Spatial distance between target and irrelevant patch modulates detection in a texture segmentation task

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Received 15 October 2008; accepted 19 July 2009

Abstract—In three texture segmentation experiments a target patch had to be detected. We studied the impact of a task-irrelevant patch in the backward mask on detection performance, and especially the modulating effects of its spatial distance to the target. It was assumed that the signals of the two texture irregularities interact as a function of their spatial distance. Experiment 1 revealed that the task-irrelevant patch impaired target detection only when the distance was small. In Experiments 2 and 3 with systematically varying distances, detection performance increased linearly with distance until a maximum point. If the task-irrelevant patch appeared outside of a critical distance, performance did not increase further with increasing distance. Our findings are discussed in terms of the biased competition account. It is proposed that the critical distance may correspond to the average receptive field size of a cortical area that is critical for target detection.

Keywords: Early vision; texture segmentation; saliency; receptive field size; retinotopic organization.

1. INTRODUCTION

Studying early vision processes often involves texture segmentation tasks with a so-called pop-out target. Stimuli are homogenous textures (e.g., tilted lines) containing a texture patch (target) with a predefined probability. The elements of the target texture differ from the context elements by one or more basic features (e.g., orientation; cf. Fig. 1a). This kind of target ‘pops out’, i.e., its detection happens quasi-effortlessly and automatically (Wolfe, 1998).

Usually, in experimental studies, the target patch that has to be detected is the unique irregularity in the stimulus. Compared to natural environments, this creates a rather artificial stimulus situation: When searching a relevant target in the real world, one encounters a lot of task-irrelevant irregularities in the visual scene that pop-out. In the present study, we wanted to explore the influence of a second,
Figure 1. Experiments 1 and 2: (a) Stimulus with target patch; (b) Mask with irrelevant patch. (a) and (b): The number of elements has been reduced for better visualization of the texture structure. For the same purpose the luminance contrast in this figure has been increased compared to the original stimuli.