CORTEX 91 (2017) 25–39

Available online at www.sciencedirect.com

ScienceDirect

Journal homepage: www.elsevier.com/locate/cortex

Special issue: Research report

Relate it! Objective and subjective evaluation of mediator-based strategies for improving source memory in younger and older adults☆

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ARTICLE INFO

Article history:
Received 29 June 2016
Reviewed 8 August 2016
Revised 5 October 2016
Accepted 23 November 2016
Published online 1 December 2016

Keywords:
Source memory
Cognitive aging
Associative deficit
Encoding strategy
Imagery

ABSTRACT

The present study examined younger and older adults' ability to improve their source memory for different types of sources through imaginal and verbal (sentence) mediators. Younger (18–29 years) and older (60–75 years) adults' strategy use and source memory for either text-type (bold *vs* italic) or person (woman *vs* man) sources was assessed; strategy use was either spontaneous or the generation of imaginal mediators was instructed before encoding. Younger and older adults did not differ in spontaneous use of mediator-based strategies; however, older adults generated more images but fewer verbal mediators than younger adults. Participants were able to increase mediator generation when instructed to, resulting in substantial increases in both item and source memory for the instructed conditions in both age groups. Use of verbal mediators was more likely for the more concrete person sources for which source memory was generally better. Importantly, these objective benefits of mediator-based strategies translated into subjective benefits for both younger and older adults: Increased use of either mediator type was correlated with lower experienced task difficulty; the instructions to use imaginal mediators resulted in a significant decrease in difficulty ratings on the group level. Participants were generally able to monitor mediator benefits to both item and source memory and accurately judged mediator strategies (especially imagery) as more effective than repetition; older adults, however, rated all strategies as less effective than younger adults. Implications of these findings, especially for neuropsychological studies on source monitoring, are discussed.

☆ This research was partially supported by a student research award from the Association for Psychological Science (APS) presented to BGK. We thank Jessica Arvidson, Amanda Brewer, Hannah Hendricks, and Jaleesa Martin for help with participant recruitment, and data collection.

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http://dx.doi.org/10.1016/j.cortex.2016.11.015
0010-9452/

1. Introduction

Remembering the source of information (i.e., when, where, how and from whom information was originally learned; Johnson, Hashtroudi, & Lindsay, 1993) is important in many situations. For example, merely knowing that one of your friends is allergic to peanuts is not very helpful. You must remember which friend told you about their allergic reactions to avoid bringing a dish with peanuts to their house. Unfortunately, adults of all ages, but especially older adults, often only know that information was learned previously but cannot remember precise source details (Boywitt, Kuhlmann, & Meiser, 2012; Chalfonte & Johnson, 1996; Kuhlmann & Boywitt, 2016; Old & Naveh-Benjamin, 2008; Yonelinas, 2002). The present study thus examines younger and older adults' ability to strategically improve their source memory.

1.1. *Strategically improving associative memory*

Successful source memory requires binding or associating item and source (context) information (Chalfonte & Johnson, 1996). Consequently, source memory draws on associative memory processes (Naveh-Benjamin, 2000; Old & Naveh-Benjamin, 2008). On a neural level, this item–source association is thought to be primarily accomplished in medial temporal lobe regions, particularly the hippocampus (see Mitchell & Johnson, 2009, for an overview). But can people *strategically* improve their encoding of associative information?

Most research on associative encoding strategies has focused on how people encode unrelated noun-pairs (e.g., dog—spoon) such that they can later successfully retrieve one of the nouns when cued with the other (e.g., dog—?). This research has repeatedly found that people remember such associations best when they generate a *mediator* connecting the to-be-associated information (see Richardson, 1998, for a review). According to strategy reports, people spontaneously use both mental images (e.g., visualizing a dog licking a spoon) and verbal sentences (e.g., reasoning that dog goes with spoon because dogs love to lick peanut butter off a spoon) as mediators. Importantly, even people who do not use mediators spontaneously can successfully generate them for most noun-pairs when instructed to, such that instructions to use mediators improve associative memory (e.g., Hulicka & Grossman, 1967; Richardson, 1998). Further, mediator-based strategies also improve memory for the individual items in the association (i.e., the words *dog* and *spoon* in our example) so they broadly benefit memory (Naveh-Benjamin, Brav, & Levy, 2007).

Unfortunately, research on source memory has not paid much attention to encoding strategies, despite evidence that mediator-based strategies improve associative memory. Indirect early evidence that encoding strategies also play a role in source memory stems from studies showing that intentional source encoding instructions improve source memory (Chalfonte & Johnson, 1996). Even for incidental source memory there is evidence that a self-referential focus during encoding (i.e., focusing on one's own emotional reactions to the presented information) impairs memory for external sources (Johnson, Nolde, & De Leonardis, 1996; Mather, Johnson, & De Leonardis, 1999). Similarly, participants achieve better source memory when asked to think about the item–source relationship than when asked to think about the item only (Bisol Balardin et al., 2009; Glisky, Rubin, & Davidson, 2001). Recently, we more systematically explored what participants exactly do when trying to encode item–source associations and found that they (a) spontaneously generated imaginal or verbal mediators for about 30–40% of the trials for which source memory was better than for trials on which another strategy (e.g., repetition) or no/word-only strategies were used, and (b) that instruction to use imaginal mediators substantially increased mediator-based strategy use and, consequently, source memory (Kuhlmann & Touron, 2012).

In summary, although little is yet known about encoding strategies in source memory, there is clear evidence that source memory can be strategically improved, particularly through the generation of mediators. On a neural level, frontal-lobe areas are crucial for the self-initiation of encoding strategies (Kirchhoff, 2009). Indeed, frontal lesions cause source-memory deficits and although most studies have focused on the contribution of frontal-lobe areas to evaluation and monitoring processes during source retrieval, there is some evidence for its role for source encoding (see Mitchell & Johnson, 2009, for an overview).

Given its theoretical and practical relevance for source memory, further research on mediator-based strategies is desirable. In the present study, we strove to replicate our previous findings regarding the benefits of mediator-based strategies to source memory (Kuhlmann & Touron, 2012) as well as to extend them by gaining novel insight about younger and older adults' mediator use across different source-monitoring tasks. Specifically, we extended our previous research by examining the effects of source type and by differentiating between mediator type (imaginal *vs* verbal). In noun-pair learning, noun concreteness (or its close correlate imageability) has been shown to particularly increase the use of imaginal mediators (Richardson, 1998; Rowe & Schnore, 1971; Tournier & Postal, 2011) whereas verbal mediators are more likely for abstract material. Further, some studies found that imaginal mediators are more effective (i.e., result in greater memory improvement) for concrete material (e.g., Dirkx & Craik, 1992; Hinault, Lemaire, & Touron, 2016). We therefore deemed it plausible that sources may differ in their affordability of the different types of mediators as well as in their affordability of mediator generation in general. Although distinct general classes of sources have been defined (i.e., internal *vs* external; Johnson et al., 1993) little is known about differences between types of sources within each class. Within the class of external sources (the focus of the present study), Boywitt and Meiser (2012) found that item–intrinsic sources (e.g., font color) are incidentally better remembered than item–extrinsic sources (e.g., color of an object near the item but not part of the item), presumably due to their automatic capture of attention (see also Mather, 2007). For intentional source learning (focused on here), no differences emerged. However, it seems plausible that it may be easier to intentionally generate a mediator for some external sources (intrinsic or extrinsic) than for others. We considered two common source manipulations (cf. Johnson et al., 1993): words