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Research Report

Event-related potential evidence of accessing gender stereotypes to aid source monitoring

P. Andrew Leynes*, Jarret T. Crawford, Anne M. Radebaugh, Elizabeth Taranto

The College of New Jersey, Department of Psychology, Ewing, NJ 08628, United States

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ABSTRACT

Source memory for the speaker's voice (male or female) was investigated when semantic knowledge (gender stereotypes) could and could not inform the episodic source judgment while event-related potentials (ERPs) were recorded. Source accuracy was greater and response times were faster when stereotypes could predict the speaker's voice at test. Recollection supported source judgments in both conditions as indicated by significant parietal "old/new" ERP effects (500–800 ms). Prototypical late ERP effects (the right frontal "old/new" effect and the late posterior negativity, LPN) were evident when source judgment was based solely on episodic memory. However, these two late ERP effects were diminished and a novel, frontal-negative ERP with left-central topography was observed when stereotypes aided source judgments. This pattern of ERP activity likely reflects activation of left frontal or left temporal lobes when semantic knowledge, in the form of a gender stereotype, is accessed to inform the episodic source judgment.

1. Introduction

Tulving (1972) first proposed that long-term memory could be separated into episodic and semantic memory. Episodic memory represents our memory of specific experiences in time, from which a person can reconstruct an autobiographical, personal event that took place. Alternatively, semantic memory concerns facts, meanings, concepts and knowledge about the external world that we have acquired and which is autonomous of both personal experience and spatial or temporal awareness. For example, being able to remember a summer vacation in London taps into episodic memory, whereas the ability to consciously declare that London is the capital city of England is the work of semantic memory.

Since Tulving's initial theorizing, the bulk of research has focused on uncovering evidence that episodic and semantic memory are dissociable while less research has been allocated to understanding how the two types of memory might interact in many situations (see Greenberg and Verfaellie, 2010 for a recent review of these issues). Tulving (1972) made it clear from the beginning that the proposed distinction was intended "for the convenience of communication, rather than as an expression of any profound belief about structural or functional separation of the two." (p. 384). He went on to further point out that "episodic memory can at times be strongly influenced by information in semantic memory" (p. 386), and theorized that this influence would be particularly powerful during encoding. For example, studying words on a list would be influenced by the prior semantic knowledge of the meaning of the words. Additionally, the memory literature is replete with examples of how episodic memories are reconstructed using general

*Corresponding author. Fax: +1 6096375178.
E-mail address: leynes@tcnj.edu (P.A. Leynes).

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knowledge to fill in missing details of episodic remembering (e.g., Barlett, 1932; Bransford and Johnson, 1972; Carmichael et al. 1932). Given these important interactions between episodic and semantic memory, it is clear that additional inquiry into their relations is needed to fully understand how we remember.

We approached studying the interaction between episodic and semantic memory by focusing on a type of episodic memory judgment called source memory. Source memory refers to remembering the contextual information associated with the origin (or source) of a particular episodic memory, and the Source Monitoring Framework describes the cognitive processes that govern these types of discriminations (SMF; Johnson et al. 1993). Sources can either be external to oneself (information that is heard, seen, touched, etc.) or internal (from oneself in the form of action or thoughts). For example, deciding whether remembered information came from a television newscast or a friend represents a discrimination between two external sources. According to the SMF, source monitoring is based on the assessment of qualitative memory characteristics that are retrieved and evaluated to ascribe source. For example, remembering more visual detail might lead one to conclude that the information was seen on the television and not heard from a friend.

Evidence suggests that social stereotypes, a form of semantic memory applied to a class of people (McCauley et al., 1980), can influence episodic memory decisions of source. When the qualitative characteristics of a memory are insufficient to identify the source of the memory, source decisions are influenced by different types of semantic memory information (i.e., categorical knowledge, schema, and stereotypes) including political party affiliation (Mather et al., 1999), professional affiliation (Bayen et al., 2000; Dodson et al., 2008; Hicks and Cockman, 2003; Mather et al., 1999; Sherman and Bessenoff, 1999), and personal characteristics such as gender and sexual orientation (Marsh et al., 2006).

Although there is evidence that semantic memory can aid source judgments, the mechanisms behind this process are not well understood, nor is it clear whether or not these effects are pervasive. For example, one issue of debate is whether stereotypes have automatic or conscious influences on source monitoring. Bayen et al. (2000) and Spaniol and Bayen (2002) argued that semantic information might consciously influence source decisions through guessing when episodic information is lacking. However, Hicks and Cockman (2003) reported that semantic information was used for highly confident memory decisions, when guessing is unlikely, suggesting more automatic than conscious processes. Similarly, Dodson et al. (2008) provide evidence that illusory recollection is affected when stereotypes are activated at test. Others have argued that stereotypes might have both automatic and conscious effects (Marsh et al., 2006; Sherman and Bessenoff ,1999). This debate can be informed by measures of neural activity, which can provide new evidence to help resolve different types of cognitive processing.

1.1. *Neuroscience of source monitoring*

Functional magnetic resonance imaging (fMRI) has identified several key brain regions that support source monitoring, including medial temporal lobe (MTL) structures, areas within the prefrontal cortex (PFC), and areas in the parietal lobes (see Mitchell and Johnson (2009) for a review). The evidence suggests that MTL structures are critical for binding or consolidating qualitative characteristics into complex memories and for relatively automatic reactivation of these features during remembering. PFC areas appear to support various types of monitoring processes. These processes have been described as heuristic or systematic processes that are used to evaluate activated information (Mitchell and Johnson, 2009) or as diagnostic or disqualifying monitoring (Gallo, 2010; Gallo et al., 2010). Parietal areas appear to support attention to specific features re-activated in memory (Cabeza, 2008; Cabeza et al., 2008; Mitchell and Johnson, 2009), which support the experience of recollection when features are sufficiently strong (Vilberg and Rugg, 2009).

Event-related potential (ERP) studies of source memory provide results consistent with the fMRI data. ERPs are recordings of the electrical activity of neurons at the scalp that are time-locked to the presentation of a stimulus. ERPs complement fMRI evidence because fMRI has a superior ability to localize areas that are active, whereas ERPs have superior ability to resolve millisecond changes in activity. Memory-related ERP components reflect memory processes because old and new items produce differences in ERP amplitudes ("old/new effects") that are distinguished by temporal onset (i.e., time after the test probe) and spatial location (i.e., electrodes where the effect is present or maximal). Source memory ERP studies have consistently reported an old/new difference that emerges approximately 600–800 ms after the onset of the probe and that tends to be largest at left parietal electrode sites for words (often called the "parietal old/new effect"; parietal effect hereafter; e.g., Wilding and Rugg, 1996). The parietal effect has been linked with activation in left inferior parietal cortex (Vilberg and Rugg, 2009) that supports recollection (see Rugg and Curran (2007) for a review), when task-relevant details are activated (Leynes, 2012).

Source memory studies also report a second old/new ERP difference that has a later onset (approximately 800 ms after the probe) and typically has a right-frontal distribution. Based on many ERP findings, the "right frontal effect" has been hypothesized to reflect post-retrieval processes (e.g., Mecklinger, 2000; Wilding and Rugg, 1997) or more general monitoring processes (Hayama et al., 2008) that are comparable to decision processes that are described by the SMF (Leynes and Phillips, 2008).

Some source memory studies also report a third ERP component, called the "late posterior negativity" (LPN hereafter), that is characterized by a late onset (approximately 1000 ms) and more negative ERP amplitudes for old sources relative to new with maximal differences at posterior electrode sites (see Johansson and Mecklinger (2003) for a review; Friedman et al., 2005; Herron, 2007; Leynes, 2012; Leynes, et al., 2006; Leynes and Phillips, 2008). The available evidence suggests that it reflects additional inspection of retrieved feature conjunctions that can support difficult source discriminations (Johansson and Mecklinger, 2003; Mecklinger et al., 2007), which is similar to systematic monitoring as described by the SMF (Leynes and Phillips, 2008).