

Color-based estimates of stimulus similarity predict perceptual similarity of image pairs to monkeys

Sarah R Allred

Neurobiology & Behavior, University of Washington, USA



**Jennifer Y Skiver
Thompson**

Physiology & Biophysics, University of Washington, USA

Bharathi Jagadeesh

Neurobiology & Behavior, University of Washington, USA
Physiology & Biophysics, University of Washington, USA

Abstract

Introduction: Studies of object perception are hampered by the difficulty of mathematically describing the similarity of realistic images. Recently, color based metrics have been developed to search for similar images in large databases of realistic images. Such metrics have been shown to predict human subjects' similarity rankings of realistic images, because the color of realistic images often depends on their content. Can color similarity metrics also predict perceptual similarity of realistic images to nonhuman primates?

Methods: The color similarity metric used was the Earth Mover Distance (EMD, Y. Rubner, Stanford Vision Lab). We measured performance in a delayed-match-to-sample task using pairs of images. In each trial, the sample was presented for 16-512 ms, followed by a mask. After a delay period, two target images appeared, and the monkey was rewarded for making a saccade to the image that matched the sample. Image pairs were chosen so that the EMD between them spanned the range in our database. For each pair, we estimated the threshold viewing duration as the presentation time required to reach 75% accuracy. If the images are perceptually similar, a longer presentation time should be required to complete the task correctly.

Results & Conclusions: Performance is correlated with EMD. Low EMD pairs have higher threshold duration (take longer to discriminate) than high EMD pairs. In addition, low EMD pairs incurred performance improvements during daily training sessions, while high EMD pairs did not. This finding is consistent with previous findings that experience improves performance in perceptually difficult tasks. A recent study has also shown that EMD can explain some of the response properties of single neurons in IT cortex, an area of the macaque brain critical for object perception (Allred et al, SFN, 2002). Taken together, these results indicate that a color similarity metric (EMD) may predict

perceptual similarity of images to nonhuman primates.

History

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