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A Study of the Variables Influencing Subliminal Perception

Daniel Gilman
Western Michigan University

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A STUDY OF THE VARIABLES INFLUENCING
SUBLIMINAL PERCEPTION

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A Thesis
Presented to
the Faculty of the School of Graduate Studies
of
Western Michigan University

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In Partial Fulfillment
of the Requirements for the Degree
of Master of Arts

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by
Daniel Gilman
Kalamazoo, Michigan
August, 1962
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A STUDY OF THE VARIABLES INFLUENCING

SUBLIMINAL PERCEPTION

This experiment represents an attempt to study many of
the factors of subliminal perception. Subliminal perception
has been defined by most authors in reference to a defined
absolute threshold. Bugelski (1951) defines the threshold
as the lowest value of a stimulus that will elicit a con­
stant response. Hebb (1958) defines the stimulus threshold
as any place between no response and 100% response. The
stimulus threshold as defined by Woodworth & Schlosberg
(1954) is that value of a stimulus which evokes a positive
response 50% of the time. Dember (1960) defines the thresh­
hold in terms of the stimulus energy necessary to evoke a
response. Dember further suggests that the lower absolute
threshold value of the stimulus varies depending upon the
type of response required of the subject. This suggests
that there are actually three threshold values; a detection
threshold, a recognition threshold and an identification
threshold. Each of these would give a different threshold
stimulus value and suggests that sub-threshold stimuli could
vary depending on which original definition was used. In
this study, subliminal perception was defined operationally as the above chance identification of a stimulus presented at an energy level below the conventionally defined lower identification threshold. The performance of a control group was used to verify this definition. Any improvement in performance exhibited by the experimental group could then be interpreted in terms of variables other than stimulus energy.

The variables of subliminal perception have been studied by many authors. Murdock (1954) defined the stimulus threshold as the level of illumination that would produce 100% accuracy of perception of nonsense words exposed at 1/100 of a second. Solomon & Postman (1952) defined the duration threshold as the flash duration just necessary for correct recognition. Smith, Spence & Klein (1959) determined the median duration threshold of a word superimposed upon a landscape picture to be 125 milliseconds. The first variable studied in early perception experiments was illumination. Dunlap (1900) demonstrated that subliminally illuminated angular lines affected perceptible straight lines in the same manner as the classic Muller-Lyer illusion.
Repeating this experiment, Bressler (1931) found that the magnitude of distortion varied directly with the illumination of the subliminal angular lines, instead of being an all-or-nothing effect. Goldstein (1960) achieved the same results using projected subliminal patterns upon supraliminal geometric figures. Baker (1937) and Williams (1938) found that verbal behavior could be influenced by a considerable range of subliminally illuminated geometrical figures. These five studies conclusively demonstrated that the visual threshold varied inversely with the intensity of illumination of the stimuli. This variable was held constant in this study.

Just after World War II, Bruner & Postman (1947a) discovered that the recognition threshold for socially unacceptable words deviated from the threshold of neutral words. This deviation was either higher or lower for separate individuals and was called respectively perceptual defense or perceptual vigilance. The variable of word connotation and its effect upon recognition thresholds was studied by Bruner & Postman (1947b), Postman, Bruner & McGinnies (1948), McGinnies (1949), Rosenstock (1951), Eriksen (1954), Blum (1954 & 1955), Chodorkoff (1954 & 1956), Freeman (1955),
Spence (1957), Dulany (1957), Smith, Spence & Klein (1959), and Walters, Banks & Ryder (1959). Because of variations in experimental controls, these authors arrived at contradictory conclusions concerning the occurrence of threshold heightening rather than threshold lowering. The general consensus agreed with Postman & Schneider (1951) that threshold changes were determined by personal predispositions. The heightening of the recognition threshold could have been due to subject embarrassment at blurring out a "dirty" word, or, as Solomon & Postman (1952) and Howes & Solomon (1951) illustrated, this effect could have resulted from the subject's lack of familiarity with the word. In defense of word connotation hypotheses, Wiener (1955) demonstrated that the effect still persisted when the variables of familiarity and embarrassment were controlled.

Not to be overlooked are experiments by Stroh, Shaw & Washburn (1908) in which guessing of letters printed on cards held at distances was found to be better than chance. Or Miller's 1940 experiment which demonstrated that learning could occur without awareness of the actual learned stimuli. And finally McClelland & Atkinson (1948), who
showed that verbal responses to subliminal stimuli could be structured by personal needs.

Verbal instructions could also affect subliminal perception. Miller (1939) illustrated that specific foreknowledge given instead of no foreknowledge before experimentation could affect the amount of illumination necessary for awareness and discrimination. Lacy, Lewinger & Adams (1953) found that when subjects had no reason to expect to see emotion-arousing words, the words were harder to recognize, but when such an expectation existed, the taboo words were easily recognized. In a similar experiment, Freeman (1954) was able to show that word recognition thresholds could be changed by introductory verbal instructions. The present study attempted to show that subjects who expected a stimulus presentation would perceive the stimulus, while those not expecting the stimulus would be unable to perceive it.

Temporal summation effects are another variable included in subliminal perception. Bricker & Chapanis (1953) and Murdock (1954) demonstrated that incorrect recognition hypotheses to stimuli, presented below the actual threshold, contained some information. Hebb (1958) defines summation
as occurring when a number of excitations achieve a reaction that no single excitation is strong enough to achieve alone.

He then goes on to demonstrate many cases where this effect was present. Howes & Solomon (1951) illustrated that the visual threshold varied with the duration of the stimulus. Gember (1960) asserted that acuity increased as the stimulus duration increased.

These studies suggest that the major variables in subliminal studies were duration of exposure, illumination intensity, word connotation, number of exposures, and verbal introductory instructions. This study then attempted to bring all of these variables together to see what interrelations might exist. More specifically, the study was designed to determine whether or not subliminal perception, as previously defined, does occur, and to determine, if it does occur, what specific conditions are associated with its occurrence.
Method

The experiment consisted of two groups of 36 subjects each. Both groups were shown a five minute segment of the film "Demonstrations in Perception". The segment consisted of the rotating trapezoidal window illusion. Tachistoscopic exposures of words, appearing in conjunction with the film, were varied so that all the possible combinations of three different exposure speeds, three exposure frequencies, and two different word connotations were presented. The exposure speeds were 1/25, 1/50 and 1/100 of a second. The exposure frequencies were every 5, 10 and 15 seconds. The word connotations were termed neutral and ego involving. These words were chosen from a list compiled in 1922 by Whately Smith (Woodworth & Schlosberg, 1954). This list included four and five letter words, which had been presented to 50 subjects in order to determine the magnitude of the average psychogalvanic response of the subjects to each word. Nine of the words which elicited the smallest average psychogalvanic response were used in this experiment as having neutral connotations and nine having the greatest average response were defined as having ego involving connotations. Smith used
the Thorndike-Lorge dictionary to choose words of equal familiarity.

The thirty-six control subjects entered the projection room in mixed-sex pairs and were asked to be seated. They were then told what would be shown on the five minute segment of film and asked to try to resolve the filmed illusion in their minds. The film was run and the particular combination of exposure duration, exposure repetitions, and word connotation were tachistoscopically flashed upon the screen simultaneously with the picture. At the end of the segment, they were told that a word had been flashed on the screen during the picture, and asked to check their guess for the word on the check list.

The experimental group followed the same procedure of instructions as the first group. After the introductory instructions were given, the experimental subjects were told that these same directions had been given to a previous group, but that the first group had not known that a word had been flashed during the movie. The experimental subjects were then told that a word would also be flashed simultaneously with their film segment and that they would
be expected to know the word by the end of the film. Because of an error, three of the presentation conditions consisted of two males instead of a mixed-sex pair. After the segment was shown, the members of the experimental group were asked if they knew the word. If they did, they were asked to write it on a blank piece of paper. If they did not, or if they had written an incorrect word on the paper, they were handed the check list and requested to check what they thought to be the correct word. Thus any differences between the control and experimental responses should be due only to the factor of verbal introductory instructions.
Results

Except for one subject, the members of the control group all professed an unawareness of the tachistoscopically projected word. The remaining thirty-five subjects registered surprise or consternation, when informed of the tachistoscopic projection. The results of their recognition on the check list (Table 1) showed that the control group had five correct estimations out of thirty-five possible. Here the control group showed some evidence of a subliminal effect. Because of the small number of correct responses, no analysis of the variables was attempted. The lack of both positive results and expected trends among the variables seems to refute the previous experiments and substantiate that the stimuli were below the threshold level. One interesting aspect of this group was that neutral words were guessed twice as frequently as the ego involving words.

All members of the experimental group were able to see that something was being tachistoscopically projected. Thirty-one of them were able to recognize the word correctly, and nineteen of the thirty-one recalled the words with-
Table 1

The list of experimental words with their respective exposure duration, exposure interval, and the male and female control subject's response to the check list.

<table>
<thead>
<tr>
<th>Exposure interval / sec.</th>
<th>1/25</th>
<th>1/50</th>
<th>1/100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exposure duration / sec.</td>
<td>5</td>
<td>10</td>
<td>15</td>
</tr>
<tr>
<td>Neutral word</td>
<td>door</td>
<td>hall</td>
<td>pencil</td>
</tr>
<tr>
<td>Response M F</td>
<td>light</td>
<td>pencil</td>
<td>wound</td>
</tr>
<tr>
<td>Ego involvement word</td>
<td>baby</td>
<td>kiss</td>
<td>dance</td>
</tr>
<tr>
<td>Response M F</td>
<td>BABY</td>
<td>pencil</td>
<td>pencil</td>
</tr>
</tbody>
</table>

Underlined words show correct responses.
The capitalized word is the response of the subject whose perception was supraliminal.
Table 2

The list of experimental words with their respective exposure duration, exposure interval, and the male and female experimental subject's response either on the check list or the blank sheet of paper.

<table>
<thead>
<tr>
<th>Exposure interval / sec.</th>
<th>1/25</th>
<th>1/50</th>
<th>1/100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exposure duration / sec.</td>
<td>5</td>
<td>10</td>
<td>15</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Neutral word</th>
<th>door</th>
<th>hall</th>
<th>pencil</th>
<th>happy</th>
<th>white</th>
<th>glass</th>
<th>porch</th>
<th>light</th>
<th>pond</th>
</tr>
</thead>
<tbody>
<tr>
<td>Response M</td>
<td>door*</td>
<td>hall*</td>
<td>pencil</td>
<td>happy*</td>
<td>white*</td>
<td>glass*</td>
<td>porch*</td>
<td>light</td>
<td>afraid</td>
</tr>
<tr>
<td>F</td>
<td>door*M</td>
<td>hall</td>
<td>pencil</td>
<td>happy*</td>
<td>white*</td>
<td>glass*</td>
<td>porch*</td>
<td>white</td>
<td>pond</td>
</tr>
<tr>
<td>Ego involvement word</td>
<td>baby</td>
<td>kiss</td>
<td>dance</td>
<td>cute</td>
<td>afraid</td>
<td>marry</td>
<td>wound</td>
<td>proud</td>
<td>love</td>
</tr>
<tr>
<td>Response M</td>
<td>baby*</td>
<td>kiss</td>
<td>dance*</td>
<td>cute*</td>
<td>hall</td>
<td>wound</td>
<td>wound*</td>
<td>proud*</td>
<td>love</td>
</tr>
<tr>
<td>F</td>
<td>baby*</td>
<td>kiss</td>
<td>dance*</td>
<td>cute*</td>
<td>light</td>
<td>marry</td>
<td>wound*</td>
<td>proud*M</td>
<td>love</td>
</tr>
</tbody>
</table>

Underlined words show correct responses.
Asterisks denote correct responses by recall.
The capital "M" following three responses denotes those made by male rather than female subjects.
out using the check list (Table 2). The experimental subjects reported that it took almost a dozen presentations before they were able to identify the word. The experimental group differed significantly from the control group in the number of correct responses (Table 3). This indicates that verbal instructions have an effect upon subliminal perception. Further analysis of Table 3 indicates that exposure duration was not a significant factor in these results. However, the variable of exposure interval influenced the experimental group's recall responses. Here, the experimental group recalled a greater proportion of words when they were presented at intervals of five seconds.
### Table 3

A comparison of the correct recognition (A) and recall (B) responses to the experimental variables for the Control and Experimental groups.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Control Correct Responses</th>
<th>Experimental Correct Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>exposure duration</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1/25 sec.</td>
<td>0</td>
<td>12</td>
</tr>
<tr>
<td>1/50 &quot;</td>
<td>3</td>
<td>9</td>
</tr>
<tr>
<td>1/100 &quot;</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>exposure interval</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 sec.</td>
<td>0</td>
<td>12</td>
</tr>
<tr>
<td>10 &quot;</td>
<td>4</td>
<td>9</td>
</tr>
<tr>
<td>15 &quot;</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>word connotation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ego inv.</td>
<td>2</td>
<td>15</td>
</tr>
<tr>
<td>neutral</td>
<td>3</td>
<td>16</td>
</tr>
<tr>
<td>Total</td>
<td>5</td>
<td>31</td>
</tr>
</tbody>
</table>

\[ P_e = 0.143 \quad P_c = 0.861 \]

\[ SD_p = 0.118 \]

\[ t = 6.12 \quad p < 1\% \]
Discussion

This experiment attempted to control and analyze some of the variables of subliminal perception. The variables included the exposure durations, the exposure intervals, verbal instructions, and word connotation effects on male and female subjects. Additional mention of exposure duration is necessary because pilot studies conducted by the author indicated that, with directed attention, speeds less than 1/100 of a second are not subliminal, in fact, Douglas (1947) found that speeds of 1/400 of a second were above the visual threshold. Since thirty-five of thirty-six control subjects expressed an unawareness of word exposure 100% of the time, the stimuli were subliminal according to the definition used in this study. Even with directed attention, the members of the experimental group found the exposure speeds to be below the word detection threshold on the first trial. On subsequent exposures awareness did occur.

The variable of subject motivation for both groups could only be manipulated by the instructions before the film presentations. It is possible that some of the subject's motivation was directed more by their experimental
partner than by the set of instructions. An uncontrolled variable was intensity of illumination. All of the words were typed on pieces of cellophane and placed inside separate glass slides, which were projected by a tachistoscope with a constant aperture setting. The tachistoscope remained at a constant distance between the motion picture projector and the screen. Unfortunately, the illumination of the room varied slightly and consequently so did the apparent illumination of both the film segment and the word. The factor of contrast between the black word and dark portions of the film was not controlled because of the variation in exposure intervals. This effect was probably not crucial because of the multiplicity of exposures given to every subject. This variable could have been better controlled by utilizing a perfectly dark projection room plus a color film containing colors of the same intensity.

Analysis of the results indicated that the stimuli presented to the control group as subliminal caused some intellectual impression. However, these results were so slight as to repudiate the contentions of Baker (1937), Williams (1938), Miller (1939), McGinnies (1949), Postman,
Bruner & McGinnies (1948) and Blum (1954 & 1955) who found that subjects would perceive words under similar conditions. The members of the experimental group said that the word perception was fragmentary, but with each subsequent presentation, they were able to mentally build an intelligible construct. The results of the experimental group showed a significant difference in recall accuracies between the different exposure frequencies (Table 3). This would support a theory that discreet amounts of exposure are necessary for perception. However, there were no corresponding differences in accuracies in the variable of exposure duration. This is probably true because the exposure speeds were not completely subliminal. Another interesting fact concerning the responses of the experimental group was the great difference between correct estimations by recognition and by recall. Apparently twelve subjects did not actually know what the word was until its written appearance on the paper structured their perception enough to cause a recognition-awareness. The performance of the group is in accordance with the results of the previous studies. However, the behavior of this group was caused by explicit introductory instructions plus repeated
stimulus exposures.

Word connotation and its effect upon the individual subject were considered. By using nine neutral words and nine ego involving ones, the chances that the word presented to the subject would have the desired effect were multiplied. The responses of the control group show that, in pure guessing, the neutral words were preferred two to one. However, there was no significant difference in frequency between correct estimations in either the first or second groups. Puzzling questions do occur when individual words are considered. As mentioned in the introduction, ego involving words can be met with either vigilant or defensive responses by the individual. The word "afraid" was correctly guessed by one control subject, but remained unseen by the two experimental subjects. The word "marry" also gave odd results. Here, the female subjects from both groups were able to respond correctly to the word, but the males from both groups responded incorrectly (Tables 1 & 2). Are these results due to the connotations of the respective words or simply physiological visual effects? This answer might be determined by using more subjects to make possible statistical manipu-
A few implications can be considered from the results of study. The interpretation of previous experimental studies is difficult because of the variable of introductory verbal instructions. With one exception the control group in this study found all the words to be subliminal, but most of the experimental group perceived them as supraliminal. The exposure speeds used in this study cover the range of speeds used in previous studies. It is conceivable that subliminal perception is only an artifact. The subliminal stimuli could have been above the lower absolute threshold, but misdirection of attention through the instructions could have caused the lack of conscious awareness. Hebb (1958) supported this idea when he pointed out that the sight of a stimulus object might arouse many different trains of thought. The one that it does arouse is determined by the already-existing central processes or selective influence referred to as attention.

The results give some insight into the mechanics of tachistoscopic perception. The subjects were not able to perceive all of the information of the stimulus at any one
exposure. Their past experiences and the resulting expectancies structured "how" they saw the visual stimulus. If the stimuli were taboo, the effective variable would be the subject's frame of reference. This is why the results of perceptual defense and perceptual vigilance studies are attributed to individual predispositions.

Under circumstances when only individual preferences determined a word choice, as in the control group guessing of neutral or ego involving words, the choice would be for the word which makes no derogatory reflections on the individual's personality. Instructions restructure the normal subject's attention enough to offset the original frame of reference, so that other variables become effective. Frequency of occurrence probably became the chief variable affecting the results of Lacy, Lewinger & Adamson's 1953 study. Freeman (1954-55), whose study most closely approximates the current one, obtained results which verify the foregoing hypothesizing. He found that instructions could weigh attitudes enough to cause subjects to believe that words, which were similar to taboo words, were the taboo words themselves.

Another study would also be helpful in analyzing var-
fables which determine recognition thresholds. This study would be to find the number of tachistoscopic exposures of a certain duration and intensity necessary for the individual to express stimulus recognition. It could be performed, without need of naive subjects, by simply continuing exposures until the subject could correctly identify the stimulus.

Finally the concept of threshold should be considered. Subject response to stimuli could be either detection, recognition or identification. Each of these three tasks has a different stimulus value threshold. This may be why previous experimental results were contradictory. The studies which obtained low thresholds asked the subjects for a detection response, those with higher thresholds asked for identification. This study used recognition and identification tasks. Thus its results differ from the results of the previously mentioned studies. Subliminal perception exists mainly because of the different operational definitions of threshold. Because of differences in definitions of threshold and sublimen, most future studies in this area will contain conflicting results and conclusions.
Summary

Eighteen different words, nine neutral and nine ego involving, were tachistoscopically exposed simultaneously with a five minute segment of a motion picture film to two groups of 36 subjects. The thirty-six subjects were grouped into mixed pairs, each pair being shown one of the eighteen words in one of the eighteen possible combinations of 1/25, 1/50 and 1/100 of a second exposure duration, an exposure every 5, 10 and 15 seconds, and words of neutral or ego involvement connotations. The control group was told to watch the film and try to resolve the filmed rotating trapezoidal window illusion. The experimental group was given the same instructions and additionally informed that a word would be flashed along with the film and that they would be asked to identify the word at the end of the film. After the instructions, each group was shown the same film and tachistoscopically exposed words. The only difference in presentation to the two groups being the additional instructions to the second group. After the film, the members of the first group were given a check list containing the exposed word and asked to guess the identity of the word.
Five of thirty-five subjects were able to make a correct estimation. One subject was not counted because he observed the word as supraliminal. The members of the experimental group were first asked if they knew the word. If they did, they were asked to write it on a blank piece of paper. If they did not, or if they had written an incorrect word on the paper, they were handed the check list and requested to check what they thought to be the correct word. Thirty-one of these subjects produced a correct recall or recognition estimation. This result differed significantly from the results of the control group. Nineteen subjects from the experimental group were able to correctly identify their word by recall, while twelve others made a correct estimation by recognition.

From these results it can be concluded that subliminal visual perception is affected by the verbal instructions given to each subject. Tachistoscopic presentations do convey some information, simply because of the mechanics of perception. Upon each exposure the word perception is fragmentary, but with subsequent exposures the word can be pieced together to become a complete perception.
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