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Proceedings of the Annual Meeting of the Cognitive Science Society

Title

Modeling Perceptual Learning with Deep Networks

Permalink

<https://escholarship.org/uc/item/38x6k01w>

Journal

Proceedings of the Annual Meeting of the Cognitive Science Society, 36(36)

ISSN

1069-7977

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Publication Date

2014

Peer reviewed

Modeling Perceptual Learning with Deep Networks

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Abstract: The mechanisms underlying perceptual learning—how our brain changes as we gain competence in a perceptual task—remain a heavily debated topic. Since the early 2000's, a number of authors have proposed competing theories on the loci of change for visual perceptual learning, ranging from V1, V4, to areas beyond the visual cortex associated with decision making processes (Doshier and Lu, 1998; Schoups, Vogels, et al., 2001). Instead of positing one loci of change in the brain, we argue that gradient descent can serve as an explicit learning rule to determine the loci of change. We show that a deep neural network trained with error-correcting backpropagation can reproduce a variety of results from neurobiology experiments, explaining both the detailed changes in neural representations in each layer, and the relative magnitude of changes seen in different levels of the visual hierarchy.