Visual recognition under conditions of high and low discrimination redundancy

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The purpose of this investigation was to measure the minimum interval for recognition under conditions of high and low discrimination redundancy. The minimum interval for recognition is the briefest interval between two stimuli at which the first stimulus can be processed. Two sets of four digits were used. Digits were selected so that one set exhibited high discrimination redundancy and the other low discrimination redundancy. Ten Ss viewed digits with high discrimination redundancy, and 10 Ss viewed digits with low discrimination redundancy. The minimum interval for recognition for Ss tested with high discrimination redundancy was nearly twice as large as the minimum interval for recognition of the digits with low discrimination redundancy.

Research has well established that the perception of a visual stimulus may be interfered with or masked by the presentation of a second visual stimulus (Sperling, 1960; Averbach & Coriell, 1961). In the case of this particular masking phenomenon, the second stimulus appears to erase the information held briefly in a visual short-term storage system. The phenomenon is also widely referred to as the destructive erasure of an icon.

The minimum time that must be allowed between the initiation of the first stimulus and the appearance of the erasing stimulus in order for recognition of the first stimulus to take place is referred to here as the minimum interval for recognition (MIR). It represents the time required to process the incoming batch of information to the point where the recognition can take place. In a previous paper, techniques were described which can be used to measure the MIR (Travers & Bosco, 1967). Various investigations have identified variables which affect the MIR. Luminance (Scharf, Zamansky, & Brightbill, 1966), type of masking pattern (Schiller & Wiener, 1963), and retinal locus (Forgus, 1966) have been identified as significant variables.

Another potentially salient variable is the discrimination redundancy of the set of test stimuli. In both the case of discrimination redundancy and its counterpart schematic redundancy, there is an excess of information. Yet, that which constitutes an excess of information when the task is memorization is not equivalent with an excess of information when the task is discrimination. If we consider any set of stimuli as composed of a schema set and a correction set, increasing the schema set (common elements) increases the schematic redundancy of the set, while increasing the correction set (distinctive elements) increases the discrimination redundancy of the set (Evans, 1967).

This study is concerned with the relationship between the discrimination redundancy of a set of stimuli and the minimum interval for recognition (MIR). In this investigation, two sets of four 2-digit numbers were used as test stimuli. In one set, no digit was used more than once (high discrimination redundant set). In the other set, each digit was used four times (low redundant set). The purpose of this investigation was to measure MIR under the conditions of high and low discrimination redundancy.

PROCEDURE

The test stimuli for this experiment were presented to the Ss through the use of a Gerbrands 2-field tachistoscope Model T-2B-1. Each stimulus consisting of a white digit on a black background was presented for 10 msec followed by a dark field which varied in duration from 60 msec to 6 msec. The dark field was followed by a blocking stimulus consisting of a complex white pattern on a black background and was presented for 10 msec. The test and blocking stimulus appeared between two dim red markers 2 mm in diameter. Subjects were instructed to respond after each trial. If they did not feel certain of the identification of the test stimulus, they were instructed to guess.

Fig. 1. Masking stimulus.

DESIGN

The digits used in the experiment were of two types: high discrimination redundancy and low discrimination redundancy. Table 1 shows the test stimuli.

Inspection of this table reveals that, in the case of high discrimination redundancy set of digits, if either of the two characters is identified, and if the set is known, it is possible to identify the stimulus. For the low discrimination redundancy set of stimuli, both characters must be observed to correctly identify the stimulus. The words and digits were presented in white print (Para-Type 36 point Gothic) with a luminance of 3.2 ft-L measured with a Spectra Brightness Spot Meter, Model UB. The letters were 3/8 in. high and 23 in. distant which results in a visual angle of less than 1 deg.

Each S was tested on either the high or low redundant digits. The digits were presented in 10 blocks of eight in random order within each block with each of the four digits appearing twice in each block. Each of the first eight stimuli were presented followed by a dark field of 60 msec followed by the blocking stimulus. Subsequent groups of stimuli had inter-exposure dark fields of 54, 48, 42, 36, 30, 24, 18, 12, and 06 msec.

The general nature of the experiment was described to each S, who was also shown a card with the pairs of digits to be used printed on it. Each S was given five trials with each of the pairs of digits alone followed by an additional five trials with the blocking stimulus presented after an interval of 200 msec. In addition, each S was given three trials with the blocking stimulus immediately following the letter in order to familiarize him with the erasure effect and to explain that he was expected to guess a letter if not certain of the letter presented. The sequence dark field—digit—dark field—masking stimulus—dark field was triggered by S pressing a switch. Between trials S was asked to look away from the apparatus into the dimly lit experimental room. The entire procedure occupied about 20 min.

Table 1
Test Stimuli

High Discrimination Redundancy	Low Discrimination Redundancy
15	26
26	22
37	62
48	66

SUBJECTS

These were 20 undergraduate students from Western Michigan University who volunteered for the experiment. The Ss were given credit in an introductory psychology course for participation by obtaining credit points.

RESULTS AND DISCUSSION

MIR for each of the 20 protocols was identified by selecting the point on the scale immediately below the S's last three consecutive correct responses. If there were three consecutive incorrect responses above this point, however, then the procedure of finding the three consecutive right responses above this point was again utilized.

Inspection of the data revealed that the MIR for Ss tested with high redundant digits was nearly twice as large as the MIR for Ss tested with low redundant digits. The means for the two groups were: high redundant 25.8 msec; low redundant 47.4 msec. The variance of the two groups was not significantly different at the .05 level. The value for t was computed to be 18.02 ($p < .0005$).

The data from this experiment strongly support the conclusion that discrimination redundancy facilitates the recognition of digits. Previous investigations (Long, Reid, & Henneman, 1960; Reid, Henneman, & Long, 1960) have reported that if the S is given the set of possible responses to be used during the experiment prior to the exposure of stimuli, the number of correct recognitions is increased. The data from this study suggest that certain sets may facilitate the recognition task more than other sets.

Studies by Solomon and Postman (1952) and Newbigger (1961) suggest a plausible explanation for the differences observed in this experiment. A stimulus which is presented for a brief duration may not be completely processed. Given that S processes some piece of the stimulus, his probability for making a correct response will be contingent on the utility of the cue. Whenever the

ensemble of responses is known by the S prior to exposure of a stimulus, the utility of the cue in recognition tasks is directly related to the discrimination redundancy of the expectancy set. If the stimuli have many common elements and few distinctive elements, and if only a random fragment of the stimulus is processed, the likelihood of a correct response is reduced. By minimizing the cue similarities, the high discrimination redundant set maximizes the usefulness of each cue in selecting the correct response.

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