Selective attention: Incentive variables and choice time¹

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The effect of instructions to respond quickly to a particular color in a three-color recognition task was studied in an attempt to determine whether the instruction operates to produce faster perception or faster response processing. Results showed large and consistent latency differences between emphasized and nonemphasized colors assigned to the same response. Since differential response bias was controlled in the design, it was concluded that the instructed selectivity operates at the perceptual level.

One of the more persistent problems in the area of selective attention is the determination of the functional locus of the attention process. Recently, Egeth (1966) reviewed a group of studies which suggested three likely locations of selectivity, namely, the perceptual process, the memory trace, and response "readiness." In most of these studies (e.g., Lawrence & LaBerge, 1956; Harris & Haber, 1963), the designs employed before-after instructions with briefly presented visual stimuli, and the purpose was to contrast the roles of perceptual and encoding-memory factors. No attempt was made in these studies to isolate perceptual and memory trace effects from pure response bias effects.

One of the methods used to separate perceptual effects from response bias effects in choice tasks involves assigning two stimuli to the same response and then conferring a bias condition on one of these stimuli. This was the procedure employed in a related study (LaBerge & Tweedy, 1964) where red and blue colors were assigned to one hand, and green to the other. The bias condition was introduced by presenting the red stimulus five times as often as the blue stimulus (and vice versa). The results showed consistently shorter response latencies for the more frequently presented stimulus. Since the red and blue stimuli were assigned to the same hand, no differential response bias could operate, and the difference in latency between these two colors was attributed to the stimulus frequency factor alone. Similar results have been found by Bertelson (1966) using letter cues in a four-stimulus design.

One question growing out of these findings concerns the manner in which presentation probability might operate on perception to increase the speed of processing. Perhaps a highly frequent stimulus is put at the top of the noticing order, and thereby is more quickly perceived. If this were indeed the case, then alternative means of manipulating noticing order should produce similar patterns of latency results in this choice task.

In the present study payoffs were given for fast correct responses to a specific color stimulus. This method of emphasizing a color seemed on a priori grounds to be

more direct because the bias can be produced immediately, whereas the bias from presentation probability manipulation requires a series of trials before the S discovers the stimulus with the highest presentation probability. It was expected, therefore, that instructed selectivity would establish stable levels of response latency more rapidly. At the same time a specific instruction to respond quickly was expected to provide a good opportunity for any existing response bias to show itself.

Method

In most respects the procedure was the same as that described in a related study (LaBerge & Tweedy, 1964). The stimuli were colored rectangles, 3/4 in. wide and 2 in. high, each framed against a 5 x 8 in. white background and illuminated behind one-way vision glass by an incandescent bulb. Two buttons were available for responding to the onset of each of the three colors, green, red, and blue. The Ss were instructed to press one of the buttons when the green color appeared, and the other button when either the red or the blue color appeared. The green color was assigned to the right hand for half of the Ss and to the left hand for the other half of the Ss.

The 16 undergraduate Ss were run in pairs, and preliminary instructions as to the nature of the task were followed by 10 warm-up trials. Then a series of five blocks of 20 trials each was given under the incentive instructions that S would receive a single point for each correct response, and lose 20 points for each error. Following this first series, the Ss were given a brief rest period in which new instructions were given. The Ss were told that one particular color was important, and that they would receive 20 points for each response to that color which was at least 1/10 of a sec faster than the average response time for that color during the first session of trials. For correct responses to the other colors they received one point, and for all incorrect responses they lost 20 points as before. The high incentive color in this condition was red for half the Ss and blue for the other Ss.

Following this series of five blocks of trials, the Ss were again given a rest period and the instructions were changed such that the high incentive was shifted from red to blue, or blue to red, depending upon the group assignment. Five blocks of 20 trials were subsequently given in this third series.

The probabilities of color presentations were always 50% green, 25% red, and 25% blue. These probabilities were maintained within each block of 20 trials. Two random schedules were constructed, and were counter-balanced across the conditions of color-hand assignment

Fig. 1. Mean response latency to the color stimuli. Curve A represents responses to the green stimulus by one hand; Curves B and C represent responses to the red and blue stimuli by the other hand. Curve B represents responses to the stimulus which had incentive assignments of 1, 20, 1 points, respectively, over the three series of blocks. Curve C represents responses to the stimulus which had incentive assignments of 1, 1, 20 points, respectively, over the three series of blocks.

and order of high-incentive color assignment.

Time durations of events within trials were controlled automatically. The color stimulus was presented for 1 sec, with an intertrial interval of 3 sec. Response choices and latencies were recorded automatically.

Results and Discussion

The mean latency curves for correct responses to the three colors are shown in Fig. 1. The shifts in latency levels due to changes in instructed payoff conditions are more pronounced and occur much more rapidly than was the case under stimulus presentation probability conditions in the study by LaBerge & Tweedy (1964). In order to test latency changes over the three series of trials, the latencies of each five-block series were averaged and contrasted across adjacent series. All shifts were highly significant ($p < .001$) by sign tests, including the smaller shifts in mean latency from Blocks 1-5 to Blocks 6-10.

The similarity of the present results to those of the LaBerge & Tweedy (1964) study constitutes support for the hypothesis that stimulus frequency and incentive payoffs operate on a common selective or bias process at the perceptual level.

The incentive contrasts of 20 to 1 produce latency differences on the order of 100 msec, which is over three times as great a difference as that obtained by manipulating presentation probabilities. However, in the LaBerge & Tweedy (1964) study, the presentation probability contrast was 5 to 1, and it is likely that the 30 msec difference obtained would have been larger if the ratio were increased. A problem inherent in using extreme presentation probabilities is that one stimulus occurs very rarely and therefore yields few observations on which to base a mean latency estimate. In addition,

errors are highly likely to occur to extremely infrequent stimuli. Biasing by incentive manipulations avoids the first problem and apparently reduces the magnitude of the second problem.

Some qualification of the conclusions of the former study (LaBerge & Tweedy, 1964) seems to be called for when we examine latencies in the first five blocks of the present experiment. Given that the saliencies of the three colors used here were equated by preliminary testing, one would expect the 50% presentation rate of the green stimulus to produce lower latencies compared to the 25% presentation rates of the red and of the blue. However, since these latency curves are indistinguishable, one is led to conclude that a 2 to 1 presentation probability contrast is not sufficiently large to emphasize the green color.

Most investigators in this field use the term "channel" to describe the sets of stimuli which are given some sort of bias in an experiment. Broadbent (1958) and Treisman (1964), for example, consider each ear as a "channel" and assume that the attention mechanism gives priority simultaneously to all sounds arriving in one ear as opposed to the other ear. For the visual modality, Rabbitt (1962) has suggested that letters and colors function as separate "channels" in a parallel fashion. In the present study, it appears that the selective or biasing effects are being focused on a particular color, as if each color were in this respect a "channel." How then does the S bias colors over letters, for example? One could argue that he does not select or bias the color dimension as a whole, but, by varying the specific color attended to from trial to trial, his average performance gives the impression that he is maintaining a preparatory set across all the color alternatives used in the particular experiment. An alternative hypothesis is that the perceiver can modify the range of stimuli to which he gives priority, so that at one time he is prepared for one specific color, another time for all colors, and at still another time for all visual stimuli.

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Note

1. This research was supported by NSF Grant GB-1387, the Graduate School of the University of Minnesota, and the Center for Research in Human Learning (NSF Grant GS-541).