Spatial context and top-down strategies in visual search

ALEJANDRO LLERAS 1,* and ADRIAN VON MÜHLENEN 2

1 Department of Psychology, University of British Columbia, 2136 West Mall, Vancouver, B. C., Canada V6T 1Z4
2 Ludwig-Maximilians-University, Munich, Leopoldstrasse 13, 80802 Munich, Germany

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Abstract—Marvin M. Chun and Yuhong Jiang (1998) investigated the role of spatial context on visual search. They used two display conditions. In the Old Display condition, the spatial arrangement of items in the search display was kept constant throughout the experiment. In the New Display condition, the spatial arrangement of items was always novel from trial to trial. The results showed better performance with Old Displays than with New Displays. The authors proposed that repeated spatial context help guiding attention to the target location, thus they termed this effect Contextual Cueing. We present three attempts to reproduce this effect. Experiments 1 and 2 were near exact replications of experiments in Chun and Jiang’s report, where we failed to obtain Contextual Cueing. Post-experimental interviews revealed that participants used different search strategies when performing the task: an ‘active’ strategy (an active effort to find the target), or a ‘passive’ strategy (intuitive search). In Experiment 3, we manipulated task instructions to bias participants into using active or passive strategies. A robust Contextual Cueing Effect was obtained only in the passive instruction condition.

Keywords: Contextual cueing; visual search; top-down strategies; individual differences; implicit information; spatial attention.

INTRODUCTION

Our day-to-day visual environment is cluttered with a multitude of objects varying in shape, color and motion, among many other visual features. The task of finding specific objects within such a rich environment is usually guided by the features of the objects themselves but is also aided by our memory of the properties and regularities of the visual environment itself. For example, when looking for a white napkin in our kitchen, we look for white and napkin-shaped objects, but also, we most likely concentrate our attention on the part of the kitchen where we know is a napkin dispenser. Seldom will we look for napkins inside the refrigerator. This is

*To whom correspondence should be addressed. E-mail: alleras@uiuc.ed
because our knowledge about napkins and kitchens, as well as our memory of when we last saw napkins, all direct our attention to a set of locations around the kitchen with a high likelihood of holding napkins.

Myriad studies in visual cognition have focused their efforts on finding what guides visual attention through the environment under similar search-task situations (e.g. Miller, 1988; Moore and Egeth, 1998; Wolfe, 1996). The experimental task, known as visual search, consists of finding one object (the target) in an array of distracting objects (the distractors), and it is usually found that the more the target differs from the distractors (on some feature-based scale), the easier the search task becomes (e.g. Duncan and Humphreys, 1989; Treisman and Souther, 1985; Wolfe, 1994). The ensuing argument is that something like a saliency map of the items in the display helps to guide spatial attention around the display (e.g. Cave and Wolfe, 1990; Wolfe et al., 1989; Wolfe, 1996).

Rather than focusing on the featural relation between target and distractors (i.e. the extent to which the target resembles the distractors), Chun and Jiang (1998) investigated whether the spatial relation between target and distractors in the display can guide spatial attention. Their rationale was that the spatial arrangement of items in which a target is presented creates a spatial context for the target, much in the same way that a refrigerator, an oven and a dishwasher create a context for the location of the napkin dispenser inside a kitchen. Chun and Jiang hypothesized that if this contextual information is held constant across trials, it will guide the participants’ spatial attention more efficiently towards the location of the target. To test this hypothesis, they ran a series of 6 experiments where they manipulated the target context: targets could appear either within an ‘Old’ or a ‘New’ display configuration. In the Old display configuration trials, targets always appeared within the same spatial configuration of distractor items (there were 12 possible Old configurations), whereas in the New display configuration trials, targets always appeared within a novel spatial configuration of distractor items (there was an unlimited number of New configurations). As predicted, Chun and Jiang found reliably faster reaction times (RT) for targets appearing within the Old configurations than for targets appearing within the New configurations. They termed this RT effect Contextual Cueing. This effect has caught the attention of many researchers and has been replicated in a number of studies in the literature (e.g. Chun and Jiang, 1998, 2003; Chun and Nakayama, 2000; Endo and Takeda, 2004; Howard et al., in press; Hoyer and Ingolfsdottir, 2003; Jiang and Chun, 2001; Jiang and Wagner, in press; Kawahara, in press; Olson and Chun, 2002; Peterson and Kramer, 2001).

It is important to note that within Chun and Jiang’s (1998) paradigm, two things need to happen for Contextual Cueing to arise. First, participants need to learn at least a subset of the spatial configurations in which the target is consistently appearing, and second, participants need to be able to use this knowledge to guide spatial attention to the target location. If either of these two conditions is not met, Contextual Cueing cannot occur. Because we have failed to replicate the Contextual Cueing...