A Computational Developmental Model for Specificity and Transfer in Perceptual Learning

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***Abstract*—How and under what circumstances the training effects of Perceptual Learning(PL) transfer to novel situations is critical to our understanding of generalization and abstraction in learning. Although PL is generally believed to be highly specific to the trained stimulus, a series of psychophysical studies have recently shown that training effects can transfer to untrained conditions under certain experimental protocols. In this article, we present a brain-inspired, neuromorphic computational model of the Where-What visual pathways which successfully explains both the specificity and transfer of perceptual learning. The proposed model autonomously develops a network of simulated neurons which learn using the simple rules of Hebbian-learning, lateral inhibition and excitation, which altogether result in neuronal recruitment. Our main hypothesis is that certain paradigms of experiments trigger two-way (descending and ascending) off-task processes about the untrained condition which lead to recruitment of more neurons in lower feature representation areas as well as higher concept representation areas for the untrained condition. Such recruitment coupled with lateral excitation from trained neurons cause formation of extended, improved representations, and hence enhanced perception, for the untrained stimulus. The model proposes such off-task processes as part of the normal response of the brain to the environment. Simulation results showed transfer of learning across retinal locations in a Vernier discrimination task in a double-training procedure, comparable to previous psychophysical data [1]. To the best of our knowledge, this model is the first neurally-plausible model to explain both transfer and specificity in a PL setting. However, such wider capabilities have yet to be experimentally demonstrated.**

REFERENCES

[1] Lu-Qi Xiao, Jun-Yun Zhang, Rui Wang, Stanley Klein, Dennis Levi, and Cong Yu. Complete transfer of perceptual learning across retinal locations enabled by double training. Current Biology, 18(24):1922C1926, December 2008.