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Midazolam amnesia and dual-process models of the word-frequency mirror effect☆

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Abstract

The word-frequency mirror effect (Glanzer & Adams, 1985) is the finding that subjects are more accurate on low frequency words than high frequency words for old and new items in recognition memory. Recently, several theorists (Guttentag & Carroll, 1997; Joordens & Hockley, 2000; Reder et al., 2000) have proposed dual-process accounts of the word-frequency mirror effect. These accounts hypothesize that the low frequency advantage on old items arises from increased recollection of these items, while the low frequency advantage on new items arises from reduced familiarity of these items. We tested these views using midazolam amnesia. Midazolam is a safe, fast-acting benzodiazepine that produces a dense anterograde amnesia. Based on the hypothesis that midazolam amnesia should have larger effects on recollection than familiarity, we predicted that: (1) old high frequency words should have an advantage over old low frequency words in a midazolam condition (i.e., the traditional effect should reverse); and (2) the traditional advantage of new low frequency words over new high frequency words should replicate in a midazolam condition. Both predictions of the dual-process approach were confirmed. Additional analyses demonstrated that a single-process signal detection model could not account for the current results and that midazolam amnesia produces a larger effect on recollection processes than on familiarity processes.

Keywords: Recognition memory; Mirror effect; Dual-process models; Word frequency; Midazolam; Amnesia; Benzodiazepines

Classical dual-process models of recognition memory (Atkinson & Juola, 1973; Humphreys & Bain, 1983; Jacoby & Dallas, 1981; Mandler, 1980) posit that two processes contribute to recognition memory performance. One process is assumed to produce a general feeling of familiarity, while the second process is assumed to produce specific recollections of prior experiences. Differential

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retrieval dynamics (Atkinson & Juola, 1973; Mandler, 1980) and informational bases (Humphreys & Bain, 1983; Jacoby & Dallas, 1981; Mandler, 1980) are also ascribed to these two processes. Dual-process models are often contrasted to single-process models (Hintzman, 1988; Hirshman & Henzler, 1998) that assume memory retrieval processes generate a uni-dimensional familiarity or memory strength value as the basis for memory judgments.

There have been significant methodological and empirical developments of dual-process models in the last decade. These developments include: the use of measurement procedures to produce quantitative estimates of the influence of recollection and familiarity (Jacoby, 1991); the use of self-report techniques to identify the functional determinants of recollective experience (Gardiner, 1988); the presentation of evidence, suggesting that a recall-like process is used to reject distracters in recognition memory (Hintzman & Curran, 1994); the use of analyses of receiver-operating characteristic curves to identify the joint effects of recollection and familiarity (Yonelinas, 1994); and the identification of brain processing correlates of the hypothesized familiarity and recollection processes (Curran, 2000; Henson, Rugg, Shallice, Josephs, & Dolan, 1999; Wan, Aggleton, & Brown, 1999). (See Curran & Hintzman (1997), Donaldson (1996), Glanzer, Hilford, Kim, & Adams (1999a), Glanzer, Kim, Hilford, & Adams, 1999b, Gruppuso, Lindsay, & Kelley (1997), Hirshman & Master (1997), Mulligan & Hirshman (1997), Postma (1999), Ratcliff, Van Zandt, & McKoon (1995), and Rotello & Heit (1999), among others, for commentaries on these approaches.)

Dual-process accounts of the word-frequency mirror effect

Recently, several theorists (Guttentag & Carroll, 1994; Joordens & Hockley, 2000; Reder et al., 2000) have applied dual-process theories to the word-frequency mirror effect. The mirror effect (Glanzer & Adams, 1985; Glanzer et al., 1999b; Hilford, Glanzer, & Kim, 1997) is the finding that stimulus variables or processing manipulations that enhance hit rates on old items simultaneously reduce false alarms on new items. Glanzer and his colleagues have demonstrated that mirror effects occur for a broad range of materials and processing variables. In the case of word frequency, the mirror effect occurs when hit rates are higher for old low frequency words and false alarm rates are lower for new low frequency words. Dual process theorists (Guttentag & Carroll, 1994; Joordens & Hockley, 2000; Reder et al., 2000) have hypothesized that differences in recollection between low and high frequency words produce the low frequency hit advantage, while differences in familiarity produce the low frequency false alarm advantage.

To review one specific approach, Reder et al. (2000) have applied the Source of Activation Confusion (SAC) model to the word-frequency mirror effect. SAC incorporates the hypothesis that the activation of concept nodes and the activation spreading from concept nodes to episode nodes influence recognition memory performance, with higher activation levels producing "old" responses (see Reder et al., 2000, Fig. 1). The activation of a concept node is assumed to produce general feelings of familiarity, while sufficient (i.e., threshold) activation of an episode node by a concept node is assumed to produce recollective experience. In this theory, activation of concept nodes, and the correlated familiarity-based response, is lower for low frequency words because base-rate activation of a concept node is an increasing function of prior presentation. In contrast, the activation of episode nodes by concept nodes, and the correlated recollection-based responding, is higher for low frequency words because activation spread from a concept node to an episode node is a decreasing function of the prior episodes in which an item appears (i.e., presentations).

Reder et al. (2000) tested their approach using the Remember–Know paradigm (Gardiner, 1988). In this paradigm, subjects give a report of the subjective state associated with a recognition memory judgment. "Remember" responses are hypothesized to reflect conscious recollections, while "know" responses are hypothesized to reflect feelings of familiarity. Given their hypothesis that high frequency words (old or new) have greater familiarity than low frequency words, Reder at al. generated the novel prediction that both old and new high frequency words would produce more "know" responses than corresponding low frequency words. These predictions were confirmed across three experiments.

Studies by Joordens and Hockley (2000) provided converging evidence for Reder et al.'s (2000) conclusion that two processes mediate the word-frequency mirror effect. Joordens and Hockley (2000) explored the relationship between the word