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The development of automatic associative processes and children's false memories

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ABSTRACT

We investigated children's ability to generate associations and how automaticity of associative activation unfolds developmentally. Children generated associative responses using a single associate paradigm (Experiment 1) or a Deese/Roediger–McDermott (DRM)-like multiple associates paradigm (Experiment 2). The results indicated that children's ability to generate meaningful word associates, and the automaticity with which they were generated, increased between 5, 7, and 11 years of age. These findings suggest that children's domain-specific knowledge base and the associative connections among related concepts are present and continue to develop from a very early age. Moreover, there is an increase in how these concepts are automatically activated with age, something that results from domain-general developments in speed of processing. These changes are consistent with the neurodevelopmental literature and together may provide a more complete explanation of the development of memory illusions.

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Introduction

A well-established finding in the literature on children's memory is that younger children are frequently more susceptible to misinformation effects than older children and adults. This age effect has been reliably shown in studies that have used suggestibility or misinformation manipulations to taint children's memories (Ceci, Ross, & Toglia, 1987). Thus, the message from suggestibility research is that false memories *decrease* with age during childhood.

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In contrast, over the past years, studies that implemented the Deese/Roediger–McDermott (DRM) paradigm (Deese, 1959; Roediger & McDermott, 1995) have shown that children's spontaneous false memories increase with age (Brainerd, Forrest, Karibian, & Reyna, 2006; Dewhurst, Pursglove, & Lewis, 2007; Dewhurst & Robinson, 2004; Howe, Wimmer, & Blease, 2009). In the DRM paradigm, participants study lists of words that are associated with a nonpresented word, namely the "critical lure". For example, *hot*, *snow*, *warm*, *winter*, *ice*, and so forth all are associated with the critical lure *cold*. Despite never hearing the word *cold*, participants falsely recollect *cold* along with correctly remembering list items that were presented.

What the findings from these different paradigms reveal is that there exists one set of conditions under which false memories increase with age (DRM paradigm) and another set of conditions under which false memories decrease with age (suggestibility paradigm). A recent study by Ceci, Papierno, and Kulkofsky (2007) may provide some insight into why these different trends have emerged across these two paradigms. These authors investigated how 4- and 9-year-olds' individual associations for concepts influenced their suggestibility. Specifically, when a suggested distractor is judged to be strongly associated with an original item's representation (and these judgements differed between 4- and 9-year-olds), children's susceptibility to misinformation increased compared with when that information was less strongly associated regardless of age. Apparently, there is an important relation between knowledge representation that is age dependent and suggestibility. That is, suggestibility is greater when it is mapped onto age-appropriate knowledge representations and the task encourages associative processing. What these results suggest is that the discrepancy between the findings for suggestibility and spontaneous false memories may be more apparent than real. Indeed, studies to date seem to show that at least one hallmark of children's false memories is the (often spontaneous) formation of associations and that the nature of these associations changes with age. To extend this line of inquiry and study these underlying associative processes in greater detail, we adopted a DRM-like procedure because this has quickly become the sine qua non for research on associative processing in both children and adults (see Gallo, 2006).

One problem with using the DRM paradigm in child research is that the word lists that are typically used are those derived from adult word association norms (e.g., Nelson, McEvoy, & Schreiber, 1999). Research on children's memory organization, like that just reviewed (Ceci et al., 2007), suggests that although associative links between concepts appear at a relatively young age, they are further strengthened and refined with increases in both knowledge and experience (Bjorklund, 1987; Bjorklund, 2005). Because children's knowledge base is different from adults' knowledge base, using adult normed word lists may explain why children have fewer false memories than adults.

Recently, three studies addressed this issue and used children's associations to construct word lists (Anastasi & Rhodes, 2008; Carneiro, Albuquerque, Fernandez, & Esteves, 2007; Metzger et al., 2008). Interestingly, all three studies found that although developmental trends were considerably attenuated, false memories still tended to increase with age. These findings suggest that the increase in false memories with age cannot be attributed solely to changes in the content or organization of children's knowledge base. Rather, as suggested in the associative activation theory (AAT) (Howe, Wimmer, Gagnon, & Plumpton, 2009), it is likely that these additional increases in false memory rates with age are due to increases in children's ability to automatically activate and use associative relations much in the same way as adults (Kimball & Bjork, 2002). In particular, AAT suggests that false memory development is the result of increases in the number and strength of associative relations in children's knowledge base as well as the speed and automaticity with which these associative relations are accessed and activated.

An alternative theory, fuzzy trace theory (FTT) (e.g., Brainerd, Reyna, & Ceci, 2008), suggests that children's memory is organized by two different memory traces: a verbatim trace and a gist trace. Verbatim traces encode surface features of items such as the phonological structure of a word. Gist traces encode the meaning or overall theme of a word or list of words. Children's false memories increase with age because gist extraction processes improve with age. The difference between the two theories is that FTT explains age increases in false memories in terms of coincident changes in *gist extraction*, whereas AAT explains these same changes in terms of increases in the number and speed of direct *activation processes* among items in a semantic network.

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