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Background

- In this work, we examined open computational questions in visual perceptual learning, by modeling the learner using shallow CNNs.
- Studies in visual perceptual learning investigate the way human performance improves with practice, in the context of relatively simple, tractable visual tasks.
- The acquired skills are highly specific to simple visual features, such as location in the visual field, orientation; As such, they do not transfer - e.g., do not generalize to other orientations.
- We focused our investigation on two hallmark characteristics of perceptual learning – **Specificity** and **Enabling**.



- We trained a two layer CNN using vanilla SGD, with a fixed learning rate and batch size. The network was initialized (32 repetitions) using a weight vector out of a fixed randomly generated set.
- In the first experimental setup (left), the task was to detect the presence of an odd line segment. The angular difference between the odd segment and the remaining segments controlled the level of difficulty (SNR) of the task
- In the second experimental setup (right), the task was to determine the rotation direction of a Gabor patch.





Hidden Layers in Perceptual Learning Gad Cohen and Daphna Weinshall

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Training on a new transfer task modified primarily channels which had been less significant for the previous task.

 o_2 after being trained with orientation o_1 .

Task

- 2 pos 3
- 2 pos 1
- $2 \text{ pos} 8^\circ$
- 8° enable

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Efficiency

	Accuracy	#bits
80^{o}	99.79%	5.094
$.6^{o}$	99.40%	5.656
80	96.90%	5.718
ed	98.43%	5.718

The minimal number of bits required to store the network's weights without reducing performance by more than 1%. More bits (or higher precision) were

required for harder discrimination tasks. The enabled network reached higher accuracy while requiring the same precision

Conclusions

• The shallow CNN networks qualitatively showed most of the characteristic behavior observed in perceptual learning, including the hallmark phenomena of specificity and its various manifestations in the forms of transfer or partial transfer, and learning enabling

• The pattern of weight modifications may identify the ways by which the domain of search in the parameter space during the network re-training can be significantly reduced, thereby accomplishing knowledge transfer



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