Symbolic Cuing of Visual Attention

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Abstract

Selective attention processes allow people to process relevant information and ignore irrelevant information in a task environment. Selective attention is controlled by top-down and bottom-up factors. The current experiment investigates how meaningful symbolic information guides attention to a visual target. Participants performed a simple detection task. Visual targets appeared on the left or right of fixation. Targets were cued by an arrow stimulus that pointed left or right. Reaction time to detect the target was faster for validly than invalidly cued targets. These findings replicate the symbolic cuing effect, and demonstrate that symbolic information can guide selective attention.

Symbolic Cuing of Visual Attention

Real-world task environments are full of information that can be relevant or irrelevant to current task-demands. To successfully accomplish task goals people must select relevant from irrelevant information and use relevant information to guide their actions. For example, when navigating a busy subway terminal people must correctly follow the path to their desired train while avoiding fellow travelers and alternative subway routes. In the subway example, signage is an important cue that travelers follow to reach their intended train. The purpose of the current experiment is to investigate how symbolic information, like signage in a subway station, guides attention to detect visual targets.

Attention refers broadly to the ability to focus on specific information. There are several factors that influence how attention is deployed in a task-environment. A common distinction is between exogenous and endogenous control over attention (for a review see, Ruz & Lupianez, 2002). Exogenous control refers to external factors that automatically attract attention. For example, highly salient perceptual information, like bright lights or loud sounds are known to orient attention toward the signal. Endogenous control refers to internal factors that control how attention is deployed. For example, people are capable of intentionally deciding to attend to particular stimuli in a display.

The Posner cuing task (or visual cuing task) is commonly used to measure exogenous and endogenous control over visual attention (Posner, 1980). In the task participants are asked to detect the onset of a visual target (e.g., a dot) that can appear on the left or right side of a computer screen. At the beginning of each trial participants view a fixation cross at the center of the screen. Following fixation a cue is presented on the left or right side of screen. Usually the cue is a small box that

flashes and then disappears. Following the presentation of the cue the target appears in one of two locations. On validly cued trials the target appears in the cued location. On invalidly cued trials the target appears in the location opposite to the cue. In many experiments the cue does not predict the location of the target. That is, 50% of the trials are valid and 50% of the trials are invalid. Nevertheless, reaction times to detect the target are influenced by the cuing manipulations. Reaction times are faster to detect validly cued targets than invalidly cued targets. This difference in reaction time is termed the cuing effect.

The above example demonstrates exogenous control over attention. The cues were small boxes that flashed abruptly on the computer screen, thereby producing a highly salient perceptual event. These visual flashes automatically attracted attention to their location. As a result, targets that appeared in validly cued locations were detected faster than targets that appeared in invalidly cued locations.

The purpose of the current experiment is to investigate whether meaningful symbolic cues can automatically control deployment of attentional resources. Rather than using abrupt visual onsets to cue target location, the current experiment employs arrow stimuli (> or <) that will be placed in the center of the screen following fixation. Arrow stimuli are interesting because they are partly exogenous and partly endogenous in nature. They are exogenous in the sense that they appear as external perceptual events. However, the arrows in this study are not highly salient. A leftward and rightward pointing arrow are fairly similar, and each arrow-type will be presented centrally. In this way when the arrow flashes on screen attention will be directed to the center of the screen and not to a potential target location. Arrows are endogenous in the sense that they convey semantic information

about direction. Arrows are symbols and people understand their meaning based on pre-experimental knowledge.

The current experiment tests the hypothesis that attention can be automatically controlled by symbolic information, like arrows, that point to a potential target location. The procedure is identical to the Posner Cuing task, with the exception that central arrows will be employed as cues rather than peripheral boxes. If arrows can automatically guide attention then validly cued targets ought to be detected faster than invalidly targets.

Method

Participants

20 Brooklyn College undergraduates participated for course credit. All participants had normal or corrected to normal vision.

Materials

The experiment was conducted on PCs (18" LCD monitor) controlled by LIVECODE. The arrow cues (> or <) were 1 cm in height and width. The target was an "x" (1cm x 1cm) that appeared 3 cm to the left or right of fixation.

Procedure

There 50 valid and 50 invalidly cued trials. On valid trials the direction of the arrow was consistent with the target location. On invalid trials the direction of the arrow was opposite to the target location. Valid and invalid trials were intermixed randomly from trial to trial.

Each trial began with a fixation cross "+" presented in the center of the computer monitor. After 500 ms the fixation cross was removed and immediately replaced by an arrow cue. The arrow cue remained on screen for 150 ms. Following removal of the arrow cue a target "x" appeared to the left

or right of fixation. The target remained onscreen until the participant detected the target by pressing the space-bar. Participants were instructed to perform the task as quickly and accurately as possible.

Results

Mean reaction time (RT) was computed for each subject in each of the valid and invalidly cued conditions. The results are presented in Figure 1. As predicted, RTs were faster for validly (150 ms) than invalidly (170 ms) cued trials, $t(19) = 5.32$, $p<.05$.

Discussion

The results of Experiment 1 show that symbolic information signaling direction can automatically orient attention toward a potential target location. This finding is interesting because it shows that salient perceptual information is not the only kind of cue that can automatically direct attention.

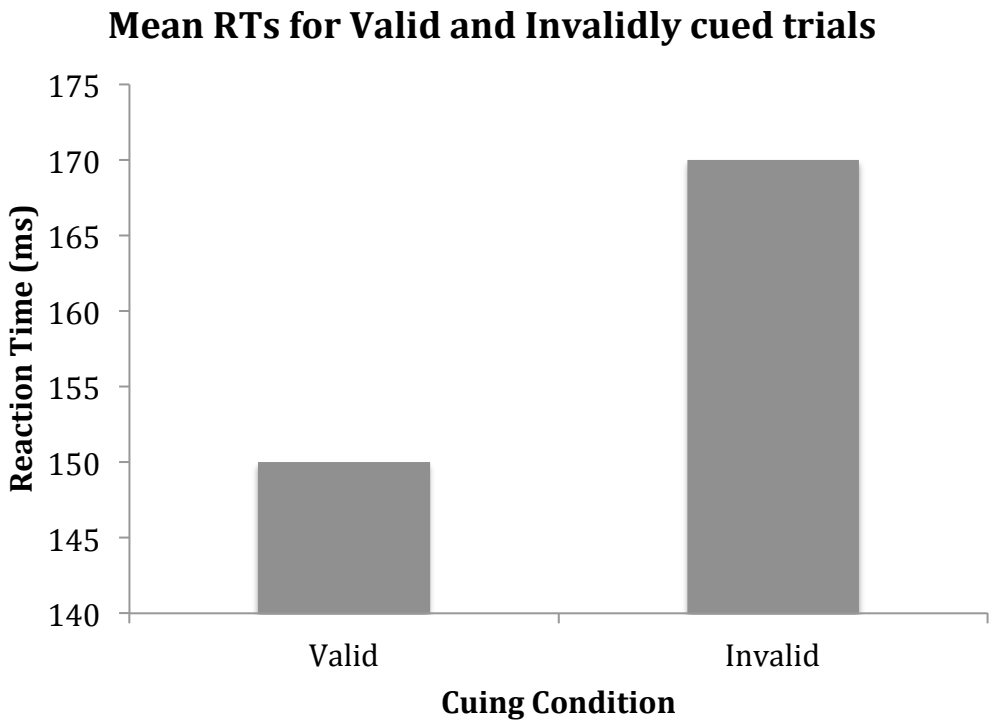
The current experiment restricted its investigation of symbolic cuing to arrow stimuli but there are many other kinds of cues that may also automatically orient attention. For example, the words “left” or “right” are symbols that convey directional information, and it would be interesting to investigate whether word cues also orient attention. Another kind of cue that is socially important is eye gaze. Perhaps replacing the arrow stimuli with pictures of eyes gazing to the right or to the left would produce a similar pattern of results as seen here.

References

Posner, M. I. (1980). Orienting of attention. *Quarterly Journal of Experimental Psychology, 32A,* 3-25.

Ruz, M., & Lupianez, J. (2002). A review of attentional capture: On its automaticity and sensitivity to endogenous control. *Psicologica, 23,* 283-309.

Figure 1.


Mean RTs for Valid and Invalidly cued trials
Reaction Time (ms)
175
170
165
160
155
150
145
140
Valid
Invalid
Cuing Condition