

What is a perceptual object? Human behavioral challenges for deep neural network modeling

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Abstract

Human perception decomposes the world into represented objects that are selectively attended, tracked, and predicted as we engage our surroundings. Object representations emancipate perception from the senses, enabling us to keep in mind what's out of sight, and provide a stepping stone toward more abstract symbolic cognition. Human behavioral studies have captured cognitive objects by documenting empirical phenomena including object permanence, proto-objects, and object files. Current deep neural network (DNN) models of visual object recognition, by contrast, remain largely tethered to the sensory input — despite achieving human-level performance at labeling objects in images. Here, we review the key behavioral phenomena and cognitive concepts related to perceptual objects. We then link them to early-stage neural network mechanisms that capture certain aspects of these phenomena. We argue that the human behavioral and cognitive literature provides a starting point for experimental paradigms that can not only reveal mechanisms of human cognition, but also serve as benchmarks driving development of a new class of deep neural network models of vision that will put the object into object recognition.

Keywords: deep neural network; object vision; object concept; object permanence

