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Recognition memory: A review of the critical findings and an integrated theory for relating them

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Abstract

The development of formal models has aided theoretical progress in recognition memory research. Here, I review the findings that are critical for testing them, including behavioral and brain imaging results of single-item recognition, plurality discrimination, and associative recognition experiments under a variety of testing conditions. I also review the major approaches to measurement and process modeling of recognition. The review indicates that several extant dual-process measures of recollection are unreliable, and thus they are unsuitable as a basis for forming strong conclusions. At the process level, however, the retrieval dynamics of recognition memory and the effect of strengthening operations suggest that a recall-to-reject process plays an important role in plurality discrimination and associative recognition, but not necessarily in single-item recognition. A new theoretical framework proposes that the contribution of recollection to recognition depends on whether the retrieval of episodic details improves accuracy, and it organizes the models around the construct of efficiency. Accordingly, subjects adopt strategies that they believe will produce a desired level of accuracy in the shortest amount of time. Several models derived from this framework are shown to account the accuracy, latency, and confidence with which the various recognition tasks are performed.

Keywords: Recognition; Memory; Memory models

1. Introduction

The nature of recognition memory has been hotly debated (e.g., Macmillan & Rotello, 2006; Malmberg, Holden, & Shiffrin, 2004; Murdock, 2006; Park, Reder, & Dickison,

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2005; Rotello, Macmillan, & Reeder, 2004; Parks & Yonelinas, 2007; Wixted, 2007), and several reviews have recently appeared (Diana, Reder, Arndt, & Park, 2006; Dunn, 2004; Wixted & Stretch, 2004; Yonelinas, 2002). The main questions are whether recognition is based on one random variable or two random variables and whether these variables differ in how they are generated. In all cases, the goal of the reviews has been to advocate for either a single-process or a dual-process model of recognition. To whit, some reviews argue for the sufficiency of a dual-process model: *Models of recognition: A review of arguments in favor of a dual-process account* (Diana et al., 2006). Other reviews defend the single-process position: *In defense of the signal detection interpretation of remember/know judgments* (Wixted & Stretch, 2004). Still other reviews assumed which is the correct model: *The nature of recollection and familiarity: A review of 30 years of research* (Yonelinas, 2002).

Many of the conclusions drawn from these reviews undoubtedly have merit, but the arguments have not produced a consensus on the "correct" model. A fair reading of them produces a sense that each side can argue points that are consistent with their position. Therefore, we need a broader assessment in order to highlight the weaknesses of these positions. This review focuses primarily on what many would refer to as "long-term" recognition memory, which involves the testing of memory for a relatively large number of stimuli after a filled delay. The review focuses on the relationship between single-item recognition, plurality discrimination, and associative recognition because these tasks place strong constraints on the models. The review also considers both the accuracy and the retrieval dynamics of these tasks because this combination places even stronger constraints on the models. Strong constraints are valuable because they expose the limitations of the models and inspire one to organize the models themselves. In the end, I will propose a framework that in some ways blurs traditional distinctions and can probably account for a wider range of empirical findings than any existing approach. I will begin with a short discussion that lays a foundation for the review of the models and data, which is to follow.

1.1. Levels of explanation and the categorization of data

Modeling recognition is conducted at two levels of understanding. At the higher level, measurement modeling assesses changes in the state of memory versus changes in response bias or assesses the contributions of the different types of information to performance. Measurement models make no assumptions about how memories are acquired, retained, or retrieved. Indeed, some of them are useful when describing the performance of perception tasks. Therefore, they make relatively few testable predictions about the nature of memory, but when they do, there is an opportunity to disconfirm a potentially large number of models that they supersede.

The lower level of modeling is process modeling. Process models describe how memories are acquired, represented, and retrieved. They are classified based on the measurement model with which they are associated given their specific assumptions about encoding processes, representational structures, and retrieval processes. With these assumptions, it is sometimes possible to make *a priori* predictions about how different factors will affect performance and how they will interact with other factors.

The two modeling approaches compliment each other insofar as measurement models address the question of "What is possible?" and process models address the question "How is it possible?" (cf. Batchelder & Riefer, 1999). For instance, a signal-detection measurement model might propose that recognition is based on a continuous random variable