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Encoding focus alters diagnostic recollection and event-related potentials (ERPs)

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ABSTRACT

The influence of encoding focus on source memory was investigated using event-related potentials (ERPs). Encoding was focused on the self (self-focus) or on the speaker (other-focus) while hearing words spoken in a male or female voice. Examination of the behavioral and ERP evidence suggests that encoding focus alters the amount of diagnostic recollection. Self-focus encoding produced more positive encoding ERPs, led to greater old/new recognition, and elicited a greater Late Positive Component (LPC; the putative neural correlate of recollection) during the source test. Other-focus encoding led to greater source memory and a smaller LPC amplitude. Collectively, the results suggest that encoding focus alters the information bound in the memory trace that leads to varying levels of source-diagnostic features. Drawing attention to the speaker facilitates binding of source-diagnostic features (i.e., voice), whereas self-focus encoding facilitates binding a host of non-diagnostic features. The results have important implications for situations that depend on encoding processes, such as false memory or classroom learning, and they provide evidence that the LPC tracks recollected details but not necessarily diagnostic recollection.

1. Introduction

Discriminating between old and new information (i.e., recognition) is a basic form of remembering that varies in memory detail. All recognition models distinguish between two experiences (i.e., recollection and familiarity) that can support accurate recognition memory; however, models differ on whether these two experiences are supported by one or two processes (e.g., Parks & Yonelinas, 2007; Wixted, 2007). Familiarity refers to a sense of oldness in the absence of any other memory detail, whereas recollection refers to remembering accompanied by specific contextual details regarding the encoding experience. One way to separate familiarity and recollection in the laboratory is to measure source memory, memory for the origin of the information. For example, participants study information with multiple features, such as male and female voices that say different words. At test, the memory for the item can be sampled with an "old or new" memory judgment (i.e., recognition) and source memory can be sampled by asking for the origin of the item (e.g., male or female voice). In this way, source memory is used to separate recollection and familiarity because accurate source memory marks instances where study details were recollected, whereas inaccurate source memory captures instances where recollection failed.

Although source memory judgments provide a more objective measure of recollection, the relationship between recollection and source memory judgments is much more complex. For example, inaccurate source judgments might also capture instances where details are recollected but these details do not provide evidence that can be used to discriminate between the sources being considered (i.e., non-diagnostic recollection). These complexities are specified in the Source Monitoring Framework (SMF; Johnson, Hashtroudi, & Lindsay, 1993; Mitchell & Johnson, 2009), which outlines the cognitive processes that are collectively used in the consolidation, re-activation, and evaluation of memories with multiple features. The quantity and quality of memory features (e.g., perceptual, semantic, affective, etc.) that are later re-activated during remembering will vary depending on a number of variables. In cases of diagnostic recollection, details that distinguish between original sources are consolidated and re-activated (e.g., auditory signatures of a deeper voice provide perceptual evidence that the source was the male voice). Non-diagnostic recollection happens when details do not distinguish between the sources being considered (e.g., thoughts of your mother triggered by the studied item, while memorable, does not distinguish between voices). The SMF also explains that accurate source judgments do not always capture recollection of all studied details because they can be supported by recollection of partial information (Dodson, Holland, & Shimamura, 1998; Hicks, Marsh, & Ritschel, 2002), familiarity (e.g., Diana,

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Yonelinas, & Ranganath, 2008; Mollison & Curran, 2012), or the absence of targeted information (Leynes, 2012; Marsh & Hicks, 1998).

Event-related potentials (ERPs) have provided important insight into recollection. ERPs provide unparalleled (millisecond) measures of cognitive processing that can be more sensitive than cognitive-behavioral measures (Luck, 2005). For example, different ERP traces have been offered as evidence that recollection can be consciously controlled depending on the testing context (e.g., Bergström, de Fockert,- & Richardson-Klavehn, 2009). Memory-related ERP components that typically contrast old item ERPs to new item ERPs (i.e., old/new differences) vary by temporal onset and scalp location. The FN400 is an ERP component largest at mid-frontal electrodes in which old ERP amplitudes are more positive than new ERPs about 300–500 ms post-stimulus. The FN400 has been correlated with familiarity (see Rugg & Curran, 2007 for a review); however, others have argued that it captures conceptual implicit memory (e.g., Voss, Lucas, & Paller, 2012). The FN400 has been observed in some studies that measure source (Addante, Ranganath, & Yonelinas, 2012; Ecker, Zimmer, & Groh-Bordin, 2007a, 2007b; Ecker, Zimmer, Groh-Bordin, & Mecklinger, 2007c; Leynes, Askin, & Landau, 2017; Mollison & Curran, 2012; Peters & Daum, 2009), but not in others (e.g., Leynes & Nagovsky, 2016; Leynes & Phillips, 2008). Accurate source judgments are consistently associated with an old/new effect (i.e., old > new) that is maximal at left parietal electrode sites for words and onsets about 500–800 ms (called the "parietal old/new effect", or Late Positive Component, LPC). The LPC is the putative correlate of recollection (Rugg & Curran, 2007; but see Voss et al., 2012 for an alternative view). The LPC is greater when specific information is targeted and activated (Bergström et al., 2009; Leynes, 2012), when more information is recollected (Vilberg & Rugg, 2009; Wilding, 2000) and when recollection is more vivid (Leynes & Phillips, 2008; Woroch & Gonsalves, 2010). Importantly, it is not present when source is based on the absence of information (Leynes, 2012), and it is smaller for inaccurate source judgments (that also elicit an FN400) presumably because recollection fails when the source is not identified (Addante et al., 2012; Leynes et al., 2017; Mollison & Curran, 2012; Peters & Daum, 2009).

Although ERPs have provided important insight into recollection, we are unaware of any direct ERP investigations of diagnostic and non-diagnostic recollection even though the influence of these recollection states (also called criterial and non-criterial recollection, Yonelinas & Jacoby, 1996) is often acknowledged when interpreting brain differences between experimental conditions (e.g., Mollison & Curran, 2012). Therefore, the purpose of the current study was to directly alter diagnostic and non-diagnostic recollection while recording event-related potentials (ERPs). In the text that follows, we briefly review logic supporting the experimental manipulation and then highlight the specific experimental predictions.

Recollection often encompasses memories that contain two or more features bound together into a memory trace. Encoding tasks can direct attention to different features and influence the kind of features that are ultimately bound in memory (Johnson et al., 1993). Consequently, encoding tasks can promote binding different features that, later, alter the balance of diagnostic and non-diagnostic recollection (e.g., Johnson, Nolde, & De Leonardis, 1996; Mather, Johnson, & De Leonardis, 1999). In these studies, participants listened to two speakers (e.g., man or woman) making statements. Encoding tasks directed participants to focus on either how the *speaker* felt about the statements (other-focus condition) or how *they* felt about what the speaker was saying (self-focus condition). These studies found that self-focus encoding either enhanced (Johnson et al., 1996; Experiments 1 and 2; Mather et al., 1999) or did not alter recognition (i.e., item) memory (Johnson et al., 1996; Experiment 3) as compared with the other-focus encoding. Alternatively, the other-focus condition facilitated source judgments. Johnson et al. (1996) explained that other-focus facilitated binding of the item and voice to improve speaker source judgments (diagnostic recollection). While self-focus generally improved feature binding, focusing on oneself diverted attention away from source-specifying details (non-diagnostic recollection). This dissociation between item recognition and source memory produced by encoding focus is an important key to observing a shift in the balance of diagnostic and non-diagnostic recollection.

Several other studies have investigated the role of "self-referencing" in remembering, and these studies typically report that both recognition and source is greater following self-referencing (i.e., self-focus) encoding (e.g., Dulas, Newsome, & Duarte, 2011; Hamami, Serbun, & Gutchess, 2011; Leshikar & Duarte, 2011; Leshikar, Dulas, & Duarte, 2015; Serbun, Shih, & Gutchess, 2011). The different pattern of effects across these studies could be attributed to the specific encoding tasks, the source memory measures, or a combination of these two variables. More specifically, the "self-external" (Dulas et al., 2011; Leshikar & Duarte, 2011; Leshikar et al., 2015) and object estimation (Hamami et al., 2011; Serbun et al., 2011) encoding tasks do not target the emotion of another, external source (e.g., speaker) that Johnson et al. (1996) argued was crucial to fully embed the item in the external source and improve source memory (diagnostic recollection). Encoding processes that lack this full contextualization "will reduce encoding of potentially relevant source information" (Johnson et al., 1993, p. 5).[1] In addition to key encoding differences, the self-referencing studies quantify source memory in a number of different ways, whereas Johnson et al. (1996) analyzed conditional source scores (i.e., proportion of correct source judgments given that the item was identified as old) to control for baseline differences in old/new recognition. While the exact factor producing the different pattern across studies is not known, focusing on the speaker's emotion consistently improves source monitoring, relative to self-focus encoding, when overall differences in recognition have been controlled (Johnson et al., 1996; Leynes- & Nagovsky, 2016; Mather et al., 1999).

1.1. Study purpose

The current study was modeled after those that manipulated encoding focus while listening to words spoken from two different speakers (Johnson et al., 1996; Leynes & Nagovsky, 2016; Mather et al., 1999). One encoding task focused participants on how much they liked the word (self-focus condition), whereas the other task focused on how much the speaker liked the word (other-focus condition). At test, they were prompted to make a source judgment of whether the male or female voice spoke the word while ERPs were recorded. Encoding focus was expected to change the balance of non-diagnostic recollection (greater for self-focus encoding) and speaker-diagnostic recollection (greater for other-focus encoding).

Because diagnostic and non-diagnostic recollection was expected to vary according to encoding focus, the primary hypotheses concerned the ERP correlate of recollection (i.e., LPC). To our knowledge, there are only two ERP studies that have manipulated encoding focus in this manner. Dulas et al. (2011) compared "self-referential" encoding to a "self-external" condition. They found self-focus encoding led to better item and source memory, presumably because the self-external condition did not promote the full contextualization of the item (i.e., object) and source (i.e., encoding task). They did not report any FN400 or LPC differences as a function of encoding focus, which suggests the LPC was not sensitive to memory details in this experiment. These results differ from studies that have reported LPC amplitude variations based on the amount (Vilberg & Rugg, 2009; Wilding, 2000) or vividness of recollection (Leynes & Phillips, 2008; Woroch & Gonsalves, 2010). They also differ from a study that manipulated encoding focus for two

[1] It is important to point out that whether information is diagnostic or non-diagnostic will depend on the specific parameters of the source discrimination. Because self-focus encoding increases recollection in general, it is likely that additional details will be useful for specifying source in some testing contexts. This is probably why the self-referencing literature has produced several examples of self-focus encoding increasing item and source memory. However, self-focus encoding does not appear to bind features that aid judgments of a speaker's voice.