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THE EFFECTS OF
SUBTHRESHOLD STIMULI UPON
SUPRALIMINAL STIMULI

by

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A thesis presented to the
Faculty of the School of Graduate
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of the
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Martin Resnick

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The earliest recorded subliminal perception experiment, according to Baker (1937), originated with the work of Suslowa in 1878 who showed that it is possible to respond to a weak electrical current presented subliminally. In another early experiment, Dunlap (1900), using a modification of the Muller-Lyer Illusion, presented the angular lines as subliminal shadows and had Ss guess the length of the various lines. He found that the subthreshold shadows did produce the illusion effect. Dunlap's results, although positive, were not conclusive. Shortly thereafter, Titchener and Pyle (1907) repeated Dunlap's experiment. Results of their experiment indicated that the subliminal shadows did not produce the effect of an illusion even when presented at a perceptible level. Stroh, Shaw, and Wasburn (1908), following this early groundwork, did not use the Muller-Lyer Illusion but, instead, presented cards at a predetermined distance from Ss so that they could not be read. The Ss then were asked to guess the letter or number on the card shown. Many of the Ss judgments were influenced in the direction of "correctness" although unaware of the stimuli.

Besides inconsistent results, the difficulties with these and other early experiments, according to Bevan (1964), not only involved methodological problems, but also that a definition of subliminal stimulation remained unclear, and that in many

instances the subliminally presented stimuli (the subliminal stimulus is usually defined as the inability of Ss to detect the presentation of a stimulus value) were even below the detection threshold level.

More recently, interest in subliminal perception was stimulated by the work of McGinnies (1949) and his "dirty word" perceptual defense hypothesis. McGinnies found that visual recognition thresholds were higher for his "taboo" word condition than his neutral or non-taboo condition. Criticisms offered by Solomon & Howes (1951) indicated that (1) the difference between the two conditions was due to the effect of word frequency and (2) that it was impossible to tell whether Ss were "repressing" the recognition of stimuli or "suppressing" recognition by not responding.

In an attempt to overcome the problem of "word frequency" or familiarity, Lazarus and Mcleary (1951) designed an experiment in which they created "taboo" words by pairing shock with nonsense syllables. The recognition visual thresholds for the taboo condition were significantly elevated as compared to the control, the neutral nonsense syllable condition.

In an effort to overcome Solomon & Howes' second criticism, Walters, Banks, and Ryder (1959) have argued that it makes little difference whether observers are "suppressing" or "repressing" their responses as long as the experimental procedure ensures the presentation of the threatening stimuli are below recognition threshold.

In contrast to studies which propose "perceptual defense," there are other studies which indicate a sensitization (lowering of threshold) or vigilance response to need-related stimuli. Certain types of motivational antecedents (for example, a primary drive such as hunger) result in the observer becoming more sensitive to stimuli which are related to the antecedents themselves. McClelland and Liberman (1949), for example, used a list of achievement related words and security related words, and found that Ss were pretested as high-achievers were more sensitive (had lower recognition thresholds) to the achievement related words; those pretested as low achievers were more sensitive to the security related words. Wispe and Deambarean (1953), Lazarus, et al. (1953), and Wispe (1954), found the "vigilance effect" when the motivational antecedent was food deprivation. In the Wispe and Drambarean study, Ss were divided into three groups of zero, 10, and 24, hours of deprivation. Identification thresholds were measured for neutral, food, and water-related words. The results of the study indicated that the nondeprived group had higher recognition thresholds than the food deprived group. However, Keys, Brozek, and Henschel, Michelsen, and Taylor (1950) reported results which did not agree with other investigators. In their study, Ss were placed on a restricted diet for 24 weeks. Using a projective technique to categorize Ss responses, they indicated no significant changes in Ss responses as a function of the restricted schedule.

Spence (1957) has suggested that "defense" or "vigilance" can be reproduced by anxiety-provoking stimuli with no indication

of a systematic polar trend, as either reaction can be evoked under the same experimental conditions.

Both defense and vigilance studies have been subject to methodological difficulties which have not proved easy to solve. Edwards (1960) has shown that the operational definition of recognition threshold for tachistoscopically presented stimuli varied with the response method used. The most sensitive method was a multiple choice task resulting in a lowered threshold; the most insensitive method was the "discerning guess" resulting in a raised threshold. Edwards suggested that subliminal perception is an artifact of establishing a threshold dependent upon the method of determination. Adams (1957) has found that a lower recognition threshold can be obtained when the subject is forced to guess than only to report when he perceives the stimulus value. Forcing the subject to guess improves upon other methods as it increases the range of various kinds of responses (Dukes & Mackinnon, 1961).

A second methodological problem of significant importance indicated by Wiener & Schieler (1960) is the lack of an adequate control for the perception of supraliminal or partial cues. What seems like the perception of subliminal events are bits of information originating from the so-called "subthreshold" stimulus thus enabling the observer to guess the identity of the stimulus object. This perceptual "leakage" can create the subliminal effect. Erikson (1958) carries this argument a step further and suggests that studies which claim positive results for the

the subliminal process have not adequately controlled for partial or supraliminal cues. He further points out that the design of most experiments do not call upon the Ss to make all of the discriminations capable of being made (Ss are usually told only to report "yes" or "no" concerning the presence or absence of the stimulus).

Both criticisms overlap; the same problems exist today which were present in the earlier experiments. An adequate operational definition of recognition threshold must be formulated that will effectively enable the respondent to discriminate to his fullest capacity and yet completely control for the perception of partial cues.

The purpose of this experiment then, is to present a design that will adequately control for the partial cueing effect, by attempting to determine valid detection and recognition thresholds.

In the present attack on the problem, an attempt was made to study the effects of subthreshold stimuli as they influenced Ss responses to supraliminal stimuli. The positive results indicated by the work of McGinnies and Sherman (1952), Black and Bevan (1960), and the previously mentioned work of Walters, Banks, and Ryder, suggested that this approach may be better than a direct attempt to look at the effects of Ss responses as a function of the subthreshold stimuli.

Secondly, in an effort to permit a more convenient operational definition of recognition threshold, the auditory modality was substituted for a visual one.

Since experiments involved with subliminal perception have shown inconsistent results, a non-direction hypothesis was formulated and specified as follows: No significant difference will exist between nontaboo words that immediately follow subliminally presented taboo words as compared to nontaboo words that subliminally follow nontaboo words.

METHOD

Subjects

Ss were 28 undergraduate introductory psychology students from Western Michigan University. The only other criteria for their selection was that they were males and never participated in any kind of psychology experiment previously.

Apparatus

A Beltone Model 15-C Clinical Audiometer, a two-channelled, pure tone and speech audiometer adaptable to single room arrangements, and an Ampex Stereo, Model 970, a self-contained stereo record and playback system were the basic equipment. Also used were a clock calibrated in hundredths of a second manufactured by the Lafayette Instrument Company, and two standard telegraph keys manufactured by Psychological Instruments. The telegraph keys were substituted for a "voice reactor" (due to equipment breakdown) which would have been a more effective way to measure responses.

Words were recorded on Scotch Tape #175 at 7.5 ips. by a speech major from Western Michigan University's Speech Department on full track monaural, in an effort to control for word uniformity. Since recorded speech was used as a sound source, a standard phone jack lead was plugged into the "tape" input receptacle located in the audiometer's "Accessory Compartment," with the other end of the lead plugged into the "output" receptacle on the tape deck.

The switching arrangements for the audiometer was as follows: the "Channel I Input" switch was set on the "Tape" position; the "Channel 2 Input" switch was set on the "Off" position; the "Gain" was set so that the VU meter peaked at "0;" the "Output" dial was set at "I & 2R" so that words from both channels were fed into the right ear (right ear was used only to avoid methodological difficulties); the "Frequency" dial was set on the "Speech" position; the "Channel I Loss" attenuator which has a range of attenuation from 100 decibels to minus 10 decibels and is graduated in one decibel steps was set on the "Threshold Masking" position.

Procedure

The experiment was conducted in a 9' X 6' acoustically treated room. Ss wearing the audiometer earphones sat with backs facing the E. The stimuli consisted of 108 one syllable common words with 98 of these words originating from the Thorndike-Lorge word count (Lorge-Thorndike, 1944). The remaining 10 consisted of words which made explicit reference to body functions and organs or else were considered normally to reflect sexual connotations. These latter 10 were operationally defined as anxiety provoking stimuli. The E was able to manipulate the db. level of all stimulus values via the Beltone audiometer. All stimuli were heard independently by the E through the "Monitor" control.

The words taken from the Thorndike-Lorge word count were equated for frequency of usage and length of each word and divided into two lists. (See Appendix A for listing of words from the

Thorndike-Lorge count). The first list consisted of 68 words used to establish recognition threshold. In effect, the definition of recognition threshold differs from the usual definition in that it not only accounts for perfect identifications but also the possibility of guessing (imperfect identifications). Ss recognition thresholds were established by utilizing a modified version of the method of limits coupled with a forced choice procedure. Alternating an ascending and descending series, 10 threshold determinations were made with starting points randomly varied for each determination. Changes in intensity level were arbitrarily manipulated by the E in 5 db. steps for each stimulus value. Each stimulus presentation had only one of four possibilities as Ss forced-choice response: (1) perfect identification: defined as Ss ability to identify the stimulus value by correctly repeating it (2) imperfect identification:defined as reflecting uncertainty and/or guessing as Ss incorrectly identifies stimulus value (3) detection: defined as delineating the presence of a stimulus value with Ss inability or unwillingness to make an attempt at its identification (4) lack of response: defined as the inability of Ss to "detect" the presence of a stimulus value. When the fourth possibility occurred, interpolations were made in one db. steps until such time Ss were able to detect the stimulus value. The operational definition of recognition threshold designated the threshold point to include the db. levels of the first two possibilities (perfect and imperfect identifications). The criterion for the determination of recognition threshold was

arbitrarily defined as two consecutive recognition or non-recognition responses depending upon whether the ascending or descending method was being utilized at the time. Thus for each threshold determination all Ss made an attempt at perfect identification; if perfect identification was not possible Ss were encouraged to guess at the stimulus value; if neither identification nor guessing was possible Ss then had to resort to the third possibility which was to indicate they "heard something;" if Ss were unable to "hear anything," the E utilized interpolating procedures. (See Appendix C for listing of Ss instructions for threshold determinations).

The second list, or test list, consisted of 40 words (30 from the Thorndike-Lorge word count plus the 10 previously defined as anxiety-provoking words) randomly divided into two groups each of 10 word pairs. The two groups were presented to Ss consecutively with a two minute interval between conditions. All Ss served under both conditions. For both treatments the first word was always presented at Ss detection threshold with the second word presented above recognition threshold to all Ss at 80 db. to insure proper identification. Ss were told to listen attentively and respond only to those words they could positively identify. Ss then, were never able to recognize the first word of a word-pair sequence although able to "detect" its sound, but were always able to recognize and identify the second word of the same sequence. Response measures were taken for all presentations under both conditions with the presentation of the subliminal

word the E's cue to start the clock and the presentation of the liminal word the Ss cue to stop the clock by removing his finger from the key. The sequence of word-pairs for the taboo condition (condition A) was as follows: bitch-shot; shit-hope; whore-year; ass-bite; breast-heat; rape-work; piss-luck; prick-lake; cock-time; teat-name. The sequence of word-pairs for the neutral condition (condition B) was as follows: inch-dare; page-fear; step-turn; fair-corn; test-loot; sign-like; send-hold; card-word; lane-boat; nose-ball. A 20 sec. interval between word-pairs was arbitrarily established, and a one sec. interval was designated within each pair. (See Appendix B for complete instructions for test conditions).

A group design was used with Ss divided into 14 groups of twos counterbalanced ABBA. The first S within a group was treated with AB sequence (treatment A then B) with the second S within a group treated with the BA sequence (treatment B then A). Response measures for each S under condition A was combined into a single result for A, and response measures for each S under condition B was combined into a single result for condition B.

RESULTS

A comparison of the mean reaction time for total number of words presented under each condition is shown in Table 1. Table 1 also summarizes the statistical analysis of the difference between means for the two conditions. (A list of word-pairs presented to the two groups is listed in Appendix B). The mean reaction time¹ for Ss was 1.37 under the taboo condition and 1.57 under the neutral condition. A t test was used to compare means, and a t value of 9.30 was obtained significant at the .001 level of confidence.

¹Subtracting the constant 1.00, the inter-stimulus interval within each word pair, gives the actual reaction time in seconds.

Table 1

Test of Significance Between Mean Number of Word-Pairs Presented
to Ss under Taboo and Neutral Conditions

Condition	X	S D	S D X	t
Taboo	1.39*	.13	.018	9.30
Neutral	1.57	.14		

significant at the .001 level of confidence

$t(28) = 2.763$

* In seconds

DISCUSSION

The results refute the hypothesis that no significant difference exists between nontaboo words that follow subthreshold taboo words as compared to nontaboo words that follow subthreshold nontaboo words. The shorter mean reaction time for the taboo condition as compared with the neutral condition led to the conclusion that Ss had produced a "vigilance" reaction contrasted with a possible "defense" reaction. The rejection of the hypothesis agrees with the findings of McClelland and Liberman, Wispe, and Spence who suggested that "defense" or "vigilance" can be reproduced with no systematic polar trend. Bevan has pointed out, moreover, that since anxiety or fear produces an organismic mobilizing function, the "common sense" view leads to the conclusion that the appropriate response to a threatening stimulus should be vigilance and lowered threshold.

One may now ask why a systematic trend toward apparent vigilance occurred? Dulany (1957) proposed and tested a theory based upon avoidance conditioning enabling him to predict when "vigilance" and "defense" responses would occur. His theory may be a satisfactory explanation for the results.

Defense or its complement, vigilance, may be viewed as a special case of selective learning. The organism comes to the perceptual learning situation with a wide variety of unknown available responses which vary in strength. This hierarachy

of possible responses is always dominated by a potential perceptual response evoked by the anxiety-producing stimulus in the experimental situation resulting in either "defense" or "vigilance." A "defense" reaction would result when the perceptual response to the anxiety-producing stimuli is inhibited from its dominant hierarchical position by some form of punishment and competing responses are instrumental to anxiety reduction. In contrast, the "vigilance" response or reaction would result when the perceptual response (already considered dominant) is repeatedly strengthened and instrumental to anxiety reduction thus eliminating competing responses.

In this experiment then, it is plausible that the subthreshold stimulus of a word-pair "generalized" its threatening affect to the liminal word making the liminal word equal to the anxiety-producing subthreshold word. If such is the case and no punishment is present, the liminal word becomes consequential or instrumental to anxiety reduction, and all other competing responses are eliminated.

The purpose of this experiment was to devise a design which would control for the perception of supraliminal or partial cues. Apparently, the design utilized proved to be a success. The possibility of false negatives was controlled by taking incorrect perceptions into account and defining them as part of the recognition point. Elimination of false negatives reduces the variance or error term which would ordinarily result from too "liberal" a definition of recognition threshold.

Although the method of determining recognition thresholds was rigidly scrutinized, Ss were allowed to discriminate to their fullest capacity by forcing them to respond with more than just a "yes" or "no" to the presentation of a stimulus. In addition, a possible practice effect was eliminated during threshold determinations and during the presentation of the test conditions by randomly presenting all stimuli to Ss with no two stimulus values repeated.

However, there is the possibility of an "methodological error" that should be discussed. It was noted that a t value of 9.30 was obtained. The implication of this value indicates that the data for the two groups are highly dichotomous. Are the results then "too good," that is, is there a possibility of an artifact operating in the experiment? Response measures were taken for all word-pair presentations under both conditions with the Ss cue to respond only after the clock was started "manually" by the E. One could argue that the vigilance effect was produced by a constant error induced by the E short-circuiting the total time under the taboo condition. There is the possibility of an error of this type. However, the E had been aware of this possibility before the experiment was carried out, and argued that it would be more plausible to conclude that this type of error would manifest itself as a random or variable one rather than show itself as systematic or directional. Undoubtedly no theoretical defense can be an

adequate substitute for tighter experimental controls; thus it may be wise to repeat the experiment with a design that eliminates this particular error.

SUMMARY

A sample of 28 undergraduate introductory male psychology students from Western Michigan University were used in a study designed to test the effects of subthreshold stimuli upon responses to supraliminal stimuli utilizing an auditory mode of presentation. Recognition threshold was determined for Ss on a db. scale using a modified version of the method of limits and a forced-choice procedure. Ss were then tested for the subliminal process by presenting them with two groups (test group and control) of ten word pairs each, with the first word of each pair always presented at detection threshold and the second word presented significantly above recognition threshold at 80 db. A comparison of the mean reaction time for the total number of word pairs presented under each condition was significant at the .001 level of confidence. The results refute the hypothesis that no significant difference exists between nontaboo words that immediately follow subliminally presented taboo words as compared to nontaboo words that follow nontaboo words. To account for the data, a theory of avoidance conditioning was proposed based on the work of Dulany. Although the results were highly significant it was suggested that the experiment be repeated with an adequate control for possible experimental error.

APPENDIX A

THORNDIKE-LORGE WORDS

Word frequency/ 100 or over
per million

1. cool	26. sent	50. loss	74. work
2. gain	27. land	51. hard	75. lake
3. long	28. seat	52. keep	76. luck
4. farm	29. trip	53. bold	77. time
5. full	30. girl	54. much	78. name
6. salt	31. plan	55. care	79. inch
7. tell	32. tail	56. need	80. dare
8. hang	33. milk	57. look	81. page
9. well	34. hall	58. ship	82. fear
10. been	35. post	59. mile	83. step
11. lead	36. mine	60. part	84. turn
12. play	37. come	61. soon	85. fair
13. nine	38. suit	62. mind	86. corn
14. hair	39. pass	63. sail	87. test
15. sent	40. hard	64. kiss	88. loot
16. must	41. mark	65. barn	89. sign
17. bill	42. bird	66. knee	90. like
18. king	43. last	67. pass	91. send
19. land	44. fell	68. sick	92. hold
20. coat	45. care	69. shot ¹	93. card
21. glad	46. self	70. hope	94. word
22. left	47. best	71. year	95. lane
23. kill	48. gone	72. bite	96. boat
24. felt	49. beat	73. heat	97. nose
26. meat			98. ball

¹Words 69-98 inclusive were used to test Ss under neutral and "taboo" conditions.

APPENDIX B

"Taboo" Word-Pairs

1. bitch-shot
2. shit-hope
3. whore-year
4. ass-bite
5. breast-heat
6. rape-work
7. piss-luck
8. prick-lake
9. cock-time
10. teat-name

Neutral Word-Pairs

1. inch-dare
2. page-fear
3. step-turn
4. fair-corn
5. test-loot
6. sign-like
7. send-hold
8. card-word
9. lane-boat
10. nose-ball

APPENDIX C

Ss INSTRUCTIONS FOR THRESHOLD DETERMINATIONS

Three possibilities may occur each time a word is presented to you over the earphones:

1. You may hear a word and definitely be able to recognize it, in which case you will immediately repeat what you heard.
2. You may hear a word and be uncertain of what you heard, in which case you are encouraged to guess at its identification.
3. Finally, **you** may hear a word, and not be able to recognize nor guess at what you heard, in which case you will indicate that you "heard something," but that you do not know what. (Any questions?)

Ss INSTRUCTIONS FOR TEST CONDITIONS

Ss had one finger on telegraph key with the following instructions presented to them:

This time when you hear a word it will be loud and clear so that you will always be able to recognize it. As soon as you do recognize it, respond by lifting your finger from the key. Be alert and react as quickly as you can! (Any questions?)

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