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Journal of Memory and Language 49 (2003) 231–248
Journal of Memory and Language
www.elsevier.com/locate/jml

A dual-process account of the list-length and strength-based mirror effects in recognition☆

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Received 20 June 2002; revision received 30 September 2002

Abstract

Manipulating either list length (e.g., few vs. many study items) or encoding strength (e.g., one presentation vs. multiple presentations of each study item) produces a recognition mirror effect. A formal dual-process theory of recognition memory that accounts for the word-frequency mirror effect is extended to account for the list-length and strength-based mirror effects. According to this theory, the hit portions of these mirror effects result from differential ease of recollection-based recognition, and the false alarm portions result from differential reliance on familiarity-based recognition. This account yields predictions for participants' Remember and Know responses as a function of list length and encoding strength. Empirical data and model fits from four experiments support these predictions. The data also demonstrate a reliable list-length effect when several potential confounding factors are controlled, contributing to the debate regarding the effect of list length on recognition.

Keywords: Memory; Word recognition; Mirror effects; Encoding strength; List length

At one level of description, theories of recognition memory can be classified as either single- or dual-process. Some theorists posit that recognition performance is based on a single process, such as familiarity (e.g., Gillund & Shiffrin, 1984; Glanzer, Adams, Iverson, & Kim, 1993; Hintzman, 1988; McClelland & Chappell, 1998; Murdock, 1997; Shiffrin & Steyvers, 1997), while others posit that recognition performance is based on two processes, such as familiarity and recollection[1] (e.g., Jacoby, 1991; Jacoby & Dallas, 1981; Mandler, 1980; Reder et al., 2000; Yonelinas, 1994, 1999). Regardless of theoretical orientation, a complete theory of recognition memory must account for mirror effects (Glanzer & Adams, 1985). A mirror effect is said to occur when one experimental condition elicits more hits and fewer false alarms than another condition. The mirror effect that has probably received the most attention is the word-frequency mirror effect, in which words with a low normative frequency have a higher hit rate and a lower false alarm rate than words with a high normative

☆ This work was supported by Grants 5-T32-MH19983, 2-R01-MH52808, and T32-MH19102 from the National Institute of Mental Health. We thank Vincent Stretch and John Wixted for providing the Remember and Know data from their (1998) Experiment 1. We also thank Jason Arndt for his insightful comments on previous versions of this manuscript. Portions of these data were presented at the 42nd Annual Meeting of the Psychonomic Society, Orlando, FL.

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[1] In contrast to current single- and dual-process models, Kelley and Wixted (2001) have recently proposed a model in which recollective (i.e., associative) information and familiarity-based (i.e., item) information are summed to produce one strength-of-evidence variable that is used to make a recognition decision.

0749-596X/03/$ - see front matter
doi:10.1016/S0749-596X(03)00061-5

frequency (e.g., Glanzer & Adams, 1985, 1990). Recently, Reder et al. (2000) proposed and found support for a formal dual-process account of the word-frequency mirror effect embedded within the Source of Activation Confusion (SAC) theory of memory. Using the same framework, they suggested accounts for the list-length and strength-based mirror effects, but did not test them. In this paper we examine whether such dual-process explanations of these two mirror effects are adequate.

The list-length effect refers to the finding that items from a longer list are recognized more poorly than items from a shorter list (e.g., Strong, 1912). Currently, there is debate as to whether this effect truly exists. Several studies have shown an effect of list length on recognition (e.g., Gillund & Shiffrin, 1984; Gronlund & Elam, 1994; Murnane & Shiffrin, 1991; Ohrt & Gronlund, 1999; Ratcliff, Clark, & Shiffrin, 1990; Ratcliff & Murdock, 1976; Strong, 1912), and the occurrence of a list-length effect has been widely accepted and considered a touchstone for models of recognition memory. However, some researchers have suggested that the list-length effect may be the result of confounds, such as retention interval, rather than list length (Dennis & Humphreys, 2001; Murdock & Kahana, 1993). To examine this alternative account of the list-length effect, Ohrt and Gronlund (1999) manipulated list length and controlled for retention interval, the number of items between study and test, the number of items scored, and the study position of tested items. Even with all of these controls, they found a reliable effect of list length on recognition, suggesting that the list-length effect is not simply an experimental artifact. In contrast, Dennis and Humphreys (2001) recently conducted a very controlled investigation of list length and found no reliable list-length effect. This issue will be addressed in our third experiment, in which we implement the same controls as Dennis and Humphreys and find a reliable effect of list length on recognition. Therefore, we consider the list-length effect to be a real recognition memory phenomenon and explore it as such.

The list-length effect is often examined in terms of overall performance measures, such as d' (e.g., Gillund & Shiffrin, 1984; Ohrt & Gronlund, 1999; Ratcliff et al., 1990). However when one examines the hit and false alarm patterns a *list-length mirror effect* is observed: There is a higher hit rate and lower false alarm rate for short lists than for long lists (see e.g., Murnane & Shiffrin, 1991; Ratcliff & Murdock, 1976).

Manipulating encoding strength also produces a mirror effect. Encoding strength is typically manipulated by varying either the presentation time for a single presentation of each item or the number of experimental presentations of each item. Overall, recognition is better for items from a strong encoding condition than for items from a weak encoding condition (e.g., Ratcliff et al., 1990). Underlying this effect is a *strength-based mirror effect* of more hits and fewer false alarms for the strong condition than for the weak condition (e.g., Murnane & Shiffrin, 1991; Stretch & Wixted, 1998).

The dual-process perspective has been shown to be beneficial in explaining the traditional word-frequency mirror effect (Joordens & Hockley, 2000; Reder et al., 2000). Additionally, this perspective has been used to predict conditions under which a word-frequency mirror effect should or should not occur. By manipulating factors that presumably affect the ease of recollection-based recognition, Joordens and Hockley (2000) created conditions under which a word-frequency mirror effect did not occur. Their results indicate that recollection, as well as familiarity, is important in producing the word-frequency mirror effect. Further, their results provide support for the influence of recollection in recognition.

A central goal of this paper is to test the adequacy of a dual-process account of the list-length and strength-based mirror effects in recognition. We do so by using a theory that has been developed to account for the word-frequency mirror effect. Although our goal is to make generalizations and conclusions concerning a class of dual-process theories, we focus on the SAC theory of memory (e.g., Reder et al., 2000) as a formally specified, computationally implemented example of this class. SAC accounts for patterns of Remember and Know responding as well as hit and false alarm patterns. The distinction between Remember and Know judgments refers to participants' classification of Old responses into those for which they can recollect a particular experience associated with the item (leading to a Remember response) and those for which the decision was based on a feeling of familiarity in the absence of recollection (leading to a Know response). From a dual-process perspective, it is especially useful to examine Remember and Know judgments in recognition memory tests, because they are presumably associated with the two processes that most dual-process theories claim people use to recognize a word, and, thus, they provide a converging measure or additional test of many dual-process theories.

In addition to offering a dual-process account of two mirror effects, we derive and test several predictions concerning the patterns of Remember and Know responses that underlie these effects. We test these predictions by presenting and simulating data from three new experiments and analyzing previously unreported data from a study by Stretch and Wixted (1998, Experiment 1). To our knowledge, this is the first study to examine Remember and Know responses as a function of list length or encoding strength. Moreover, we test for the presence of a list-length effect when several potential confounding factors are controlled.