Combining local difference signals across different spatial filter maps *

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Linear spatial filters were found to have an important role in processing of textures and in search tasks. Human performance on such tasks can be accounted for by assuming that performance is limited by the distribution of local activity (energy) difference signals in sets (maps) of spatial frequency and orientation filters (Sagi and Rubenstein, OSA meeting 1989). Here we wanted to know how signals from the different filter maps are combined, if at all.

We used a task where observers had to detect a vertical Gabor signal (4 cpd) embedded in a background of 210 horizontal Gabor signals of the same frequency (1 degree separation). Stimulus duration was 36 msec and target appeared at an unknown location having an eccentricity of 4 degree.

We found target (vertical) detection rate to be independent of the background (horizontal distractors) contrast. This result is consistent with the assumption that vertical and horizontal signals are processed by independent filters, and argues against a detection mechanism that is sensitive to activity difference between filters responding to target and distractors. However, target detection rate decreased dramatically when some (5%) of the distractors were assigned a higher contrast, of 2.5 times the background contrast. The same contrast ratio was required to detect a target that differed from background by contrast only. We did not find any improvement in performance when targets of different orientations were presented in the same location. The latter results imply that local difference signals, generated within each filter map, are mapped (but not added) into a single master map which is used by the detection mechanism. This detection mechanism does not have access to the labels (vertical or horizontal) of the filters originating the difference signals.a

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