Vision Sciences Society Annual Meeting Abstract | September 2015

Object-based perception of orientation in the Ternus-Pikler display

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Journal of Vision September 2015, Vol.15, 237. doi:10.1167/15.12.237

Abstract

Early visual processing is based on orientation-selective receptive fields in a retinotopic reference frame. Perception of visual features over longer time scales, exceeding this fast feedforward encoding, has been demonstrated to involve object-based, rather than only retinotopic coordinates (Fracasso et al., 2010; Boi et al., 2011). For example, non-retinotopic encoding has been found using the Ternus-Pikler (T-P) apparent motion display in which object identity is mapped across the object motion path given the inter-stimulus interval (ISI) is sufficiently long (Boi et al., 2009). Here, we report evidence that feature integration over time can involve an object-based frame of reference, even for the perhaps most paradigmatic example of retinotopically defined features: orientation. We presented observers with repeated series of T-P displays, in which the perceived rotation of Gabor patches depended on the combination of Gabor orientations in either retinotopic or object-based coordinates across display frames. We report that the frequency of perceived retinotopic rotations linearly decreases with increasing ISI between T-P display frames. For very short ISIs (< 50 ms) perceived rotation is strongly biased towards retinotopic processing but on longer time scales (exceeding ISIs around 100 ms) the rotation percept appears ambiguous or predominantly non-retinotopic for individual observers. In addition to these temporal factors, we show that in perceptually ambiguous T-P displays (constant ISI; 200 ms) the perceived

rotation can be strongly biased towards either retinotopic or non-retinotopic integration based on object grouping. Cueing either static spatial object position or apparent motion resulted in robust element- or group motion percepts, respectively, and the frequency of retinotopic vs. non-retinotopic rotation reports depended strongly on the perceived object matching. Our results indicate that temporal integration of even basic, low-level visual features like orientation can be biased towards non-retinotopic processing in order to support the perceived constancy of objects in motion.

Meeting abstract presented at VSS 2015