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# Perceptual priming enhances the creation of new episodic memories

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**Abstract**

In recent years, most studies of human memory systems have placed the emphasis on differences rather than on similarities. The present study sought to assess the impact of perceptual priming on the creation of new episodic memories. It was composed of three distinct experimental phases: (1) an initial study phase, during which the number of repetitions of target words was manipulated; (2) a perceptual priming test phase, involving both target and new control words, which constituted the incidental encoding phase of (3) a subsequent Remember/Know/Guess recognition task. Results showed that the greater the perceptual priming at encoding, the more the episodic memory performance was enhanced, whereas no such relation was found for know judgments or feeling of familiarity. Furthermore, the words that were associated with the creation of new episodic memories had been perceptually primed to a greater extent during the incidental encoding phase than the words that were subsequently judged to be known or forgotten. These results suggest that the perceptual contents of episodic memories are constituted by the very perceptual representations that generate priming effects. Potential mechanisms linking perceptual priming to the creation of episodic memories are discussed.


*Keywords:* Implicit and explicit memories; Perceptual priming; Episodic memory; Remember/Know

## 1. Introduction

One of the most fundamental advances in the study of human memory in recent years has been the distinction between implicit and explicit memory phenomena (Graf & Schacter, 1985; Schacter, 1987). Implicit memory has been defined as the expression of past experiences occurring beyond the boundaries of consciousness and without any intentional recollection. Priming is one of the most well-known implicit memory phenomena and refers to a change in the speed or accuracy with which a stimulus is processed, following prior experience of the same or related stimulus. Different kinds of priming have been identified, such as perceptual priming, which is based on the stimuli's physical properties (Tulving & Schacter, 1990). By contrast, explicit memory entails the conscious recollection of previously studied information. The Remember/Know procedure

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(Gardiner, 1988; Tulving, 1985) is intended to gauge states of consciousness associated with memory retrieval. As such, it constitutes a sound approach to autonoetic consciousness and noetic consciousness respectively (for a review, see Gardiner, 2001; Tulving, 2001).

Numerous studies of behavioral, neuropsychological and neuroimaging dissociations (for a review, see Gardiner, 2001; Roediger & McDermott, 1993; Schacter & Buckner, 1998; Schacter, Dobbins, & Schnyer, 2004; Wheeler & Buckner, 2004; Yonelinas, 2002) have demonstrated that these three distinct memory expressions (perceptual priming, knowing and remembering) rely on three distinct memory systems, namely the perceptual (Tulving & Schacter, 1990; see also Schacter, 1990, 1992, 1994), semantic and episodic memory systems (Tulving, 1995, 2001, 2002; Tulving & Markowitsch, 1998). While these memory systems overlap to a certain extent, they differ in their processing characteristics, representations and neural substrates (Schacter & Tulving, 1994). However, rather than being the expression of two distinct processes or memory systems, it has been suggested that Remember/Know behavioral dissociations may actually reflect variations in a response criterion/decision process along the continuum of a single memory trace (one-dimensional model) that can be modeled on the basis of signal detection (SD) theory (e.g., Donaldson, 1996; Hirshman & Master, 1997). Even if some data on the receiver operating characteristics (ROCs) have questioned this model (e.g., Rotello, Macmillan, & Reeder, 2004), it may nonetheless be worthwhile assessing this one-dimensional SD account if only to discard a potential explanation based on decision processes (Hirshman, Lanning, Master, & Henzler, 2002; Hirshman & Master, 1997).

Tulving (1995, 2001) has given us a powerful model to explain the functional relations between memory systems, which he calls the serial-parallel-independent (SPI) model. This states that although the encoding of information occurs serially, moving from perceptual to semantic and then to episodic memory, distinct information is stored in each system and information can be retrieved from one system independently of the other systems. However, little is known about the role of perceptual priming and, consequently, about the contribution of perceptual representations to the creation of episodic memories. These considerations lead us to the unsolved question of whether episodic memory creation relies on perceptual representations stored in perceptual memory—representations which also subtend perceptual priming.

On the one hand, there is substantial evidence to show that perceptual priming and explicit memory rely on distinct neural substrates and representations. Whereas amnesic patients demonstrate intact perceptual priming despite explicit memory impairment (for a review, see Schacter & Buckner, 1998), Gabrieli, Fleischman, Keane, Reminger, and Morrell (1995) reported the case of a patient with a right occipital lobe lesion who presented the reverse dissociation. In an fMRI study using a priming paradigm adapted from the word-stem completion task, Schott et al. (2006) found that activity while encoding words in perceptual memory occurred in regions involved in perception and identification, whereas activity during explicit memory encoding occurred in the bilateral medial temporal lobe and left prefrontal cortex, but not in those regions involved in perceptual priming.

On the other hand, there is growing evidence to suggest that implicit and explicit memory share common resources and representations, and interact at encoding. Those regions involved in processing perceptual information that are believed to support perceptual priming are also thought to be involved in the formation and recollection of memories (e.g., Wheeler, Petersen, & Buckner, 2000; Woodruff, Johnson, Uncapher, & Rugg, 2005; for a review, see Buckner & Wheeler, 2001; see also Johnson & Chalfonte, 1994; Moscovitch, 1994). Using fMRI, Turk-Browne, Yi, and Chun (2006) recently found that subsequently remembered scenes were associated with greater neural and behavioral priming during encoding than subsequently forgotten ones (see also Kirchhoff, Wagner, Maril, & Stern, 2000). These authors posit that implicit and explicit memory may share factors and representations at encoding but rely on different retrieval mechanisms. However, in their study, explicit memory was assessed in the form of a high-/low-confidence judgment which does not necessarily imply the presence of episodic memory (Gardiner, 2001). Moreover, as all the items were repeated twice, it was impossible to assess a single episodic memory trace.

The present study sought to assess the impact of perceptual priming on the creation of new episodic memories. The idea was to prompt the encoding of unique events in episodic memory that had been perceptually primed to a greater or lesser degree during an incidental encoding phase. To achieve this, the experiment was divided into three distinct phases (see Fig. 1): (1) an initial study phase consisting of a perceptual phonological processing, during which verbally presented target words were heard either once or three times; (2) a priming