

# Crowding alters the spatial distribution of attention modulation in human primary visual cortex

Department of Psychology and Key Laboratory of Machine Perception (Ministry of Education), Peking University, Beijing, PR China

Fang Fang



Sheng He

Department of Psychology, University of Minnesota, Minneapolis MN, USA



Crowding effect is the visibility reduction of a target when presented with neighboring distractors. It has been explained by either lateral inhibition at a pre-attentive level or coarse spatial resolution of attention. To test these theories, high-resolution fMRI was used to measure V1 response to the target in the presence or the absence of the distractors in both attended and unattended conditions. We found the cortical response to the target was not affected by the presence of distractors in the unattended condition. However, the spatial distribution of attention modulation in the target and its surrounding area depended on the crowding configuration. When distractors were placed in the same radial axis as the target, a configuration with a severe crowding effect, significant attention enhancements were observed not only in the target's and the distractors' locations, but also in regions next to the target where even no stimulus was presented. But this spread of attention enhancement did not occur when distractors were placed in the same circumference as the target, a configuration with a weak crowding effect. The pattern of interaction between attention and target-distractor configuration supports that crowding results from coarse spatial resolution of attention.

Keywords: attention, contrast, crowding, fMRI, vision, V1

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## Introduction

crowding effect (Felkey & ... (Bauer & 1970; ... (He, 1991) ... (Chen & ... 2002; Lee & ... 1997). ... (Lee, Ke, & ... 1985; ... & ... 1986), ... ( ... & ... 1988), ... ( ... & ... 1976), ... ( ... & ... 1997), ... ( ... & ... 2004), ... (Lee, ... & ... 2007; ... & ... 2005). ... (Bauer, ... & ... 1979; Lee, ... & ... 1987) ... ( ... 2004). ... ( ... & ... 1973; ... & ... 1983) ... (He, ... & ... 1996, 1997; ... & ...

2001) ... ( ... 2005; ... 1991). ... (Bauer & ... 1970; ... & ... 1962). ... fMRI: (1) H ... ( ... )? (2) H ... ?

## Methods

### Participants

A ... (3 ... 4 ... fMRI







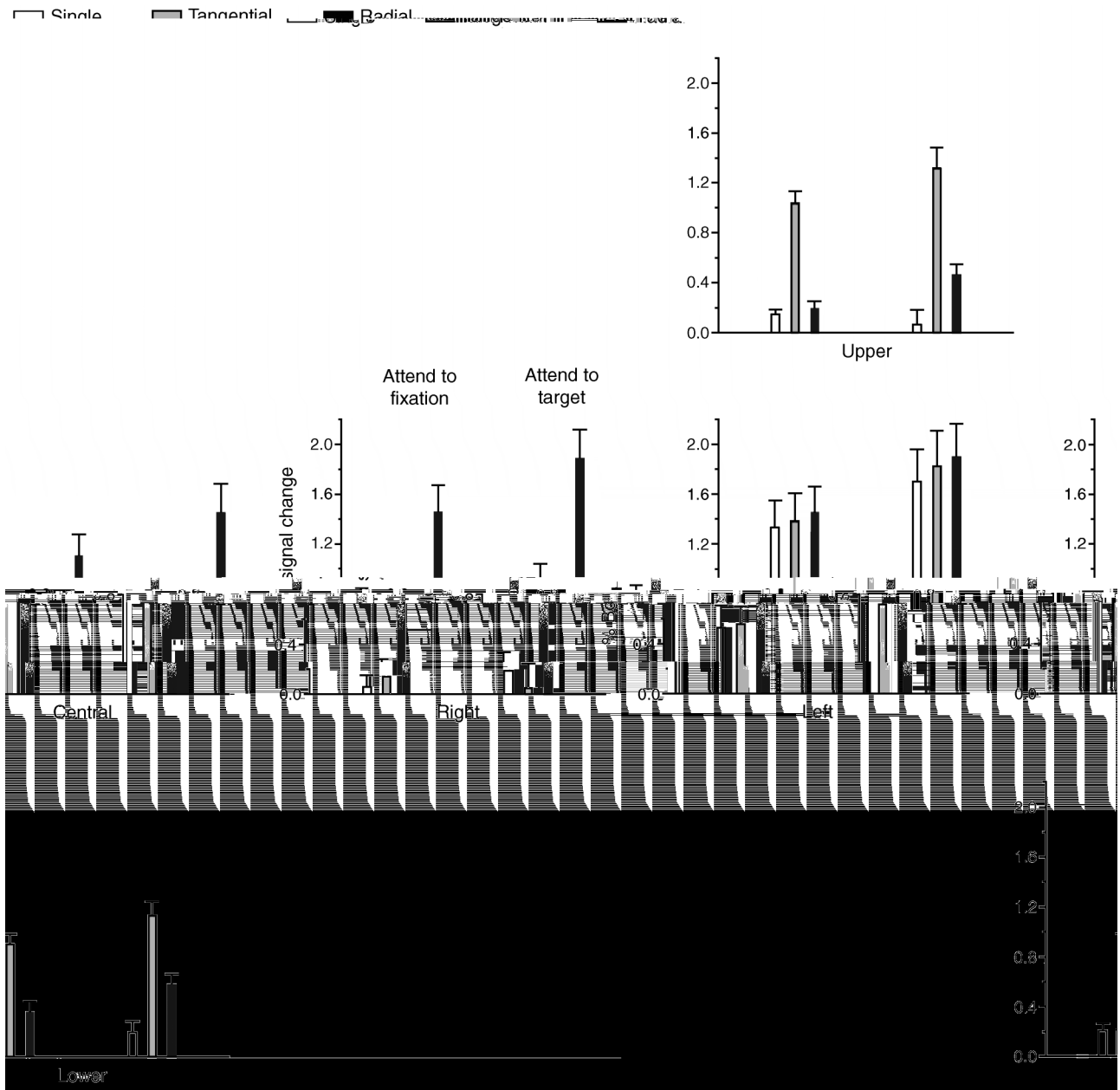


Figure 4. BOLD signals in the left, right, upper, lower, and central ROIs in the single, tangential, and radial configurations when subject attended to either the fixation (left part of a panel) or the target (right part of a panel). Error bars denote 1 SEM calculated across subjects.

... (Fang & He, 2002). In the present study, we used a similar design to investigate the BOLD signals in the left, right, upper, lower, and central ROIs in the single, tangential, and radial configurations when subject attended to either the fixation (left part of a panel) or the target (right part of a panel). Error bars denote 1 SEM calculated across subjects.

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