A Computational Consideration of Object Recognition Across Development

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Introduction

Connectionist models of semantics have suggested that visual object recognition occurs through interactions between visual input and conceptual representation. In this account, as knowledge degrades memory of shared properties is preserved, supporting recognition, while memory for idiosyncratic properties is lost (Hodges, Graham & Patterson, 1995; McClelland & Rumelhart, 1985; Rogers, McClelland, Patterson, Lambon-Ralph & Hodges, 1999). Computational models within this domain predict a similar effect over the course of learning and development (Rogers & McClelland, 2004), but there is very little research exploring changes in object recognition across development. We describe recent work using a developmentally-adapted version of the over-regular animal task (OAT; See Figure 1) previously used within semantic dementia patient populations, wherein we assessed recognition and naming in 3- and 5-year-olds, finding that young children tended to incorrectly choose visually prototypical chimeras (e.g., a camel without a hump) as "real" items over their less prototypical (but presumably more familiar; e.g., a camel with a hump) counterparts. To determine whether this pattern reflects task demands associated with explicit label categorization/recognition, or is driven by perceptual differences, we employed a touchscreen computer based change-detection paradigm using the same OAT images.

The Present Study

In this change-detection study we found reaction time differences that suggest the impact of category knowledge on visual search and change detection, wherein the semantic relationship of the changing feature favors earlier detection for images that adhere to category general norms. This was demonstrated by children more rapidly detecting a change when the alternating feature was atypical and presented on a more category prototypic animal (e.g., the alternation between a flat-backed donkey and a donkey with a hump) than when the visually identical feature was depicted on an animal that exhibits a more atypical category form (e.g., the alternation between a flat-backed camel and a camel with a hump). To better understand mechanisms underlying these developmental patterns, we report simulations with a neural network model designed to consider whether learning/development and degradation/aging show parallels in the underlying model structure, or if similar behaviors might arise through different structures in the support of learning than those which have shown graded declines in patient populations.

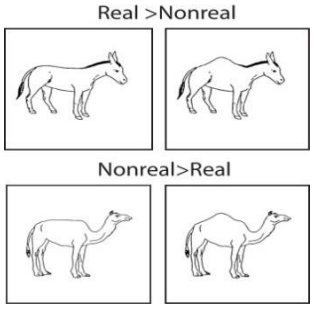

Figure 1. Examples of over-regular animal task (OAT) images used in prior semantic dementia patient research and the described developmental studies.

References

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