Sensory Integration with Arbitrary Low-Level Visual Features

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Vision scientists often talk as if there is something special about visual cues, such as visual motion, texture, shading, or binocular disparity, in the sense that perceptual processes operating on these cues can be regarded as independent modules or dimensions forming building blocks for our visual systems. We wanted to test whether visual cues have such a privileged status. To do so, we examined human sensory integration. A number of studies have demonstrated that people often integrate information from multiple visual cues in a statistically optimal manner when judging properties of surfaces in a scene. For example, subjects typically weight the information based on each cue to a degree that is inversely proportional to the variance of the distribution of a scene property given a cue's value. What happens if images are constructed in such a manner that they are not best interpreted via linear combinations of known cues, but rather are best interpreted via linear combinations of arbitrary low-level features? In this case, will people learn to combine the information from these features in a statistically optimal manner? In two experiments addressing these questions, we found that human observers do indeed learn to optimally combine the feature information. These results suggest that there is nothing special about optimal cue combination.