

## CHAPTER 9

# Models of Categorization

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In: Ron Sun (Ed.), 2008. *The Cambridge Handbook of Computational Psychology*. New York: Cambridge University Press.

### 1. Introduction

This chapter surveys a variety of formal models of categorization, with emphasis on exemplar models. The chapter reviews exemplar models' similarity functions, learning algorithms, mechanisms for exemplar recruitment, formalizations of response probability, and response dynamics. The intended audience of this chapter is students and researchers who are beginning the daunting task of digesting the literature regarding formal models of categorization. There are numerous variations for formalizing the component processes in exemplar models of categorization, and one of the contributions of the chapter is a direct comparison of component functions across models. For example, the similarity functions of several different models are expressed in a shared notational format, and formulas for the special case of present/absent features are derived, which permits direct comparison of their behaviors. No previous review cuts across models this way, also including comparisons of learning, exemplar recruitment, and so forth.

By decomposing the models and displaying corresponding components side by side, the chapter intends to reveal some of the issues that motivate model builders, and to identify some of the unresolved issues for future investigators. Along the way, a few promising but undeveloped ideas are pointed out, such as an identity-sensitive similarity function (Kruschke, 1993), a new gradient-descent learning rule for the Supervised and Unsupervised Stratified Adaptive Incremental Network (SUSTAIN) model (Love, Medin, & Gureckis, 2004), an attentionally modulated exemplar recruitment mechanism (Kruschke, 2003b), a proposal for cascaded activation in Attentional Learning Covering map (ALCOVE; Kruschke, 1992), among others.

Whereas this chapter is specifically intended to survey exemplar model formalisms, it avoids discussions of the various empirical effects explained or unexplained by each model variation. A survey of empirical phenomena can be found in the highly readable book by Murphy (2002). A chapter by Goldstone and Kersten (2003) describes the various roles of categorization in

