The proposal that peripheral visual changes (cues) tend to summon attention automatically was tested by studying the effect of peripheral cueing on simple detection latency. Delay between cue onset and target onset, the contingent relationship between cue location and target location, and instructions to subjects were manipulated. Results showed that a peripheral display change could capture attention even when the target was far more likely to appear at an uncued location. When subjects were explicitly informed that targets were likely to appear away from the cued location they were able to suppress this effect, but were unable completely to reverse it by rapidly orienting attention towards the uncued side. Hence the process appears to be automatic in the sense that it occurs unless there are explicit instructions to the contrary. With explicit instructions the processing operation can be suppressed, but not completely reversed.

Visual selective attention can be aligned covertly (i.e., independently of movements of the head or eyes) with locations in space. Recent studies of covert spatial attention have made use of a technique whereby a pretrial cue informs the subjects of the likely location of an impending display item. It has been found that the efficiency of perceptual processing at spatially cued locations is improved relative to uncued locations, and this has been interpreted in terms of the alignment of a covert attentional mechanism with the cued location (e.g., see Posner, 1980; Posner, Snyder, & Davidson, 1980). Jonides (1981) has discussed shifts of attention induced by spatial cues in relation to the distinction between automatic and controlled processing. He distinguished between the attentional effects of two different methods of spatial cueing, peripheral and central. In Jonides' experiments both peripheral and central cues consisted of an arrowhead pointing towards the most likely location for the next target. In the former the cue was presented peripherally in a position directly adjacent to the target location, while in the latter the arrowhead was presented centrally. Hence, peripheral cues signalled spatial location directly, while central cues were related to target position symbolically. Jonides proposed that peripheral cues tend to summon attention in an automatic, reflexive manner, while shifting attention on the basis of a central cue relies more on consciously directed, controlled processing. Posner (1980) and Posner and Cohen (1984) make essentially the same distinction between exogenous/peripheral and endogenous/central control of attentional orient-
ing. In the experiments of Jonides (1981) shifts of attention in response to peripheral cues appeared automatic according to several criteria. They made little demand on central capacity, being unaffected by the presence of a secondary memory load—unlike attention shifts made on the basis of central cues. In addition, they were resistant to suppression, and occurred even when subjects were instructed to ignore peripheral cues that provided no information concerning target location.

In an experiment reported by Posner and Cohen (1984) the attentional effects of a peripherally presented cue varied as a function of stimulus onset asynchrony (SOA) between the cue and a simple dot target. At brief SOAs (100ms or less) simple reaction time (RT) was faster for targets appearing on the cued relative to the uncued side. At a later SOA (500ms) target detection was slower at the cued location. These effects were termed facilitation and inhibition, respectively, and both occurred even though the cue was uninformative with respect to target location: that is, targets were equally likely to occur at cued and uncued locations. In fact the latter were both relatively improbable locations ($p = .1$), since most targets occurred at the center. The authors attributed these findings to a dynamic balance between two mutually opposed processes. The first of these, giving rise to the facilitation effect observed at brief SOAs, is a tendency for peripheral visual changes to capture attention. However, their views concerning the automaticity of this process were somewhat ambiguous. On the one hand they suggest that peripheral cues can capture attention independently of target location probability, since the effect “occurs even when the probabilities would favor noncued locations” (p. 549). Indeed, in a previous study (Posner, Cohen, & Rafal, 1982) the facilitation effect was observed in a condition where targets were more likely to appear at an uncued rather than a cued location ($p = .8$ vs. $p = .2$). Despite this they suggest that “subjects have considerable voluntary control over the facilitation effect” (p. 549). Explicit evidence was not provided on the latter point, and at first sight the two proposals appear contradictory.

A number of previous studies have noted the tendency of subjects to pay greater attention to likely target locations (Shaw & Shaw, 1977), particularly when these are indicated by a pretrial cue (Posner, Nissen, & Ogden, 1978; Posner et al., 1980; Eriksen & Yeh, 1985). If the facilitation effect is subject to voluntary control then one would expect subjects to orient attention away from the cue in a situation where target probability favors a noncued location. Full procedural details were not provided in the Posner et al. (1982) report. It is unclear how far subjects were explicitly made aware of the probabilistic relation between cue and target locations. The new experiment reported below attempted to clarify this issue by manipulating both the probabilistic link between cue location and target location, and the information and instructions given to subjects. The experiment therefore provided (1) a further test of the claim that peripheral visual changes capture attention even when targets are more likely to appear elsewhere, and (2) a test of the degree to which this attentional capture effect is subject to voluntary control.

In the Posner and Cohen (1984) study the facilitatory effect was complemented by a later acting inhibitory effect, which was apparent at an SOA of 500ms. It is worth noting here that both the SOAs used by Jonides were relatively short (50-125ms). On