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Modeling Distinctiveness: Implications for General Memory Theory

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The capacity to remember, to use the past in the service of the present, is a highly adaptive component of cognitive functioning. Although one need not reproduce the past, either consciously or unconsciously, in order to benefit from the service of memory, reproduction is clearly an important design feature (Anderson & Schooler, 2000; Nairne, 2005). Telephone numbers, street addresses, medication times, passwords—each needs to be recovered exactly, with the components in sequence, and inferential or reconstructive processing is unlikely to suffice.

To explain the specificity of retention, students of memory appeal often to the concept of distinctiveness, the focus of the present volume. Mnemonic distinctiveness can be defined in various ways—for example, as a property of a stored trace, a retrieval cue, or as a type of processing (see Hunt, Chapter 1 this volume; Schmidt, 1991). I define it here as the extent to which a particular cue (or set of cues) specifies a particular stored event (or target response) to the exclusion of others. Framed in this way, distinctiveness is not a fixed property of a cue, or a target trace, or even of an interaction between a given cue and a given target. It is a property of a cue in context: given a fixed set of alternatives, a measure of distinctiveness can be assigned to a particular cue with respect to a particular alternative. Change the context—for example, by changing how the cue is perceived or the range of possible responses—and the measure of distinctiveness changes as well.

To facilitate our discussion, and to add some formality to the preceding definition, I introduce a simple retrieval model below (borrowed from my feature model of immediate retention; Nairne, 1990a) and show how it helps account for some of the phenomena classically associated with the study of distinctiveness. For example, I show how the model informs us about the particulars of the von Restorff effect (Hunt, 1995;

von Restorff, 1933) and about the paradoxical effects of processing similarity and difference on episodic retrieval (Hunt & McDaniel, 1993). I then consider the role of time in the calculation of distinctiveness and contrast the retrieval model with certain extant models of temporal distinctiveness (e.g., Brown, Neath, & Chater, 2002; Neath, 1993). Finally, I end the chapter by discussing how the retrieval model forces us to reassess some widely held beliefs about memory, particularly the notion that memory is directly related to the match between an encoded cue and an encoded target.

A SIMPLE MODEL

Directed retrieval reduces ultimately to a matter of response selection. There is a vast storehouse of information in the brain; the retrieval problem is to select appropriate content based on information available in the present. When we forget an item from a memory list, we are not really forgetting the item—we are forgetting that it occurred in a particular space and time defined by the memory list; when we forget where we parked our car, we are not forgetting our car, we are forgetting the position our car occupied today as opposed to yesterday or the day before. Retrieval cues help us solve these kinds of discrimination problems. They provide us with the information we need to pick and choose from the wide variety of responses that are potentially available.

To formalize the response selection process, I adopt a simple retrieval, or choice, rule of the type often found in categorization and some memory models (e.g., Nosofsky, 1986; Nairne, 1990a, 2001). Under this formulation, an item is chosen for recall by comparing, or matching, the operative retrieval cue(s) to possible candidates in long-term memory (see also Raaijmakers & Shiffrin, 1980). The probability that any particular event, E_1 , will be selected as the recall candidate depends on how well the retrieval cue, X_1 , matches E_1 to the exclusion of other possible recall candidates (e.g., E_2, E_3, \dots, E_N):

$$P_r(E_1|X_1) = \frac{s(X_1, E_1)}{\sum s(X_1, E_i)} \quad (1)$$

The quantity $s(X_1, E_1)$ refers to the similarity of X_1 to E_1 , which in turn varies as a function of the number of matching or mismatching features between the two terms (a distance measure). Shepard (1987) recommends relating distance (d) to similarity in the following manner:

$$s(X_1, E_1) = e^{-d(X_1, E_1)} \quad (2)$$

This means that nearby items in psychological space (e.g., those that contain few mismatching features) will be deemed the most similar (and thereby

