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Levels of processing and the cue-dependent nature of recollection

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ABSTRACT

Dual-process models differentiate between two bases of memory, recollection and familiarity. It is routinely claimed that deeper, semantic encoding enhances recollection relative to shallow, non-semantic encoding, and that recollection is largely a product of semantic, elaborative rehearsal. The present experiments show that this is not always the case. In four experiments, the rhyme recognition test was adapted to two popular assessments of recollection (the Remember-Know technique and the process-dissociation procedure). The rhyme recognition test provides a better match to a non-semantic (phonological) encoding condition than to the semantic encoding condition. The experiments revealed a consistent reversal of the usual levels-of-processing effect, such that the measures of recollection were higher for the non-semantic than semantic encoding condition (the familiarity measures registered no differences between encoding conditions). This indicates that unqualified statements about particular encoding conditions producing recollection are not well founded. More generally, the results underscore the cue-dependent nature of recollection and transfer-appropriate-processing analyses of recollection.

Introduction

Modern research on memory differentiates between recollection, characterized as the conscious re-experience of a prior event marked by the retrieval of context-specifying information, and familiarity, an a-contextual bases of memory often attributed to the fluent re-processing of stimuli. Such dual process analyses have proven very influential over the past 30 years and an extensive body of behavioral and neuroscience research is taken as evidence for this distinction (Yonelinas, 2002). Substantial research has been directed at delineating the characteristics of recollection by determining what factors produce high levels of recollection. Related research assesses the extent to which various encoding effects are mediated by recollection vs. familiarity. Such complementary studies relate the distinction between recollection and familiarity to well-known memory phenomena and help embed these effects in the dual process framework.

One traditional encoding manipulation that has been extensively investigated in terms of the dual process model is levels-of-processing, in which study items are processed under deep (semantic) or shallow (non-semantic) encoding instructions. It has long been known that deep encoding can enhance later recall and recognition (Craik & Tulving, 1975). In terms of the dual process model, semantic encoding has been repeatedly shown to enhance the recollective basis of memory as measured by all the typical assessments.

One popular measure of recollection is based on the Remember-Know (RK) procedure, which was designed to shed light on the phenomenological states thought to underlie recognition (e.g., Gardiner, 1988; Skinner & Fernandes, 2009). In this procedure, when items on a recognition test are judged as old, participants also render an *R* response if they can consciously recollect details about the item's study presentation or a *K* response if they know that the item was presented earlier but do not recollect specific details (these choices are sometimes

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supplemented with a *G*, or guess, response). According to the usual (dual process) interpretation, *R* responses are assumed to reflect recollection and *K* responses (or an appropriate transformation, see Yonelinas (2002) for details) are assumed to reflect familiarity. Using this procedure, researchers have consistently reported that deep, semantic encoding conditions yield more *R* responses than shallow, non-semantic encoding conditions, supporting the conclusion that deep encoding enhances recollection (e.g., Bisby, Leitz, Morgan, & Curran, 2010; Bodner & Lindsay, 2003; d'Ydewalle & van Damme, 2007; Gardiner, 1988; Gardiner, Java, & Richardson-Klavehn, 1996; Java, Gregg, & Gardiner, 1997).

Another technique designed to measure the dual processes is the process-dissociation procedure (PDP) (Jacoby, 1991, 1998). This technique entails model-based measurement in which parameters for familiarity and recollection are estimated from performance on experimental tasks (to be explained in detail in the introduction to Experiment 4). In this procedure, the recollection parameter is largely based on the ability to discriminate the memorial source of an item. Examinations of levels-of-processing using the PDP show that recollection estimates are consistently greater for deep than shallow encoding (e.g., Cohn, Moscovitch, & Davidson, 2010; d'Ydewalle & van Damme, 2007; Horton, Wilson, Vonk, Kirby, & Nielsen, 2005; Newell & Andrews, 2004; Richardson-Klavehn, Gardiner, & Ramponi, 2002; Toth, Reingold, & Jacoby, 1994). It should be noted that there is debate regarding whether levels-of-processing impacts familiarity (e.g., as measured in the PDP or RK procedure), with some studies showing no effect of levels-of-processing on familiarity and others finding significant effects sometimes favoring semantic encoding and other times favoring non-semantic encoding (see Richardson-Klavehn et al., 2002; Yonelinas, 2002). Most critical for present purposes, however, is the consistent agreement that deep encoding enhances recollection by all extant measures.

The notion that deep encoding enhances recollection is also embedded in the ways that the levels-of-processing variable is used in memory research. For example, in research on implicit memory, levels-of-processing is sometimes used as a marker variable. The logic is that if a purported implicit test demonstrates a significant levels-of-processing effect, this may indicate that the test has been compromised by explicit, recollective retrieval strategies (Roediger & McDermott, 1993). Likewise, the presence of a levels-of-processing effect on *R* responses in the RK procedure has been taken as evidence that the *R* instructions have been correctly implemented by the researcher and understood by the subject (e.g., Bodner & Lindsay, 2003; Gardiner, 1988). Finally, the idea that levels-of-processing affects recollection has also formed the basis of attempts to measure the neural correlates of recollection. For example, in studies by Rugg and colleagues (Henson, Hornberger, & Rugg, 2005; Rugg, Mark, et al., 1998; Rugg, Walla, et al., 1998; see also Paller, Kutas, & McIsaac, 1995), recollection was operationally defined by contrasting recognition memory for items that had previously been deeply vs. shallowly encoded. The neural correlates of recollection were taken as the differences in ERP or fMRI measures of brain activity between these two types of trials.

This consensus opinion, that semantic encoding produces greater recollection, can be found in any number of papers on this topic: "Deep encoding leads to better recollection than shallow encoding" (Thoma, Schwarz, & Daum, 2010, p. 7); "... differences in recollection emerge only when participants encode the stimuli semantically ... consistent with the notion that recollection depends strongly on conditions that promote rich and elaborative encoding." (Ghetti & Angelini, 2008, p. 354); "depth of processing affects especially recollection mechanisms" (Marzi & Viggiano, 2010, p. 247); "conscious recollection can be affected by manipulations in the levels of processing at encoding" (Bisby et al., 2010, p. 73); "The idea that deep processing of words leads to more distinctive recollections than shallow processing can explain many findings" (Gallo, Meadow, Johnson, & Foster, 2008). Richardson-Klavehn et al. (2002, p. 350) state that with regard to the dual-process model "level of processing has become something of a gold standard" with "very well-known effects ... on recollective experiences". Yonelinas (2002, p. 457), in a review of research on the dual process model, concludes that "Processing the meaning of a stimulus (e.g., is the word concrete or abstract?) compared to processing perceptual aspects of a stimulus (e.g., is the word in upper or lower case?) at time of study leads to an increase in recollection." These views are virtually always stated without qualification.

So, is it the case that deep encoding enhances recollection, or alternatively stated, that recollection is a product of deep, elaborative encoding? A consideration of research specifically designed to assess the construct of recollection would indicate so but a consideration of early research on levels of processing suggests that this may not always be the case. In particular, the concept of transfer-appropriate processing (TAP) originated from the question of whether deep encoding necessarily produces superior memory compared to shallow encoding. Morris, Bransford, and Franks (1977) argued that encoding conditions do not dictate memorial outcomes but rather that memory performance is a product of the match between encoding and retrieval processes. In the TAP tradition, it is questionable to claim that superior memory of any sort is due to encoding conditions without reference to the retrieval processes invoked by the memory test. In the same vein, the effect of levels-of-processing on recollective aspects of retrieval may be dictated not simply by the form of encoding but by the match between encoding and retrieval. This match may be experimentally manipulated by the nature of the retrieval task.

The present study examines the extent to which deep encoding enhances recollection, using traditional measures of recollection found in the dual process literature, combined with varying types of retrieval tasks derived from the original TAP research (Morris et al., 1977). Before moving onto the experiments, it should be noted that techniques designed to assess recollection have been the subject of substantial debate. For example, the typical dual-process interpretation of Remember-Know responses has been subjected to an alternate interpretation based on