

The V1 Saliency Hypothesis and the Reduction of Visual Crowding of Unique Ocularity Peripheral Visual Targets

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The V1 Saliency Hypothesis states that the highest response in the primary visual cortex to a visual location signals the saliency of that location, thereby attracting attention or gaze in a bottom-up or stimulus-driven manner (Li, 2002). This hypothesis led to the surprising, but subsequently confirmed (Zhaoping 2008) prediction, that a visual item that is unique in its eye of origin (e.g., when it is shown to the left eye whilst other times are shown to the right eye), is salient in the same way as an item that is uniquely red among a background of green items. Here, we apply this insight to crowding.

Crowding is the reduction in discriminability of a target item in the visual periphery when this item is flanked by neighboring items. For example, a letter 'T' presented 10 degrees away from fovea is easier to recognize when it is presented alone than when it is flanked by other letters. It is known that crowding is reduced for targets that are more salient by virtue of differing from their flankers in a basic feature such as color or orientation. This is presumably because a more salient item provides stronger inputs to higher visual centers (responsible for visual recognition), thereby overcoming the interference from the flankers. We apply the V1 Saliency Hypothesis to predict that a target differing from flankers in ocularity (defined as the signed difference in input strengths from left and right eyes associated with an item) will be salient, and thus also somewhat relieved from crowding.

This prediction was tested in an experiment involving recognizing a peripheral letter 'T' among flanking letters 'O's. For each letter, the input contrast to one eye was three times as strong as the input contrast to the other eye. In one condition, the eye receiving the stronger input was the same for all letters; in another condition, the letter 'T' was unique in its stronger eye of origin. The binocular sum of inputs for each letter was identical for the two conditions. Observers reported in which of four possible orientations was the 'T' shown. As predicted, performance was better when the target 'T' had a distinct ocularity, demonstrating reduced crowding.

[1]. Li, Z. (2002). "A saliency map in primary visual cortex." *Trends in Cognitive Sciences* **6**(1): 9-16.

[2]. Zhaoping, L. (2008). "Attention capture by eye of origin singletons even without awareness—A hallmark of a bottom-up saliency map in the primary visual cortex." *Journal of Vision* **8**(5).