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Recognition and source memory for pictures in children and adults

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Abstract

The present experiment investigated the developmental aspects of source compared to item memory. College students and 7–8-year-old children viewed pictures drawn in red or green during a study phase, and were asked either to remember the pictures for a subsequent recognition test, or to remember both the pictures and their associated colors for a subsequent source memory test. In the test phase, new and old pictures were presented in black. In the recognition task, participants were asked to make binary old/new recognition judgments, while in the source task, they were asked to make trinary old-green/old-red/new source judgements. Performance on all tasks improved with increasing age, but the age difference for source was much larger than that for item memory. It has been suggested that the frontal lobes play a critical role in the retrieval of source information, and that this brain region relative to the medial temporal lobes continues to develop into late adolescence. Thus, it is possible that immaturity of the frontal lobes may be causally related to the children's lower performance on the source memory task.

Keywords: Source memory; Development; Frontal lobes

1. Introduction

Within the episodic memory domain, it is possible to distinguish between memory about the occurrence of an event (i.e. content or fact memory such as recognition of a person's face), and memory for the context in which knowledge about the event was acquired (e.g. when and/or where one met the person). The latter aspect of episodic memory is referred to as source memory, whereas the former is referred to as item memory. Source memory can be based on temporal (when) or spatial (where) aspects of events, on the modality in which events were presented, on the perceptual details accompanying them, and on the emotional or cognitive state at the time the events occurred (for a review see [22]).

In everyday life, memory is typically better for facts than for their sources. While this phenomenon can be partially explained by the amount of contextual detail available in the memory trace [7], recent studies have suggested that item and source memory are functionally and neuroanatomically dissociated. For example, healthy older adults, as opposed to young adults, have more difficulty recalling specific perceptual details accompanying facts, such as the modality of presentation [25,29], the letter case in which words were presented [23], and whether heard information was presented by a male or a female voice [24,40]. Similarly, older adults have more difficulty than younger adults in remembering the context in which they encounter events, such as whether they learned a fact during or before the experiment [19], whether they were instructed to state out loud or to think about a word [16], and which of two tasks they had performed when words were encoded [5].

Studies of amnesic patients have demonstrated that, among patients who show similar deficits in remembering facts, impairment of source memory may vary greatly [39,43]. These data further suggest that source memory may be dependent on brain structures other than the medial temporal lobes and diencephalon that

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are implicated in general amnesia. Because patients with frontal lobe lesions exhibited normal item recognition but disproportional numbers of errors regarding source information [19,32,33], it has been suggested that the frontal cortex is critical for accurate source memory. There is also behavioral and physiological evidence suggesting that the frontal lobes are particularly sensitive to the effects of aging [1,10,53], which is consistent with the decline in source memory that has been reported in the elderly. It is important to note that the contextual information (e.g. perceptual attributes such as color, as in the current investigation) encoded during an initial study episode is not likely to be stored in prefrontal cortex (e.g. [13]). Rather, this kind of information is probably stored in material-specific brain regions (where these perceptual attributes were originally processed) and is retrieved under the direction of a mechanism (or mechanisms) located in frontal cortical areas.

The frontal lobes also appear to have a long developmental course, as myelinization [55] and synaptic density counts [17] do not appear to be complete until late adolescence. Because other brain regions that are assumed to be involved in memory functions such as the medial temporal lobes and the hippocampus are mature early in the course of development [34], a dissociation between item and source memory would be expected in children. Thus, the purpose of the present investigation is to address the issue of item versus source memory in children, as there is a paucity of information in this research domain (see below).

A developmental aspect of source memory has been addressed in the context of studies of reality monitoring, a paradigm which is a special case of source memory. In a reality monitoring task, the ability to discriminate memories of external events from those created internally (e.g. thoughts, imagining) is measured. Foley et al. [12] found that 6-year-old children had difficulty discriminating between memories of words they had actually said aloud and memories of words they imagined saying. However, they had no problem discriminating between words they imagined saying and words they heard spoken by someone else, or remembering which of two people had said a particular word. In another study, Foley and Johnson [11] concluded that young children are capable of distinguishing between memories for self generated actions and external events, but tend to be more confused than adults as to whether they performed or imagined the events (both were self generated events). The fact that, under some conditions, children failed to accurately monitor source was attributed to action similarity, person similarity, and to the involvement of the self (for more detail see [9,30]). While reality-monitoring studies showed a clear developmental trend, their focus differs in many respects from the neuropsychological approach used to study source memory in the elderly and amnesic patients. For example, they lack a direct comparison with other forms of memory such as recognition, and their prediction is based on psychological theories [9] rather than on the developmental course of brain structures.

A neuropsychological approach was taken by Rybash and Colilla [38] who assessed 10–14-year-old children with the source-forgetting paradigm. In this task, the children were asked to discriminate between facts learned during the experiment and those learned at some other time in the child's life (this paradigm was based on Schacter et al. [39]). The children were also administered the Wisconsin card sorting test (WCST) and the verbal fluency task, which are presumed to assess frontal lobe functions. Rybash and Colilla [38] did not report the levels of performance for fact and source recall, nor performance on the WCST and verbal fluency tasks. Their major result was that error performance on the WCST was correlated with source recall error but not with item recall error, suggesting that children show poorer performance on source memory tasks requiring mature frontal cortex. However, the omission of the levels of item and source recall performance, and the lack of comparison with young adults, did not permit conclusions concerning the differential development of the item versus source aspects of episodic memory.

The purpose of the present investigation was to examine the development of the relationship between item and source memory, by comparing performance between children and adults. As there is some evidence that modality information is encoded automatically in both adults and children [26], while memory for colors appears to be an effortful process [15,35], color was used to define the context or source for initial learning during which children and adults were asked to memorize pictures and their colors for a subsequent memory test. Following the study phase, recognition memory tasks were administered in which participants were required to retrieve item as well as source information. It was expected that children would demonstrate relatively poorer source compared to item memory than adults. Two tests that are presumed to reflect frontal lobe function (i.e. the controlled word association test [27,52], and the competing programs task [31]), as well as a memory test that is assumed to depend on the medial temporal lobes (the story memory sub-tests [41,51]) were also administered to examine their correlation with the measures of item and source memory. If item and source memory are dissociable processes with distinct neurological underpinnings, then it was expected that performance on the frontal lobe tests would correlate with source but not item memory, whereas performance on the medial temporal lobe test would correlate with item but not source memory indices.