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The Effects of Frequency of Usage on Pre-recognition Responses and Recognition Thresholds of Words

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By CHARLES D. SMOCK

Tachistoscopic presentation of words has been widely used in the study of the relationship between personality variables and perception. The procedure is to present words drawn from relevant meaning classes, such as needs or values, for increasing periods of exposure until the S is able to correctly identify the stimulus words. The results of several such experiments (3, 4, 8, 10) lend support to the view that personality factors are important determiners of an individual's sensitivity to visually presented stimuli. However, since most of these studies have used verbal report as the index of perceptual sensitivity, many investigators have become increasingly concerned with the effects of verbal learning variables on recognition thresholds. Particular attention has recently been focused on the contribution of frequency of usage of words to variations in these recognition thresholds (5, 6, 7, 11, 12).

Solomon and Postman (11) in the most direct test of the frequency hypothesis required Ss to read and pronounce nonsense words in a pretraining session, thus building in frequencies ranging from 1 to 25. Later the Ss' recognition thresholds for the practiced and for the control words were determined. The recognition thresholds for these words were found to vary inversely with the frequency of usage in the practice sessions. These results demonstrate that at least part of the variance in recognition thresholds that has been attributed to motivational factors in selective perception can be accounted for in terms of the frequency variable.

The purpose of this investigation was to study the effects of frequency of usage on the responses made prior to recognition of the stimulus word. These pre-recognition guesses or hypotheses have been offered as additional evidence in support of the motivation component of selective perception (3, 4). In view of the data on the influence of frequency of usage on recognition thresholds it is reasonable to assume that pre-recognition responses also are some function of the frequency mechanism (2, 5, 6). Classification of the pre-recognition response under the usual verbal report conditions, however, is sometimes difficult and arbitrary. Therefore, a visual matching (multiple-choice) response condition was included in the attempt to gain some experimental control over the responses

King-Ellison and Jenkins (7) have replicated this study with even more convincing results.

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and to facilitate analysis of the pre-recognition data. Data relevant to the effects of frequency of usage on recognition thresholds under the two conditions will also be reported.

**METHODS**

Forty undergraduate students were assigned randomly to four experimental groups: Group I was designated as the low frequency—verbal report group; Group II, the high frequency—verbal report group; Group III, the low frequency—multiple-choice condition group; and Group IV, the high frequency—multiple-choice condition group.

The Ss were brought into the experimental room and told we were conducting an experiment on how quickly they could see things. The E showed them a stack of cards; on each of eight cards was a two syllable, five letter nonsense word. Ss were instructed to look at each word carefully and to pronounce it aloud, and to remember it, since they would be asked to recognize the word at very high speeds. Groups I and III, the low frequency groups, received five such pre-test trials, and the high frequency groups (II and IV) received 25 trials.

Following the pre-training experience, a one minute period of conversation was interpolated and then the Ss were asked to write down all the words they could remember. The operation of the tachistoscope was then explained and a practice recognition trial was administered to each S.

Eight, five letter nonsense words were then presented for recognition; four of the words, hereafter called the experimental words, were randomly selected from the pre-training series. Four words were selected as control words; these words were not on the list but had structurally similar counterpart in the list. All Ss received the same list of eight words, but in different random order of presentation during the test series. The words were presented in a mirror tachistoscope beginning at five milli-seconds and continuing in stages of five milliseconds each until three consecutive correct responses were elicited.

Pre-recognition responses and recognition thresholds were obtained under two response conditions. Group I and II, the non-multiple-choice groups, were told they were being shown nonsense words, some of which they had just seen, and were to write down after each presentation their best guess as to what word was being shown. Ss were forced to guess. Groups III and IV, the multiple-choice groups, were provided with answer sheets on which were listed the eight pre-training nonsense words in different random order for each trial. After each presentation of the stimulus word,
the S was to select from this list their first, second, and third guesses according to which word they though was being presented. If their first choice was not listed, the Ss were instructed to write it down in the space provided, and to select their second and third guesses from the list. Criterion of recognition was again three consecutive correct identifications of the stimulus word.

**Results**

The effect of frequency on pre-recognition responses was determined by comparing the similarity of these responses for the high and low frequency groups. A similar response in the verbal report group was arbitrarily defined as any response having three or more letters in common with the exposed test word. For the multiple-choice group, a similar response was recorded if the exposed test word appeared as one of the S's three choices. For purposes of analysis, a similarity score, defined as the ratio of similar responses to the total number of pre-recognition responses, was computed for each individual. Analysis of variance of these similarity ratio scores yielded a significant F-ratio for the main effect of frequency ($F = 16.23$; $df = 1, 36; p < .001$). Table 1 contains the mean ratio scores obtained for the four experimental groups when a pre-training word was being presented. As indicated, the means of the 5 and 25 pre-training trial verbal report groups were 39.8 and 49.4 respectively. The difference between these means, as evaluated by a t-test, is significant between the .10 and .05 level of confidence ($t = 1.84$; $df = 19$). The respective means for the group under the visual matching conditions were 40.1 and 62.4. The test of significance of this difference yielded a t of 2.71, which with 19 degrees of freedom is significant between the .02 and .01 level of confidence. These results indicate that frequency of usage is an important determiner of response to stimulus words presented for duration periods below the recognition thresholds. This finding, in conjunction with Bricker and Chapanis' (2) results on the effects of the stimulus on pre-recognition guesses, is supportive of a probability of response emission interpretation (5, 6) of variation in recognition thresholds.

**Table 1**

<table>
<thead>
<tr>
<th>Frequency of Usage</th>
<th>Verbal Report</th>
<th>Visual Matching</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Gp. I</td>
<td>Gp. III</td>
</tr>
<tr>
<td>5</td>
<td>39.8</td>
<td>40.1</td>
</tr>
<tr>
<td>25</td>
<td>49.4</td>
<td>62.4</td>
</tr>
</tbody>
</table>

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Recognition thresholds were also obtained for all the words. Analysis of variance performed on the average trial of recognition yielded significant main effects of response conditions ($F = 21.60; df = 1, 36; p = .001$); and between experimental and control words ($F = 23.65; df = 1, 36; p = .001$). The main effect of frequency did not reach the 10 per cent level of confidence. Figure 1 presents the relevant data in graph form. The control words are plotted as having zero frequency.

Figure 1

The Effects on Frequency of Usage on Recognition Thresholds

The analysis indicates that the major effects of frequency on recognition thresholds apparently occur within five prior occurrences of the stimulus. From this point on, the effects of frequency on recognition thresholds are not at all evident under the multiple-choice (visual matching) condition. Under the verbal report condition the mean trial of recognition was 14.3 for the low frequency group and 10.8 for the high frequency group. The test of the significance of this difference yielded a $t$ of 1.68 ($df = 19$), which is just short of the 10 per cent level of confidence. Although differences in the experimental procedures and design between this study and the Solomon and Postman (11) investigation preclude clear-cut conclusions regarding the limits of the frequency effects, the two studies do yield very similar types of curves. The most tenable hypothesis appears to be that frequency of usage is a significant determiner of variation in recognition thresholds only under conditions of very low frequency (probably 5 or fewer prior occurrences of the stimulus) and/or short exposure durations (1, 3).

Although the control words for the visual matching condition are plotted as having zero frequency, procedural artifacts preclude clear-cut interpretation of the lower curve in Figure 1. That is, the control words were not listed on the multiple-choice response sheet, therefore, both recall and matching functions are involved in the responses to these words as stimuli.
WORD RECOGNITION THRESHOLD

SUMMARY AND CONCLUSIONS

In summary, these data indicate that:

1. Frequency of usage significantly influences responses to words when they are presented for exposure periods below the recognition threshold. This relationship holds under both a multiple-choice and the usual verbal report response condition.

2. The data on recognition thresholds warrant the conclusion that the effects of frequency of usage reach an asymptote at about 5 pre-training trials, although a slight, but not significant, effect was obtained between the 5 and 25 trial group under the non-matching condition.

3. It was found in this experiment that recognition thresholds under a visual matching condition were significantly lower, and less affected by frequency, than recognition thresholds under a verbal report response condition. The multiple-choice technique would seem to offer possibilities for studying the limits of the frequency variable on the perceptual process, and in conjunction with the usual verbal report, measure the function of associative factors in selective perception.

REFERENCES


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