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Eye-tracking and Simulating the Temporal Dynamics of Categorization

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Temporal Dynamics of Categorization

Recent research in categorization has seen a growing emphasis on the temporal dynamics of classification responses (e.g., Lamberts, 1998, 2000; Nosofsky & Palmeri, 1997). These dynamic models generally predict that the degree of fit between an exemplar and the possible categories to which it might belong is a gradually increasing function over hundreds of milliseconds for the correct category and a gradually decreasing function for the incorrect category (or categories).

The development of experimental techniques that can provide evidence for these simultaneously partially-active category representations during the early moments of the categorization process has faced some methodological obstacles, such as imprecision in response deadlines, or limited reaction-time ranges, extensive repetition of stimuli, and potential strategies resulting from speeded classification instructions. The present work recorded eye movements as a semi-continuous, real-time measure of partially activated categories during a normal-speed categorization task (cf. McMurray, Tanenhaus, Aslin, & Spivey, 2003).

Eye Movements During Categorization

Participants were presented with a pair of category bins and given several toy animals sequentially. Eye movements were recorded while they placed the toy animal in one or the other category. We were thus able to calculate an indirect estimate of the moment-by-moment partial activation of the categories being adjudicated among. Figure 1 shows example data (averaged over 17 subjects) for two of the eight critical toy animals used in this experiment.
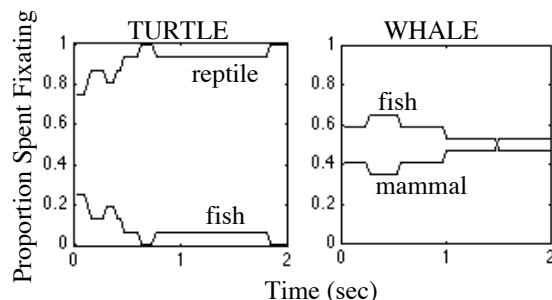

Figure 1: Proportion of time spent fixating two different classification bins while categorizing a toy animal.

Localist Attractor Network Simulations

A simple version of the normalized recurrence competition algorithm (Spivey & Tanenhaus, 1998) was constructed with five feature banks (limb type, environment, blood temperature, oxygen source, birth method) and four taxonomic classes (mammal, reptile, bird, fish). The resulting activation curves over time approximated the eye movement data (compare example items from Figures 1 and 2). Thus, experimental data and network simulations coincide with the general predictions of current temporally dynamic models of categorization (Lamberts, 1998, 2000; Nosofsky & Palmeri, 1997).
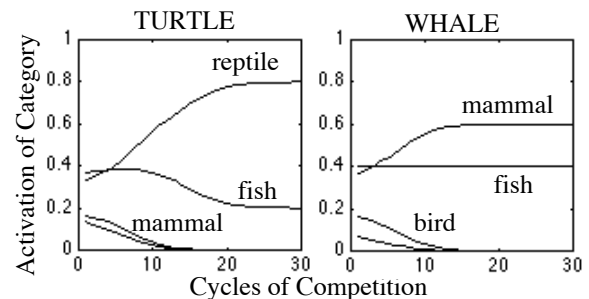

Figure 2: Activation of taxonomic classes as normalized recurrence settles into a stable state.

References

Lamberts, K. (1998). The time course of categorization. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 24,* 695-711.

Lamberts, K. (2000). Information-accumulation theory of speeded categorization. *Psychol. Review, 107*, 227-260.

McMurray, B., Tanenhaus, M., Aslin, R., & Spivey, M. (2003). Probabilistic constraint satisfaction at the lexical/phonetic interface: Evidence for gradient effects of within-category VOT on lexical access. *Journal of Psycholinguistic Research*, *32*, 77-97.

Nosofsky, R. M. & Palmeri, T. J. (1997). An exemplar-based random walk model of speeded classification. *Psychological Review, 104*, 266-300.

Spivey, M., & Tanenhaus, M. (1998). Syntactic ambiguity resolution in discourse: Modeling effects of context and lexical frequency. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 24*, 1521-1543.