imposed either between the to-be-integrated facts (between-stem delay) or after the stem facts but before the test (before-test delay). Integration performance was diminished in both conditions. Moreover, memory for individual stem facts was lower in Experiment 2 than in Experiment 1, suggesting that self-generation through integration promoted memory for explicitly taught information. The results indicate the importance of tests for promoting self-generation through integration as well as for retaining newly self-generated and explicitly taught information.

Introduction

The question of how knowledge is acquired, organized, and retained is fundamental to an understanding of cognitive development. These processes also are critical for informing educational practice and have been identified as the primary concern of educational psychologists (Beliner, 2006). In everyday contexts and educational settings alike, individuals are bombarded with a vast amount of

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information and faced with the burden of sorting the material, connecting it to previously learned content, and building on what is already known. Semantic memory serves a primary role in the storage and retrieval of this newly and previously acquired information, respectively. Semantic memory also exhibits a capacity for extending itself such that new information can be self-generated through processes such as semantic integration—the combination of two or more separate but related traces of information to yield new knowledge (Bauer, 2012). Preschool-age children have been shown to generate new knowledge through integration of information explicitly taught in separate passages of text (e.g., Bauer & San Souci, 2010). However, whether the newly self-generated knowledge persists over time has not been examined. In addition, how the temporal spacing of to-be-integrated information and the timing of the subsequent test for integration affect self-generation are largely unknown. Thus, in the current research, we tested whether newly self-generated knowledge remains cognitively available over a 1-week delay (Experiment 1) and how delays imposed either between presentation of to-be-integrated information or after presentation of the information but before the test for integration affect self-generation of new knowledge (Experiment 2).

The capacities to store and organize information about the world and to generate meaningful connections and understandings are present from infancy. Within the first year of life, infants demonstrate retention of information about the properties of objects, as evidenced by long-term recall of unique actions and temporal sequences of actions such as in elicited and deferred imitation paradigms (e.g., Carver & Bauer, 1999, 2001; Meltzoff, 1988). At least by the second year, infants have created organized semantic knowledge structures based on taxonomic categories of animals and vehicles, for example (e.g., Mandler, Bauer, & McDonough, 1991), as well as categories based on spatial–temporal contiguities (so-called *contextual* categories) such as kitchen things and bathroom things (e.g., Mandler & Bauer, 1988; Mandler, Fivush, & Reznick, 1987). Infants also generate meaningful connections and understandings by generalizing what they know to novel instances of categories. For example, they induce that a novel vehicle such as a forklift starts with a key, based on knowledge that familiar vehicles such as cars exhibit this property (Mandler & McDonough, 1996). The capacity for flexible and productive use of existing knowledge through logical processes such as induction (e.g., Gelman & Markman, 1987), deduction (Dias & Harris, 1988), and analogy (Goswami, 2011) increases over the preschool years (see Goswami, 2011, for a review). These capacities are foundational to establishment of a knowledge base.

The preschool years also are marked by changes in another important means of knowledge expansion, namely, self-generation of new knowledge through integration of separate episodes of experience. This capacity is called on in a variety of learning contexts and is especially salient in curricula that require children to learn subject matter in units spaced over days and weeks. Children are expected not only to retain the information from separate episodes but also to integrate the material across lessons. The productive aspects of semantic memory are apparent when the process of integration results in self-generation of new knowledge that was not present in the individual episodes. To test this ability, Bauer and San Souci (2010) employed a paradigm in which 4- and 6-year-old children were read passages of text, each of which conveyed a novel fact (i.e., "stem" facts). The novel stem facts could be combined or integrated with one another to generate new information that was not presented in the texts (i.e., "integration" facts). For example, children were read stories in which they were explicitly taught the stem facts that "dolphins talk by *clicking and squeaking*" and "dolphins live in groups called *pods*." They then were asked the question, "How does a pod talk?" The 4-year-olds generated the novel integration fact that "pods talk by clicking and squeaking" on only 13% of the trials, yet they recognized the correct answer from among distracters on 62% of the trials. The 6-year-olds generated the novel integration facts on 67% of the trials. Memory for the individual stem facts facilitated productive self-generation of the integration facts. That is, children who remembered more stem facts also generated more integration facts. Memory for the stem facts was not sufficient, however, as evidenced by the fact that 4-year-olds who were brought to a criterion level of learning of the stem facts nevertheless failed to achieve the high level of self-generation demonstrated by 6-year-olds (4-year-olds generated the integration facts on 33% of the trials, whereas 6-year-olds generated the integration facts on 67% of the trials).

For semantic integration to be psychologically, cognitively, and educationally meaningful, its products must persist over time. That is, the continual development of a knowledge base requires that