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Abstract:

Perception of spatial position is a basic function of the visual system, yet there are still many questions regarding how position is computed in the brain and how this information is integrated across space. The quantification of these processes is an important first step in elucidating the underlying neural mechanisms. We propose that spatial integration can be modeled as a weighted average of visual position information and that weights at particular locations in space are modulated by various factors including retinal eccentricity and spatial attention. The current study utilized psychophysical methods in human subjects to quantify the extent to which different regions of the visual field influenced performance on a centroid estimation task. Subjects located the centroid of briefly presented one-dimensional and two-dimensional arrays of dots positioned randomly within a large region of the visual field. To probe the effects of endogenous and exogenous spatial attention, a central or peripheral cue was used to bias attention toward one side of the display. Using statistical models, we generated maps of weights that described the influence each region of the visual field had on the centroid determinations in each of the conditions. The data suggest that 1) subjects estimate centroids reliably, but with some degree of idiosyncratic bias; 2) spatial locations are not utilized equally when determining the centroid, with most subjects prioritizing foveal regions over peripheral regions and 3) endogenous and exogenous attention modulate the contribution of spatial locations to the overall percept with higher weights typically allocated to attended areas. Taken together, these results suggest that subjects prioritize information at different regions of space based on the reliability of the information or signal associated with that region. Reliability depends not only of the level of acuity due to retinal eccentricity, but also on cognitive influences such as attention.