

Notes and Comment

On interpreting the effects of location preknowledge: A critique of Duncan

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In a recent paper in this journal, Duncan (1981) discusses the theoretical implications of the finding that responding to a target in the visual field is facilitated by advance knowledge of its spatial location (e.g., Eriksen & Hoffman, 1973, 1974; Posner, 1980; Posner, Snyder, & Davidson, 1980; Tsal, 1983). He concludes that such results do not show that attention can facilitate perceptual processing *per se*; they could be due to postperceptual processes. Furthermore, Duncan contends that the facilitating effect of location preknowledge for a target presented in an otherwise blank visual field deserves no special interpretation, since the blank parts of the field are themselves real stimuli which may be admitted for, or rejected from, further processing by the attentional mechanism. Accordingly, comparable conclusions should be reached regardless of whether the target appears alone in the visual field or is surrounded by other noise elements. In both cases, the comparison of performance with or without preknowledge of target location reflects the difference between two selection schedules, one based on location and the other on some other criterion. Duncan proposes that spatial location is a basis for postperceptual (late) selection on a par with digithood, color, or the like. These various bases (schedules) for selection are not equally efficient, however; Duncan notes that location seems to be the most efficient. Even when only a single item is presented, advance location cuing will permit the viewer to use this efficient schedule; otherwise, the schedule would be (say) having-a-shape or having-a-color (vs. "blank").

Presumably, longer RTs for responding to a stimulus in the absence of location preknowledge are due to a time-consuming search operation by the selection mechanism, which interviews irrelevant portions of the visual field. Similarly, increases in error rate when the stimulus location is not known in advance result from the greater likelihood that a stimulus of a rapidly decaying initial representation will be interviewed later in time.

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Duncan's position implies that the magnitude of reduction in RT or improvement in accuracy as a result of location preknowledge should be unaffected by the difficulty of analyzing other characteristics of the stimulus, because the facilitation of location preknowledge is produced by eliminating the need to interview the irrelevant stimuli and is entirely independent of the perceptual processing of the relevant stimulus. One finding that clearly contradicts this prediction is that reported by Beck and Ambler (1973). They found that location preknowledge improved performance substantially for a difficult discrimination (detecting the letter L embedded among Ts) but had no effect on an easy discrimination (detecting a tilted T embedded among upright Ts). Beck and Ambler proposed that differences in line slant could be detected preattentively and in parallel, whereas the detection of line arrangement required focal attention. This result seems to contradict Duncan's claim that experiments varying target location preknowledge are irrelevant to the question of early versus late attentional selection.

Although Duncan treats spatial location as just another physical property of the stimulus, along with color, shape, orientation, etc. (e.g., Von Wright, 1968), location is in fact different from those attributes. Location is not merely a stimulus property, since the set of all locations is present in each perceptual act whether or not there is a stimulus object. The other physical properties do not exist independently of the stimulus; the properties "big," "red," and "square" acquire their existence in the real world only upon the appearance of a big or a red or a square object. This may be why advance knowledge of those stimulus properties need not improve performance when there is only one stimulus in the visual field (Posner et al., 1980).

The implications of this distinction for visual processing are apparent. Attending to a stimulus on the basis of its location is not contingent upon the occurrence of the stimulus, since the relevant location exists independently of the stimulus that is expected to occupy it. Thus, given sufficient time between a location cue and the stimulus, attention could be directed to the relevant location prior to the onset of the stimulus, and irrelevant stimuli need not require any processing on the basis of a selection schedule in order to determine whether they are relevant to the response.

As a result, unlike other stimulus properties, the efficiency of selection on the basis of location cuing is not largely determined by the degree of distinguishability between relevant and irrelevant items (which is

the major characteristic of selection schedules) but, rather, seems to be constrained by properties of the attentional mechanism, which can be allocated to various regions in the visual field. To clarify this distinction, consider the following two hypothetical experiments. The first experiment compares the efficiency of selection when specific color information vs. general color information is provided. In the specific color condition, a mixed array of red and blue items is presented briefly and subjects are cued before each trial as to whether they should report the red or the blue items. The general color condition is identical to the above except that here the items may slightly differ from trial to trial in hue or brightness. I doubt that selective performance will show serious impairment in the second condition as a result of eliminating specific color information. The reason for the expected similar performance under both conditions is that, despite the variations in color, the relevant and irrelevant items remain highly distinguishable (as in any typical effective schedule of selection). Now consider an analogous experiment for location cuing. In the specific location condition, a target appears in one of two precisely specified locations either to the extreme right or to the extreme left of fixation, and before each trial a cue directs the subject's attention to the relevant location. The general location condition is identical to the above except that here the cue directs attention not to a precisely specified location but to a relatively general area in the extreme right or extreme left of fixation. From what we know of the effects of spatial attention, it is reasonable to expect a significant impairment in performance in the absence of specific location information. Note that, as in the color experiment, the right and left general regions which might contain the target are clearly distinguishable from each other. Thus, this inferior performance could not be attributed to the reduction in efficiency of a selection schedule, but rather to the nature of the spotlight-like attentional mechanism which produces maximal

sensitivity at a focal area of a limited size (e.g., Eriksen & Hoffman, 1972).

Duncan's note was to dissociate positive effects of location cuing from the question of early versus late attentional selection. The purpose of this reply has been to reassert the claim that location preknowledge can affect perceptual processing (and is thus "early") and does not simply facilitate a postperceptual stage of selection for entry into a conscious limited-capacity system. Note that the ability of attention to facilitate perceptual processing does not imply that unattended stimuli are incompletely analyzed; to adopt Duncan's words, "the results are consistent with any claim concerning the detail of such analysis".

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