

The consequences of differentiation in episodic memory: Similarity and the strength based mirror effect [☆]

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Abstract

When items on one list receive more encoding than items on another list, the improvement in performance usually manifests as an increase in the hit rate and a decrease in the false alarm rate (FAR). A common account of this strength based mirror effect is that participants adopt a more strict criterion following a strongly than weakly encoded list (e.g., Cary & Reder, 2003; Stretch & Wixted, 1998). Differentiation models offer an alternative: more encoding leads to a more accurate memory representation for the studied item. A more accurate representation is less confusable with an unrelated item, resulting in a decrease in the FAR (McClelland & Chappell, 1998; Shiffrin & Steyvers, 1997). Differentiation models make additional predictions about reversals in FARs for foils similar to a studied item as a function of the composition of the study list. These predictions were empirically tested and confirmed.

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When some manipulation results in two different levels of performance in a recognition memory task, the different levels of performance are typically expressed as a mirror pattern (e.g., Glanzer & Adams, 1985). That is, the probability of correctly claiming that a target item was studied (i.e., hit rate, HR) mirrors the probability of erroneously claiming that a foil item was studied (i.e., false alarm rate, FAR). Mirror effects are ubiquitous and have been observed for normative word frequency, part of speech, word concreteness, rated typicality, known versus unknown scenes, and several other manipulations (e.g., Dobbins & Kroll, 2005; Glanzer & Adams, 1985, 1990;

Hockley, 1994; Stretch & Wixted, 1998; Vokey & Read, 1992). The focus of this research is the strength based mirror effect where different levels of performance are obtained by manipulating encoding time. For example, suppose one group of participants studies each item once (weak list) and another group studies each item five times (strong list). The strong list tends to produce both higher HRs and lower FARs than the weak list. The strength based mirror effect has been the focus of much recent discussion and has been observed when strength is manipulated by study time or by repetition and for both single item and associative recognition (e.g., Cary & Reder, 2003; Hockley & Niewiadomski, in press; Kim & Glanzer, 1993; Stretch & Wixted, 1998).

The simple fact that participants are better to identify an item that received more encoding is not too surprising. Of more theoretical interest is why the FAR changes

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between the two conditions. Why should encoding conditions affect the response to items that were not on the study list? The most common answer is that the participant adopts a more stringent criterion for calling an item “studied” following a strong list than following a weak list. For example, many assume that recognition memory can be thought of as a case of signal detection theory (SDT; Benjamin & Bawa, 2004; DeCarlo, 2002; Dobbins & Kroll, 2005; Dunn, 2004; Green & Swets, 1966; Morrell, Gaitan, & Wixted, 2002; Stretch & Wixted, 1998; Verde & Rotello, in press). In this framework, the subjective response (also referred to as familiarity, strength, or global match) to targets and foils can be represented by two overlapping normal distributions as illustrated in Fig. 1. Participants select some criterion and any item evoking a subjective response greater than the criterion is called “studied” while other items are called “not studied.” Additional study increases the mean of the target distribution, hence the increase in the HR. However, the foil distribution does not change as a function of encoding conditions, evident in the single foil distribution in Fig. 1. Within this framework, the only way to change the FAR as a function of the strength of the study list is to assume a change in the criterion. In the figure, the criterion for the weak list is shown as a solid line and the more stringent criterion for the strong list is shown as a dashed line.

The preceding discussion refers to a single process model where a recognition memory decision is based on the overall familiarity of the test item. Dual process models assume two different retrieval routes and the decision can be based on either route. For example, in the Source of Activation Confusion model (SAC),

HRs are based on recollecting the details of the study event and FARs are based on the pre-experimental familiarity of the test item (Reder et al., 2000). Additional study time improves the ability to recollect and increases the HR. However, the pre-experimental strength of the item is not affected by the study list. In order to account for a reduced FAR in the strong list, Cary and Reder (2003) assume a criterion shift. Thus, both single process (e.g., Stretch & Wixted, 1998) and dual process models (e.g., Cary & Reder, 2003) attribute the strength based mirror effect to a change in the criterion between lists. Indeed, all models require a criterion for responding “old” and could adopt the criterion change assumption to account for the strength based mirror effect.

Differentiation models provide an alternate account, one that is not dependent on strategic criterion shifts, but is a natural consequence of the encoding process. In these models, additional experience with an item in a given context results in updating a single memory trace. The more accurate a memory trace, the less similar it is to unrelated items. Thus, the match between an unrelated foil and episodic memory is lower following a strong list than a weak list. There are two important differences between the criterion placement account and the differentiation account of the strength based mirror effect. In the former, the effect results from the *decision* process and might be influenced by external pressures such as costs and rewards, instructions given by the experimenter, age of participants, emotional valence of the stimuli, etc. In the differentiation account, the phenomenon naturally follows from the *encoding* process and should not be subject to the whims of the

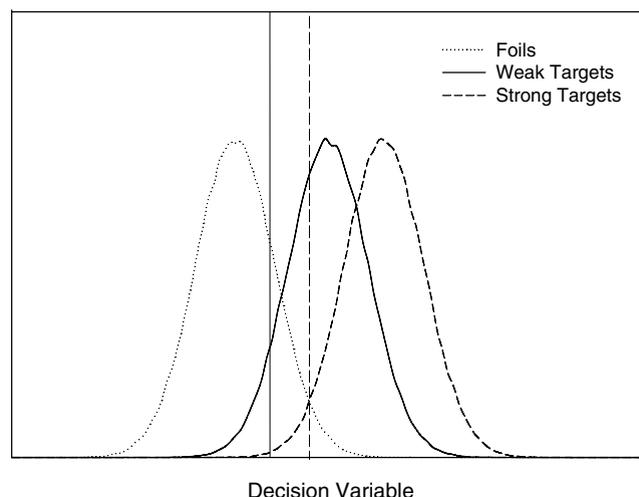


Fig. 1. An example of a signal detection theory account of the strength based mirror effect. The foil distribution is fixed regardless of the encoding conditions but the criterion changes between the two lists producing a lower FAR for the strong compared to the weak list. The dashed line is the criterion for the strong list and the solid line is the criterion for the weak list.

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