Visual selection: Scanning vs filtering¹

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Abstract

Ss were required to report whether two successively presented lines of Os and Ds were same or different. In a pretest, failure to detect differences was a function of the position of the substitute letter, increasing with the distance of that letter from the left of the line. However, after training, it is the utility of a position, the probability of its containing a substitute letter, and not position per se, which determines accuracy. This result, and the conditions of training which produced it, cast some doubt on theories which regard visual selection as a scanning process derived from overt eye-movements. A filter model seems more appropriate to the data.

Problem

There is an impressive amount of evidence showing that visual processing of textual material runs off from left to right, so that material presented in the left half of the visual field is more likely to be recognized than material presented in the right half of the visual field. (See, e.g., Harcum, 1964.) It is assumed that this result reflects habits acquired in reading English texts. A further assumption often made is that this result supports Hebb's (1949) position that visual selection results from a scanning process which is an internalized form of eye-movement, overt eye-movement being considered a necessary condition for the internalized, covert eye-movements. It seemed worthwhile testing to see whether the textual case really substantiated the hypothesis or whether factors other than internalized eye-movements had to be taken into account.

Method

Twenty-four volunteers from an introductory psychology class served as Ss. Stimuli were lines of six letter positions, each letter position being filled with either an O or a D. The letters were arranged two letter spaces apart around a fixation point which bisected the line. All possible combinations of Os and Ds, 64 in all, were used. Letters were typed black capitals. Stimuli were presented in a Scientific Prototypes G.A. tachistoscope. The visual angle of a line of letters was $16^{\circ}40'$. During pretesting the 63 pairs of lines differing in only one letter were presented eight times each in random order, interspersed with 128 same presentations (i.e., each line was presented with itself twice). The first line in a presented pair was on for 100 msec., followed by an interval of 140 msec., followed by the second line for 10 msec. The second line appeared randomly in one of three positions relative to the first line, in the same spatial position, 5° to the left, 5° to the right. The fixation point was present in all three fields and between trials. Field-luminance was 30 ft-L. Ss were

instructed to fixate the fixation point and to say whether the presented pair of lines were same or different.

One day after completion of pretesting, Ss were trained in the following way. They were divided into six groups. Each group was trained with a different subset of lines so that over the training period, different letter positions had a different probability of containing different letters over all pairs. For every group letter positions could differentiate pairs on 34, 26, 16, 10, 4, or 0% of trials. The differential utility of the six letter positions was counterbalanced across groups. The remaining 10% of trials were 'same' presentations. A total of 600 trials were given. Presentation conditions were as before save that second lines were on for 100 msec.

One day after training the pretest was repeated exactly as before. Results were corrected for guessing.

Discussion

Figure 1 shows the results of the first pretest. The expected increase in accuracy with shift of the differential letter position to the left clearly occurs. Figure 2 shows the result of the post-test. Accuracy is plotted against the differential utility during training of the differentiating letter position and is clearly a function of differential utility. Letter position has no effect here since every letter position had every differential

Fig. 1. Accuracy as a function of differentiating position (measured from the right of the line) in pretest.

Fig. 2. Accuracy of the differential utility during training of the differential letter position.

utility value across groups. Position of appearance of the second line had a slight but insignificant effect on performance in pre- and post-test. (Chi-square = 3.02, 2.88, $df=40$, N.S.)

The conditions of training used here preclude any explanation of the effect of utility in terms of eye-movements. During training exposure time was too short

for eye-movements to occur. The ordering of utilities over eye position was in any case non-linear for four groups so that a very odd pattern of recursive eye-movements would have been necessary to successively foveate positions in order of utility. The fact that the second line appeared randomly in one of three positions relative to the first also precludes any explanation based on changing eye-posture to ignore the fixation point and instead look at highly useful regions.

These results in fact are scarcely in accord with any kind of orderly scanning mechanism however derived. A scanner, unless it leapt from point to point, ignoring intervening regions, could not produce the results shown in Fig. 2. A simpler conceptual mechanism is a filter feeding into a funnel, the filter being in reality a myriad of small filters, which can open in any order as dictated by environmental contingencies. Such a scheme could handle these results, the reading of normal texts, and perhaps also the transposition effects in tachistoscopic perception discussed by Koestler & Jenkins (1965).²

References

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Notes

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