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Inhibition of Thought Categories Under Stress:
An Exploratory Study*

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The problem of the present study was to investigate the possibility that the response of stopping thinking about something can be learned as a means of avoiding punishment. Dollard and Miller (2) have recently made much of the thesis that the neurotic person is unable to use the higher mental processes in the solution of his emotional problems. They attribute this deficiency essentially to the process of repression. Certain thoughts, as well as acts, have, in the history of the neurotic person, been associated with painful experiences and can therefore arouse anxiety. Cessation of thought about a particular topic may lead to a reduction of anxiety. Reduction of anxiety is thought to be rewarding, and hence the response of stopping thinking about a particular topic is reinforced and learned.

This concept is an exceedingly important one, since it is fundamental to the learning theory analysis of neurotic behavior provided by Dollard and Miller. The argument as given by these authors, however, is supported largely by theoretical analysis and anecdotal evidence. An experiment by Miller (2) is cited to show that punishment of a visually presented symbol will generalize to the thought of that symbol, and an unpublished experiment by Greenspoon (3) is offered as presenting evidence of the tenability of the argument. The Greenspoon experiment, however, has been repeated by others (3) with negative results. Hence the only experimental evidence cited by Dollard and Miller is the experiment by Miller mentioned above.

This paper reports an investigation designed to explore the possibility of learning to stop thinking. The results are naturally dependent upon the particular methods used and consequently negative results cannot contraindicate the possibility that stopping thinking is a learnable response. On the other hand, positive results would lend weight to the Dollard-Miller thesis and would point the way to more detailed investigation of the process and conditions governing such learning.

METHOD

In general, the method was as follows: A list of words, consisting of words known to produce as free associations either a high proportion of antonyms or of synonyms was presented one at a time to individual subjects. The order of the antonyms and synonyms was scrambled. During the presentation of the first few words half the group of subjects was shocked each time they gave an antonym to an antonym producing word. The other subjects were shocked when they gave a synonym to a synonym producing word. The remainder of the list was presented without shock, and the responses given to the stimulus words and the response latencies were recorded. If the subjects were learning to stop thinking as a result of being shocked, it would be expected that the frequency of antonym or synonym responses would decrease or that the latencies of such responses would increase as evidence of that learning.

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It was further desired that the subjects be unable to report the system on the basis of which they were shocked. The subjects were interrogated following the experimental session, and the data for those subjects who reported correctly the basis for the administration of the shock were discarded.

SUBJECTS

The 53 subjects who participated were volunteers from undergraduate psychology classes. Of this number, twelve subjects were eliminated because they did not satisfy the conditions stated above. Prior to entering the experimental situation the subjects were not informed as to the nature of the material or apparatus used. In an effort to minimize the possibility that some subjects might after being tested pass on information about the experiment two precautions were taken:

1. All questions concerning the principle governing the administration of shock were evaded by the experimenter.
2. The subjects were requested to refrain from discussing the experiment with other students.

Word List

For the purpose of this experiment it was necessary to develop a list of verbal stimuli in which the type of responses could be predicted with a high degree of success. Several studies have shown that when the responses to such word lists as the Kent-Rosanoff are categorized synonyms and antonyms are among those showing the highest frequencies. An additional advantage found in the use of synonym and antonym producing stimulus words is that a rapid and relatively clear cut judgment of antonymity or synonymity could be made by the experimenter each time a response was given. In the interest of efficient learning it was desirable that the electric shock follow responses in the punished category as quickly as possible. After hearing the response the experimenter could very rapidly decide whether or not a shock was to be given since for any given word synonym responses were easily differentiated from antonym responses.

The present word list was developed by selecting a large number of words which the experimenter considered likely to produce either a synonym or an antonym response. In part the selection was made on the basis of the frequency counts of the Kent-Rosanoff list and the studies previously cited. Additional words were chosen on an *a priori* basis from Webster's Dictionary of Synonyms. These words, a total of one hundred and twenty-five in all, were listed and numbered and a response space was provided beside each word. The list was mimeographed and administered to an introductory psychology class. The students were requested to write their first associations to the stimulus words and to work as rapidly as possible. In all, one hundred and eleven students from the same population as the experimental group participated in this phase of the study.

A tabulation of these data was made so that each response word was classified as an antonym, synonym, or other. The percentage of the type of response that the stimulus word had produced was then calculated. The 24 words with the highest percentage of antonym responses and the 24 words with the highest of synonym responses were selected. From these two groups, two lists were made such that each list contained 12 synonyms and 12 antonyms and approximately equated response frequencies. The antonym having the highest response frequency was placed in the first list, the one having the second highest in the second list, the one with the third highest in the first list, and so on alternately. These lists were then combined so that each constituted a separate half of the longer list of 48 words. The order of words in each half of the list was then independently randomized.

Since a necessary condition for a test of the hypothesis was that the subject be unable to state the system governing the administration of shock it was necessary to limit the subjects' opportunity to learn. The first four subjects were shocked each time their responses fell into the proper category. All of the 48 words were used and shock was administered throughout the list. Two of these subjects were shocked for giving antonym responses and two were shocked when the response was a synonym.

TABLE I

Randomized word Lists as Used in the Experiment¹

<u>Synonym Shock</u>		<u>Antonym Shock</u>	
High	Moist	High*	Retain
Conceal*	Retain	Conceal	Dense
True	Dense	True*	Big
Terminate*	Big	Terminate	Cold
Easy	Cold	Easy*	Sweet
Open	Sweet	False*	Display
False	Display	Yell	Poor
Yell	Poor	Good	Fable
Hard	Fable	Alike	Frequent
Long	Frequent	Certain	Give
Good	Give	Distant	Left
Alike*	Left	Alter	Adhere
Distant*	Adhere	Blaze	Fast
Task*	Fast	Task	Soft
Dry	Soft	Right*	Elevate
Right	Elevate	New*	Thick
Win	Thick	Cash	Precise
Now	Precise	Abode	Light
Cash	Light	Pursue	Accurate
Abode	Accurate	Apparel	Arid
Apparel	Arid	Slow	Old
Slow	Old	Moist	

The two halves of the list (apparel begins second half) were independently randomized.

* Indicates words on which shock was given for synonym or antonym responses.

All four were able to tell why they were being shocked, and they ceased to give responses in the shocked category after half of the list had been presented. Since this insight on the part of the subject defeated the purpose of the experiment, it was necessary further to restrict the opportunity to learn. The shock was then administered only during the presentation of the first 24 words. Even with this change it was found that four of five subjects were able to report the reason for the shock. Therefore under each shock condition some of the words tending to produce responses in the shocked category were removed.

It was found that if more than seven antonym producing words or more than eight synonym producing words were shocked in the first half of the list a majority of the subjects were able to say why there was shock being given. Hence, under conditions of antonym shock five antonym producing words were pulled from the first half of the list. Under conditions of synonym shock four synonym producing words were removed. The list as used in the experiment is shown in Table 1. The remainder of the list was the same for both conditions.

Apparatus

The exposure device used was designed so that 5 x 7 cards could be presented in a rapid order. Essentially it consisted of a large black screen of plyboard with arrangements for a clock, a voice key and the shock apparatus. Located in the center of the screen was an aperture, $4\frac{1}{2}$ x $6\frac{1}{2}$, which, when the apparatus was mounted on a 30 inch desk stood at eye level for a seated subject. A slide worked so that while one card was exposed a second card could be placed in the additional slot ready for the next exposure. Lighting for the cards was provided by a shaded fluorescent lamp directly below the aperture. The card holder and the slide frame were fitted with microswitch contacts so that when the card was drawn into position the clock was actuated. Also connected to the clock was a voice key which stopped the clock when the subject spoke into a microphone. The exposure of the card started the clock, the subject's response stopped it.

The shock apparatus consisted of four $1\frac{1}{2}$ volt dry cells connected to an inductorium which in turn supplied the electrodes. A telegraph key was connected onto one of the electrode leads. The brass electrodes were $\frac{1}{4}$ inch in diameter and were held in place on the subject's calf by a rubber strap.

The stimulus words were printed on 5 x 7 white cardboard. The lettering was one inch in height, printed with a Leroy pen and template.

Procedure

During the experimental periods the subjects appeared at 15 minute intervals. To avoid the possibility of interruption or of a subject overhearing the final conversation between the experimenter and the current subject the new arrivals were detained by a receptionist until the session had been completed. Upon arrival and after a few brief comments on the weather or a like topic the subject was seated in front of the apparatus about two feet from the aperture. The experimenter gave the following introduction to the situation.

"I am going to show you a number of words which will appear one at a time in this opening. As soon as you see the word, respond with the very first single word that you think of. It is important that you respond quickly and, remember, give the first word that comes to mind no matter what it is. One more thing, before we start--on certain occasions I will give you an electric shock. I'll be frank. The shock will annoy you, but I can assure you that it is not harmful. The voltage and amperage are very low. So if you don't object I would like to strap this (the electrode) to you leg."

The shock apparatus was checked by giving a single shock after the subject had been warned and asking if he had felt it. Two practice words were presented to eliminate misunderstanding of the directions and to check the operation of the voice key. The subject was again asked to respond as quickly as possible and to give the very first word he thought of. As each word was presented, the experimenter was ready to give or to withhold shock depending upon the category into which the response fell. After the shock-nonshock decisions had been made the experimenter replaced the card in the unexposed slot and the recorder* noted the response word, the latency, and whether or not a shock had been given. The recorder then reset the clock and the voice key and the next word was presented. Shock was only administered during the presentation of the first part of the list although the shock apparatus remained in place and the subject was not informed that he would not be shocked again.**

After the entire list had been presented the experimenter asked the following questions:

1. Can you tell me why I was shocking you?
2. Could it have been connected with the type of word you gave in response?
3. Do you think that antonym and synonym responses might have had something to do with it?

If this subject could correctly state the system governing shock, his data were not used in the final tabulations. Excluding the preliminary runs to set up the list, only 8 of 49 subjects were lost in this way.

RESULTS

The data presented in this section were obtained from the second half of the word list comprised of 12 antonym producing words and 12 synonym producing words. This section of the list together with the mean latency for each word under both shock conditions is shown in Table III. For each subject two measures were obtained on each word; latency in one-hundreds of a second and the verbal responses to the stimulus. Only the data from those subjects who were unable verbally to satisfactorily state the principle governing the administration of shock were used in the computations.

*Andrew Molnar and John Coonan faithfully served as recorders.

**The number of shocks received by each subject ranged from 4 to 7 with a median of 6 under antonym shock and from 4 to 8 with a median of 6 under synonym shock.

Latency. In order to remove the distorting effects of blocks (long delays, on the part of the subjects an upper limit of two seconds was placed on the latencies. For any response that required more than two seconds the additional time was ignored and the time used in the computations was taken as two seconds. Such a treatment was justified since the plot of response time showed that the distribution was continuous only up to two seconds. Some subjects took as long as 15 seconds to respond while other failed to respond on some of the words.

The mean reaction time for each category under each shock condition was calculated. Tests of the significance of the difference between means were made on the mean of the antonym producing words under antonym shock vs. the mean of the antonym producing words under synonym shock and in the same manner the means for synonyms producing words under the two conditions.

Only in the case of the synonyms were the means under the two shock conditions significantly different at the .05 level of confidence. The means, differences and "t" tests of significance for the differences between mean response times under both the antonym shock condition and the synonym shock condition are shown in Table II.

TABLE II

Means, Differences, and t Values for Response Time Under
Antonym and Synonym Shock Conditions

	Syn. Producing Words	Ant. Producing Words
	\bar{x}	\bar{x}
Syn. Shock	120	104
Ant. Shock	111	100
t	2.06	1.06

The mean response time for each word under each shock condition appears in Table III.

TABLE III

Mean Response Time for Each Synonym Producing Word and Each Antonym
Producing Word Under Each Shock Condition

Syn.	Ant. Shock	Mean Syn. Shock	Ant.	Mean Ant. Shock	Syn. Shock
Fable	95	124	Cold	91	110
Frequent	114	129	Sweet	97	99
Accurate	124	130	Slow	105	80
Arid	120	103	Big	95	103
Adhere	129	145	Thick	111	100
Elevate	111	114	Light	106	107
Precise	112	131	Fast	108	93
Retain	112	112	Soft	113	113
Dense	118	126	Give	96	127
Apparel	103	109	Left	90	99
Moist	82	84	Old	102	103
Display	113	121	Poor	112	107

Response Frequencies. A tabulation of the frequencies of the words given in response to the stimulus words shows that the experimental subjects responded with the same words in about the same frequencies as the Psychology I class. There was of course some variation between the two groups but it proved to be nonsignificant.

In order to satisfy the conditions of the hypothesis it would be necessary that when synonyms were shocked a smaller number of synonym responses would occur and that when antonyms were shocked a smaller number of antonyms would occur. However, the data do not show such differences. Only one of the differences between frequencies approached significance and that one is in the wrong direction. According to the hypothesis there should have been fewer synonyms given under the synonym shock condition, but more are given. The frequencies and the tests of significance are given in Table IV.

TABLE IV

Number of Synonym and Antonym Responses Given Under The Two Conditions

	Syn. Responses	Ant. Responses
Syn. Shock	172	189
Ant. Shock	149	180
Difference	23	9
Z	1.44	.61

Summary of Results. The mean response times were computed for both synonym producing words and antonym producing words under the antonym shock condition and the synonym shock condition. The significance of the differences between these means was tested. Only one of these differences proved to be significant, that between the means of synonym producing words under the two conditions.

In addition the frequency of antonym and synonym responses to synonym producing words and antonym producing words under each shock condition was tabulated. Tests of the significance of the difference between frequencies were made for synonym producing words under the two shock conditions and for antonym producing words under the two same conditions. The difference between the frequency of synonym responses under synonym shock was found to approach significance. However, this difference was in the wrong direction. More synonym responses were given under the synonym shock condition than under the antonym shock condition.

Discussion

The results of this experiment are equivocal. For one set of data there were no differences that reached significance. The response latencies and response frequencies for antonym producing words did not differ under the conditions of synonym shock and of antonym shock. The results for the synonym producing words are contradictory. Latencies for response to these words did increase under the synonym shock condition, and this was expected. The frequency of synonyms as responses, however, declined under the antonym shock condition, not under the synonym shock condition as anticipated. This latter difference is significant, if only a single-tailed test of significance is justified in these circumstances.

There are several reasons which may be advanced to account for these equivocal results. One is that the strength of the shock was insufficient to lead to fear. Another lies in the choice of stimulus words. Stimulus words were used that had high probabilities of producing either synonym or antonym responses. It may be that these high probabilities indicate verbal habits too strong to be overcome in an experiment of short duration. Regular shock reinforcement was used during the experiment; perhaps random or partial reinforcement would have been more effective in producing the desired effects. The stimulus words were presented clearly and unambiguously. Perhaps the test words should have been presented very briefly or very unclearly so that the strong verbal habits which apparently operated might have been overcome.

The failure to secure clearcut evidence of learning to stop thinking cannot be considered as evidence that this response is not learnable or that the argument of Dollard and Miller (2) is unsound. The methodological issues pointed out above are perhaps responsible for the unsatisfactory results. The authors feel that this study has had value as a first experimental attack upon the problem and in showing some of the methodological problems involved in such an endeavor.

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