Selectivity for multiple orientations in visual search

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Abstract

Observer strategies in visual search for targets containing multiple orientations were considered in the study. We used our efficient search framework (Tavassoli *et al.*, 2007), a reverse-correlation based technique distinguishing between nonfoveal and foveal processes, to examine how observers search for low-contrast targets created from sums (Experiment 1) and mosaics (Experiment 2) of Gabors. Eye movements were recorded while observers searched for one target randomly embedded in one tile of a grid of $1/f$ noise tiles. Fixated noise-only tiles (representing our nonfoveal false alarm category) and a subset of these noise tiles selected by the observer as target candidate (constituting our foveal false alarm category) were analyzed off-line. We present several key discoveries. First, we show a strong presence of visual guidance in saccadic targeting in search for our composite targets, demonstrated by selectivity for spatial frequencies and (in some cases) orientations close to the characteristics of each target. Second, multiple orientation attributes of the targets are shown to be represented in saccadic programming and target selection in most cases, modulated by the observer's sensitivity / selectivity for each orientation. Third, different configurations of the Gabor mosaicing produce distinct tunings in orientation, but visibly idiosyncratic to each observer (Experiment 2). Moreover, a localized analysis has been performed for the use of phase. Fourth, a curious presence of close-to-vertical structures is observed in fixated distracters, although the search targets did not contain vertically-oriented structures (Experiment 2).