

Against Image-Based Theories of Shape Recognition

Hongjing Lu , Zili Liu
Department of Psychology, UCLA

Purpose:

To find a critical condition to test image-based theories, which predict that the more similar a query image is to a studied, the better recognition will be. By assuming that two identical images are more similar to each other than two different ones, we found that the latter could in fact yield better recognition.

Method:

In a same-different matching task, American subjects determined whether two images were of the same or different Chinese characters. A stimulus was created by randomly occluding with red pixels either 60%, or (by removing 10% of red pixels) 50%,... or 20% area of a gray-level Chinese character. So when the two images were of the same character and percentage of occlusion, the two images were identical. No trials were repeated. When the first image was 60% occluded, the second image that was the same character but 40% occluded yielded higher hits (and accuracy) than that that was identical to the first.

Modeling:

All results of 25 conditions were explained by our model. We assumed that, due to limited capacity, up to a certain number of occluded pixels were recovered, each by the mean value of its neighboring unoccluded pixels. An unrecovered pixel was assigned a random value. In each of the 25 conditions, the model computed the following two distributions of pixel value differences between the two images: when the two images were of the same and different characters, respectively. The model's performance was assumed to be a monotonic function of the χ^2 measure between the two distributions, and was found to match that of subjects'.

Discussion:

In an experiment that favored template matching, we found that a different, but more structured image gives rise to better recognition. The results confirmed our earlier results with faces, which were explainable by the same model. We conclude that image-based theories cannot account for our results, and that structural organization is important in shape representations.