

Autobiographical and episodic memory—one and the same? Evidence from prefrontal activation in neuroimaging studies

Asaf Gilboa^{a,b,*}

^a Baycrest Centre for Geriatric Care, Rotman Research Institute, Baycrest Centre 3560 Bathurst Street, Toronto, Ont., Canada M6A 2E1

^b Department of Psychology, University of Toronto, 100 St. George Street, Toronto, Ont., Canada M5S 3G3

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Abstract

Laboratory investigations of episodic memory often require participants to encode and later retrieve lists of items (words, pictures, or faces). The underlying assumption is that recollection of items from the list is analogous to recollection of events from one's past, i.e. autobiographical re-experiencing. Functional neuroimaging studies of episodic memory have provided extensive evidence suggesting that regions of the prefrontal cortex (PFC) play a role in episodic memory retrieval. A review of PFC activations reported in imaging studies of autobiographical memory and matched sub-sets of list-learning episodic memory studies reveals patterns of similarity but also substantial differences. Episodic memory studies often report activations in the right mid-dorsolateral PFC, but such activations are absent in autobiographical memory studies. Additionally, activations in the ventromedial PFC, primarily on the left, are almost invariably found in autobiographical memory studies, but rarely occur in studies of episodic memory. It is suggested that these two regions mediate different modes of post-retrieval monitoring and verification. Autobiographical memory relies on quick intuitive 'feeling of rightness' to monitor the veracity and cohesiveness of retrieved memories in relation to an activated self-schema. Episodic memory for lists requires more conscious elaborate monitoring to avoid omissions, commissions and repetitions. The present analysis suggests that care and caution should be exercised in extrapolating from the way we recollect 'events' from a list learned in the laboratory to the way we recollect events from our lives. © 2004 Elsevier Ltd. All rights reserved.

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1. Introduction

Episodic memory is a term that was proposed originally in order to distinguish personally experienced events from the general facts we know about linguistic concepts, the world and ourselves (Tulving, 1972, 1983). Episodic memory is conceptualized as a system that enables the conscious recollection of an event and the context in which it occurred. This conceptualization implies that autobiographical memory is either synonymous with episodic memory or is a specific case of it (e.g. Gardiner, 2001; Kopelman & Kapur, 2001; Tulving, 1972). By this view, recalling a discrete experimental stimulus and the context in which it was presented ('an event') has the same status as recalling autobiographical events; both should be retrieved by a similar set of cognitive processes and be supported by similar brain structures. However, some have questioned the assumption of equivalence

between these modes of remembering on theoretical grounds (Conway, 2001; Conway & Pleydell-Pearce, 2000; Tulving, 2001; Wheeler, Stuss, & Tulving, 1997). Specifically, Wheeler et al. (1997) highlight the idea that episodic memory is primarily characterized by the type of awareness that accompanies retrieval whereas autobiographical memory is defined by the content of the material retrieved (i.e. self-related). Episodic memory involves remembering by re-experiencing and being aware of the continuity of the experiencing self across time; autobiographical memory refers to information that directly involves the rememberer but need not entail the same subjective awareness. Autobiographical re-experiencing, the ability to travel back in time and re-experience an event from the past, is only one (important) aspect of autobiographical memory and is thought to be uniquely human by this view. Conway and Pleydell-Pearce (2000); see also Conway (2001) distinguish the time frame within which these memory types operate, with episodic memory measured in seconds, minutes and hours, whereas autobiographical memory encompassing much longer

* Tel.: +1-416-785-2500x2943; fax: +1-416-785-2862.

E-mail address: asaf@psych.utoronto.ca (A. Gilboa).

periods. This view echoes an earlier distinction made by Brewer (1986) who suggested episodic re-experiencing aspects of autobiographical memory may only last for days to weeks. By this view, detailed event-specific remote autobiographical memory has little in common with episodic memory as measured in the laboratory. Nonetheless, laboratory investigations of episodic memory most commonly involve encoding and retrieval of lists of items, and findings are generalized and deemed pertinent to the way humans recollect specific events from the past. This is true of investigations in cognitive psychology and cognitive neuroscience.

Neuroscientific investigations, and in particular functional neuroimaging, have provided in extensive evidence that links episodic memory to functions of the frontal lobes. For example, studies of episodic retrieval using lists of items consistently find activations in the prefrontal cortex (PFC). Some have suggested that retrieval-related processes tend to be lateralized to the right (Fletcher, Shallice, Frith, Frackowiak, & Dolan, 1998; Henson, Rugg, Shallice, Josephs, & Dolan, 1999a; Nyberg et al., 1996; Rugg, Fletcher, Chua, & Dolan, 1999) although this view has been challenged by suggestions that this asymmetry is related to the nature of the material (verbal versus non-verbal) rather than the nature of the process (retrieval) (Lee, Robbins, Pickard, & Owen, 2000; McDermott, Buckner, Petersen, Kelley, & Sanders, 1999; Miller, Kingstone, & Gazzaniga, 2002; Wagner, Poldrack et al., 1998b). Either way, neuroimaging studies very often implicate the right PFC in episodic retrieval processes (see Cabeza & Nyberg, 2000; Fletcher & Henson, 2001 for recent reviews). The consistent involvement of the right PFC in early PET studies of memory retrieval was first noted by Tulving, Kapur, Craik, Moscovitch, and Houle (1994) who proposed the hemispheric encoding/retrieval asymmetry (HERA) hypothesis to account for this regularity. With regard to the right PFC, the HERA model asserts that it is involved in retrieval of episodic, as opposed to semantic, information and that it is more involved in retrieval of such information than the left PFC (see Habib, Nyberg, & Tulving, 2003 for slight revisions of the model which also attempts to accommodate the material specificity arguments).

Subsequent imaging research, which employed more sophisticated technologies and research designs, indicated that different regions within the PFC are differentially activated in response to different task demands at various stages of the retrieval process. For example, in relation to task demands, studies began to probe the episodic aspect of retrieval by employing source memory paradigms. In these studies, subjects were required to retrieve specific contextual information such as where, when or how an item appeared rather than simply the content, or occurrence of an item in the study list (Cabeza et al., 1997b; Cansino, Maquet, Dolan, & Rugg, 2002; Dobbins, Foley, Schacter, & Wagner, 2002; Henson et al., 1999a; Nyberg et al., 1996; Ranganath, Johnson, & D'Esposito, 2000; Rugg et al., 1999; Rugg, Henson, & Robb, 2003). Theoretically, these

judgments require additional cognitive processes compared to simple recognition that can be performed based on familiarity alone or a conjunction of familiarity and recollection (Jacoby, 1991). Retrieval of items and their context in the above mentioned studies was indeed associated with increased activity on either left or bilateral anterior PFC and either right or bilateral dorsolateral PFC when compared to retrieval of context-free items. These paradigms more closely approximate the phenomenology of autobiographical re-experiencing and the neuroanatomical evidence derived from them is thought to reflect its functional neuroanatomy better.

In a recent fMRI study of autobiographical memory (Gilboa, Winocur, Grady, Hevenor, & Moscovitch, in press), we noted the absence of activation in the anterior and mid-dorsolateral right PFC (around Brodmann areas (BA) 46/10 and 9/46, respectively), which we had expected to observe based on evidence from laboratory tests of episodic memory described above. This was particularly remarkable since our paradigm emphasized re-experiencing as opposed to general autobiographical knowledge, and because even direct comparisons between context-rich and context-poor memories did not yield the expected activation. Recently, this absence was also noted in another study of autobiographical memory (Maguire & Frith, 2003) and in a laboratory-based study of episodic memory (Burgess, Maguire, Spiers, & O'Keefe, 2001; see also Burgess, Maguire, & O'Keefe, 2002). These authors have hypothesized that differences in PFC activation may be due to differences in the temporal context of autobiographical memory, which is more distinct across memories, and the diversity of events, which reduces interference susceptibility, compared to laboratory-based episodic memory studies.

Such discrepant data again raise the question of the equivalence of episodic memory for lists and autobiographical re-experiencing, this time on empirical grounds. The present review seeks to address the question of similarities and differences in patterns of activation of the frontal lobes in laboratory tests of episodic memory and autobiographical memory studies.

2. Method

2.1. Selection and categorization of studies

There are only a handful of neuroimaging studies of autobiographical memory. The experimental techniques they use to select and elicit memories differ on several dimensions. For example, some studies emphasize re-living and re-experiencing of personal events by allowing longer retrieval times or by selecting events that are particularly memorable and significant in the subjects' lives. Other studies allow less time for retrieval and thus are unlikely to elicit the same type of re-experiencing (Conway & Bekerian, 1987).

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