Available online at www.sciencedirect.com

SciVerse ScienceDirect

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

Research report

Lateralized processing of false memories and pseudoneglect in aging

Rémy Schmitz [a], Hedwige Dehon [b] and Philippe Peigneux [a,*]

[a] UR2NF [Unité de Recherches en Neuropsychologie et Neuroimagerie Fonctionnelle], Université Libre de Bruxelles, Campus du Solbosch CP191, Brussels, Belgium

[b] Cognitive Psychology Unit, Department of Cognitive Sciences, University of Liège, Liège, Belgium

ARTICLE INFO

Article history:
Received 29 August 2011
Reviewed 9 January 2012
Revised 27 April 2012
Accepted 19 June 2012
Action editor Sergio Della Sala
Published online 29 June 2012

Keywords:
Aging
Cerebral dominance
False memory
Pseudoneglect

ABSTRACT

Aging is associated with higher propensity to false memories and decreased retrieval of previously studied items. When young adults (YA) perform on a lateralized version of the Deese–Roediger–McDermott (DRM) paradigm, the right cerebral hemisphere (RH) is more sensitive than the left (LH) to false memories, suggesting hemispheric imbalance in the cerebral mechanisms supporting semantic and episodic memory processes. Since cerebral asymmetries tend to be reduced with age, we surmised that behavioral asymmetries in the generation of false memories would be diminished with aging. To probe this hypothesis, a lateralized version of the DRM paradigm was administered to healthy older adults (OA) and YA. During the encoding phase, lists of semantically associated words were memorized. During the retrieval session, targets (previously seen words), lures (LU) (never seen strongly semantically related words) and distracters (never seen, unrelated words) were briefly displayed either in the left or right visual fields, thus primarily stimulating the RH or LH, respectively. Participants had to decide whether the word was previously studied (Old/New), but also whether they had a strong episodic recollection (Remember) or a mere feeling of familiarity (Know) about Old words. In line with our predictions, false memories were globally higher in OA than YA, and vivid false recollections (i.e., Remember responses) were higher when LU were presented in the RH in YA, but not in OA. Additionally, we found significant correlations between YA participants' Familiarity scores and leftward attentional bias as previously evidenced using a visuospatial landmark task (Schmitz and Peigneux, 2011), an effect not present in OA. This result is in line with the hypothesis of an interplay between attentional resources allocated to visuospatial and memory processes, suggesting a *memory pseudoneglect* phenomenon that would be altered with aging.

* *Corresponding author*. UR2NF [Unité de Recherches en Neuropsychologie et Neuroimagerie Fonctionnelle], Université Libre de Bruxelles, Campus du Solbosch CP191, Avenue F.D. Roosevelt 50, B-1050 Brussels, Belgium.
E-mail address: Philippe.Peigneux@ulb.ac.be (P. Peigneux).
URL: http://dev.ulb.ac.be/ur2nf

http://dx.doi.org/10.1016/j.cortex.2012.06.005

1. Introduction

Originally introduced by Deese (1959) then updated by Roediger and McDermott (1995), the Deese/Roediger–McDermott (DRM) task is probably the most widely used paradigm to investigate the development of false memories (Brainerd et al., 2011; Gallo, 2010; Pezdek and Lam, 2007). In the DRM procedure, participants have to study thematic lists of words semantically related to a critical, but never-presented lure (e.g., the non-presented lure *sleep* is semantically related to a network of words to be learned such as *bed*, *rest*, *night*, *awake*, etc.). In subsequent recall and/or recognition tests, participants tend to erroneously accept the critical lure as being part of the list of learned words, a false memory effect consistently observed across hundreds of studies (for reviews see Gallo, 2010; Roediger and McDermott, 2000). Even when informed about the risk to produce erroneous memories in an attempt to reduce hit and false alarm rates, participants persist in the false recognition of the critical lure (Gallo et al., 2001; McDermott and Roediger, 1998), demonstrating the robustness of this effect. Moreover, the critical lure can be associated with a strong feeling of recollection, i.e., participants' recognition can be accompanied by specific details of the study episode instead of a simple feeling of familiarity (Gallo and Roediger, 2003; Roediger and McDermott, 1995).

The false memory phenomenon observed in the DRM paradigm can be explained using two complementary, not mutually exclusive theories. According to the Fuzzy Trace Theory (FTT; Brainerd and Reyna, 2002; Brainerd et al., 2008), both verbatim and gist traces are encoded and activated during the study phase. Verbatim traces represent the surface details of the stimuli and gist traces constitute the core meaning of the stimuli without the perceptual details. Thus, accurate memory of studies items is principally based on verbatim traces whereas false memory is mainly driven by gist traces. Alternatively, according to the Activation-Monitoring Account (AMA; Gallo, 2010; McDermott and Watson, 2001; Roediger et al., 2001), two opposing processes give rise to false memories. During the encoding of the thematic lists, the critical lure is activated either consciously by elaborative processes or automatically through spreading activation within an associative network. During the testing phase when a critical lure is activated, participants have to differentiate between the activation generated by the actual presentation of the item and its previous internal activation. Reality-monitoring confusions may then appear for critical lures (LU) as compared to semantically unrelated distracters, leading to the false memory phenomenon.

At the functional neuroanatomical level, prefrontal and temporal regions appear to play both common and different roles in the generation and expression of false memories. Indeed, neuroimaging data have highlighted left prefrontal (PFC) and lateral temporal cortices activations during lists encoding, likely reflecting semantic associations processing (Burton et al., 2003; McDermott et al., 2003). However, left PFC activation during encoding is predictive of participants' performances on both studied items and critical LU (Kim and Cabeza, 2007a; Kubota et al., 2006), whereas left medial temporal lobe activity is associated to true memories only (Kim and Cabeza, 2007a), implying elaborative semantic processes and the storage of real events, respectively. Nonetheless, the anterior temporal lobe may also contribute in semantic activation since magnetic (Gallate et al., 2009) or electrical (Boggio et al., 2009) stimulation at encoding reduces false memory formation. Besides, it has been shown that hippocampal activity during lists encoding is predictive of the occurrence of list-related false memories up to three days later (Darsaud et al., 2011). During the retrieval phase, hippocampal and the left ventrolateral PFC activities may reflect the recovery of semantic information whereas dorsolateral PFC may subtend source-monitoring (Cabeza et al., 2001). Moreover, high confidence judgments in true and false memories have been associated with medial temporal lobe and fronto-parietal activities, respectively (Kim and Cabeza, 2007b). Overall, temporal and prefrontal activations during encoding and retrieval are in accordance with the two distinct processes of semantic activation and source-monitoring proposed in the AMA model (Gallo, 2010).

Using a modified version of the DRM paradigm, hemispheric differences have been also highlighted in the processing of true and false memories (Bellamy and Shillcock, 2007; Ben-Artzi et al., 2009; Faust et al., 2008; Ito, 2001; Westerberg and Marsolek, 2003). Indeed, when primarily targeted using a divided visual fields procedure, the left hemisphere (LH) tends to be more accurate for studied items (Ito, 2001) and to reject more easily the critical LU (Bellamy and Shillcock, 2007; Westerberg and Marsolek, 2003). Moreover correct rejections of critical LU in the LH are associated with higher confidence levels (Westerberg and Marsolek, 2003). Overall, these results suggest that the LH better discriminates true from false memories than the right hemisphere (RH). However, the LH may be more susceptible to critical LU when encoding is composed of dominants-meaning lists as compared to subordinates-meaning lists (Faust et al., 2008). Hence, LH-dependent false memory may be enhanced by the semantic strength of the material presented at encoding. Interestingly, as compared to the LH, the RH generates less false memories than the LH and is not affected by the strength of the associates at encoding. Nevertheless, the RH becomes more prone to false memory when participants have to study short texts containing semantically associated words (Ben-Artzi et al., 2009).

A common explanation for these LH/RH differences fits in the framework of the Fine-Coarse Semantic Coding Theory (FCT; Beeman, 1998; Jung-Beeman, 2005), according to which each hemisphere differently processes semantic information during word processing, in that semantic fields are more focused in the LH and more diffused in the RH. Consequently, the RH is more likely than the LH to activate a concept connected by distant semantic relations, and in the DRM task, a thematic list (e.g., *bed*, *rest*, *night*, *awake*, etc.) is more susceptible to activate the critical lure (i.e., *sleep*) in the RH. Accordingly, critical LU are more confidently rejected when primarily presented in the LH (Westerberg and Marsolek, 2003). Likewise, the LH produces more critical LU when coming from dominant-meaning lists being strongly activated, whereas the RH is sensitive to the same degree to subordinate- and dominant-lists (Faust et al., 2008). A