The Effect of Pooling in a Deep Learning Model of Perceptual Learning
Modeling Sensitive Initial Conditions for Perceptual Learning
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INTRODUCTION

- The neural mechanisms of visual perceptual learning remain unclear. Even focusing on orientation discrimination tasks alone, empirical studies have found wildly different results, with some arguing that the site of plasticity is in early cortical layers such as V1 and others arguing it is in later decision layers.
- Here we consider two studies with nearly identical paradigms but widely divergent results: Schoppe et al. (2002) and Ghose et al. (2002) both recorded changes in V1 after Monocular deprivation and evaluated training in orientation discrimination. Both groups conducted follow-up studies in V1 using their respective experimental paradigms (Fig. 1). The most significant difference is that one used fixed spatial frequency for training stimuli while the other used randomized spatial frequency for training stimuli (Table 1).

- Ghose et al. (2002) found substantial generalization to untrained positions, and no changes in V2, while Schoppe et al. (2002) found the opposite. Explaining this variability to task details is a key challenge for theory.

In summary, we aim to answer these questions:
1. How can we capture our visual cortex’s marked sensitivity to the details of task paradigms?
2. Why do seemingly trivial task details lead to divergent results?

DEEP LEARNING MODEL OF PERCEPTUAL LEARNING

We develop a deep learning model of perceptual learning in orientation discrimination tasks. Our model has four main components (Fig. 2):

- a. Deep, chain-like structure
- b. Pooling over phases
- c. Initial orientation tuning
- d. Gradient descent learning

We suggest that learning in a deep, layered structure can be highly nonlinear, amplifying the effects of small task differences.

REFERENCES


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