

Ensemble similarity between binocular images promotes binocular matching

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Humans have two laterally displaced eyes, producing two image streams with slight differences in their perspectives. The visual system utilizes these perspective differences to infer three-dimensional structures from two-dimensional images. To do that, the visual system needs to find binocular matches of visual elements. Then, the visual system can infer three-dimensional depth of a visual element depending on the disparity of the element. However, finding binocular matches of every visual element would be inefficient considering the redundant nature of a visual scene. The current study investigated whether the visual system could utilize ensemble information for binocular matching. Binocular images with similar ensembles have higher chance of being matched. We hypothesized that the visual system integrates binocular images into a coherent percept when ensembles are similar between the images. To test the effect of ensemble similarity while controlling for binocular matches, we created novel stimuli made of circles. We randomly placed circles and then assign each of them to either left or right eye image. Thus, circles did not contact any other circle either within or between the eyes. We varied the color of circles in each eye to manipulate ensemble similarity between the left and right eye images. Binocular rivalry was utilized as a proxy index indicating a failure to establish binocular matching. When visual information is highly dissimilar between the eyes, the visual system spontaneously suppresses one of the images in the two eyes and perceptual dominance alternates between the left and right eyes. As expected, participants experienced strong binocular rivalry when the circles had dissimilar colors between the eyes. If the circles had similar colors, participants saw the combination of the two images most of the time. Our results suggest that the visual system utilize ensemble information to determine whether binocular images can be matched.

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