THE EFFECTS OF AVOIDABILITY AND NON-AVOIDABILITY OF PUNISHMENT ON STIMULUS SELECTION

by

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ABSTRACT

The present experiment attempted to clarify the role of avoidability of punishment on stimulus selection. The subjects, 48 firemen, were randomly assigned to either the avoidance (Av) or the non-avoidance (N-Av) group. Four geometric figures, equated for area and presented tachistoscopically, served as stimulus figures, one being randomly assigned to each subject as a shock stimulus. During baseline each subject was required to select which of the four stimuli, presented simultaneously, appeared as clearest to him. During treatment, in which the stimuli were presented separately, the N-Av group was shocked following each presentation of their shock stimuli. The Av group was allowed to learn a key-pressing response, avoiding the shock which otherwise followed presentation of their shock stimuli. In the test phase, procedure for both groups replicated that of the baseline. Analysis of each group's baseline-to-test shift in selection frequency of the shock stimulus was performed by a Wilcoxon matched-pairs signed-ranks test. As hypothesized, subjects in the Av group exhibited a significantly increased selection of their shock stimuli, while N-Av subjects showed a significantly decreased selection of their shock stimuli. Theoretical interpretation of these shifts in stimulus

selection followed that employed in explaining the acquisition of a motor avoidance response.

INTRODUCTION

The human being is capable of handling only a limited number of the stimuli which constantly surround him. Some provision must accordingly be available for him to respond selectively to those stimuli which are important for him and to disregard other stimuli. It is thought that learning plays a major role in this regard.

Berlyne (1960) has pointed out that one of the stimulus factors which determines the direction of attention is affective value. Some stimuli are endowed with innate or primary reinforcing value while others, initially neutral in themselves, acquire affective value through association with other positively and negatively valued stimuli. The affective value of a given stimulus or stimulus complex will then help to determine the extent to which a given individual will choose to attend to and respond to it rather than to the stimuli with which it competes.

A number of investigators have studied the effects of reward and punishment on reversible figure-ground perception. For purposes of describing these effects, it is convenient to classify the experiments according to the differential treatment histories of the stimuli which compete for selection. Thus, there are studies in which: (1) previously rewarded stimuli compete with previously punished stimuli (Schafer & Murphy, 1943; Rock & Fleck, 1950; Jackson, 1954; Snyder & Snyder, 1956; Sommer, 1956); (2) previously rewarded stimuli compete with previously non-rewarded stimuli (Sommer, 1956, 1957; Sommer & Ayllon, 1957); and (3) previously punished stimuli compete with previously non-punished stimuli (Smith & Hochberg, 1954; Sommer, 1956, 1957).

The initial study to test the effects of reward and punishment on figure-ground perception was conducted by Schafer and Murphy (1943), and its experimental design became the prototype for subsequent investigations. Preliminary training involved two visually-presented line profiles. Each profile was shown separately to the subject, named, and then followed by either the gain (reward) or loss (punishment) of money. During tachistoscopic testing, the two profiles were combined to form a reversible figure and the subject was required to name which was recognized. Results showed that the subjects reported seeing the rewarded profile significantly more often than the punished one.

In an attempt to replicate Schafer and Murphy's study, Rock and Fleck (1950) found no significant difference between the total number of previously rewarded and previously punished faces which were correctly identified.

Jackson (1954) was later able to replicate the Schafer-Murphy results as well as those of Rock and Fleck by duplicating the procedural and apparatus differences that existed between them. He concluded that these differences were responsible for the disparity in findings. Two other studies, one by Sommer (1956) and a second by Snyder and Snyder (1956) on auditory figure-ground, also found that rewarded stimuli are selected more often than punished stimuli when the two are in competition.

Similar results are generated in experiments in which previously rewarded stimuli are compared to previously non-rewarded or neutral stimuli. Sommer (1956, 1957) and Sommer and Ayllon (1957) all reported that rewarded perceptions prevailed over non-rewarded perceptions.

Somewhat less agreement exists among studies in which the competing test stimuli have been either associated or not associated with punishment. Smith and Hochberg (1954), using electric shock, concluded from their data that punished visual profiles were perceived significantly less often than competing non-punished profiles. However, two studies by Sommer (1956, 1957) are in disagreement with Smith and Hochberg's finding, reporting no such significant difference. Allport (cited in Cantril, 1957) reported that threatening figures (pictures of certain people) dominated non-threatening figures (pictures of other people) in a visual binocular-rivalry test.

Among other studies which bear on the effects of reward and punishment on stimulus selection are two concerned with perceptual defense and perceptual vigilance. Dulany (1957) experimentally induced these perceptual phenomena using an instrumental learning paradigm with four geometric figures as stimuli. Defense training consisted of the subject's being shocked whenever he saw his respective "critical stimulus" in preference to the other three during tachistoscopic presentation; vigilance subjects were shocked each time they did not perceive their critical stimulus. Defense subjects recognized their critical stimulus significantly fewer times, in competition with the other three stimuli, in the test series than in a pre-training baseline series. The converse was true of vigilance subjects who recognized their critical stimulus more often.

Pustell (1957) also experimentally induced perceptual defense and perceptual vigilance, incorporating a classical conditioning procedure into Dulany's design. Interestingly, his results showed a consistent trend whereby male Ss exhibited a perceptual vigilance reaction and female Ss a perceptual defense reaction. Pustell suggested a "cue-drive" hypothesis to account for his results. Females, according to this hypothesis, experienced a relatively stronger conditioned anxiety reaction from the critical stimulus-shock training. In testing, the selection of the critical stimulus elicited the unpleasant drive of intense anxiety, so that perceptual defense occurred. Only moderately strong anxiety became conditioned to the critical stimulus of the male and this resulted in heightened or vigilant perception of the critical stimulus.

Ayllon and Sommer (1956), in a figure-ground perceptual study of the tactual-kinesthetic mode, presented evidence that, along the unpleasantness continuum points exist in which an alerting rather than a defensive trend appears. In opposition to Pustell, however, Ayllon and Sommer stated that if S rates the punishment (shock) as slightly unpleasant, he will tend to perceive the non-punished aspects of the field. If he rates the punishment as moderately or very unpleasant, he will tend to perceive the punished aspects of the field.

That stimuli associated with reward are selectively attended to in preference to competing stimuli appears, then, to be supported by the available literature. What is less clear, however, is what happens to stimuli which have been associated with noxious stimulation. Some of the studies show that association with punishment results in a decrease in the tendency to selectively attend to a stimulus, but there is also evidence to the contrary. Indeed, there is some indication that the initial tendency may be toward increased selective perception of the punished stimulus.

The purpose of the study described here is to clarify the effects of differential association with punishment on stimulus selection. By "differential" association is meant the avoidability of punishment, for this is hypothesized to be an important factor in determining whether or not a given stimulus will be selected in preference to competing stimuli. It is hypothesized that if selection of a stimulus is inevitably followed by punishment, the frequency of selecting that stimulus should decrease, just as a punished motor response decreases in frequency (Hypothesis I). If, on the other hand, selection of a stimulus affords an opportunity for the organism to avoid punishment, there should be an increasing tendency for that stimulus to be selected from among competing stimuli (Hypothesis II).

METHOD

Subjects and Apparatus

Forty-eight firemen from the Tucson City Fire Department, all volunteers, served as Ss. Their mean age was about 31, ages ranging from 24 to 53. All were aware only that shock and visual stimulation were involved. Subjects were randomly assigned to one of two treatment groups, each group numbering 24.

The stimulus objects, prepared on black and white slides for visual presentation were four geometric figures (circle, square, diamond, and triangle), used for their relatively non-emotional character. Each figure served as a "shock stimulus" for six Ss in each of the treatment groups. All figures were equated for area (nine square inches projected on the screen) and appeared as light on a dark background. The brightness of the figures was 22.0 ft. lamberts, with pre-exposure brightness at 4.54 ft. lamberts.

Two sets of slides were prepared. Slides of the set used in the baseline and test phases of the experiment contained all four figures, one in each of the quadrants. Each of the 24 combinations possible with respect to figure placement was used twice, totalling 48 stimulus slides. On the slides of the set employed in the treatment phase, only one of the quadrants contained a figure, making possible 16 different stimulus slides with respect to figure and placement. For all slides the center of each figure was equidistant from the center of the slide. Order of slides in both sets was randomized according to the random number table.

A Kodak Carousel projector, Model 800, was used to project the stimuli onto a white 22 by 28 inch cardboard screen. A manual Wollensak Alphax tachistoscope was attached to the lens of the projector to limit length of stimulus presentation, in all three phases, to 1/100th of a second. Stimulus duration, room and figure illumination, and focus of the figures were set in such a way that S could not easily recognize more than one figure at a time.

Apparatus for delivering shock consisted of an inductorium operated by a 1 1/2-volt battery, a Hunter Decade Interval Timer for timing shock duration, a response key for activating and terminating the shock, and leg electrodes. The response key and a diagram showing quadrant designation (following the Cartesian coordinate system, see Appendix II) were mounted on the arm of the Ss' chair. The chair situated S at approximate eye level with the focal point on the screen and 66 inches from it. A response sheet was provided for each S (see Appendix III).

Procedure

The experiment consisted of three distinct phases: a baseline phase, a treatment phase, and a test phase. Before each phase began, S received instructions appropriate to that phase (for instructions, see Appendix I). And for all phases intertrial interval, defined as the interval between E's tachistoscopic presentation of two successive slides, was determined by each individual S and took about 5-7 seconds for most.

For each of the 48 randomly-arranged stimulus slides in the baseline phase, S's task was to determine which of the figures appeared as clearest to him. Each such judgment was recorded by S on the response sheet provided him, according to the figure's quadrant number. An S's baseline thus consisted of the frequency with which he judged each figure, and particularly his shock stimulus, as being clearest to him.

At this point, S was asked to strap the shock electrodes to his left leg. Verbal instructions on setting the shock intensity were given to S, and the shock level set (see Appendix I).

In the treatment phase, the set of stimulus slides was presented twice, once forward and once backwards, making a total of 32 presentations. The task for all Ss was to press the response key <u>at</u> <u>least</u> once after each of the tachistoscopically-presented stimulus slides, although they were informed they could press more than once if they wished. Each time S's assigned "shock stimulus" was presented, a single press of the response key by S initiated a two-second shock, the level of which had previously been set. Because of a slight lag in the operation of the inductorium, subjects in the avoidance condition were afforded the opportunity to learn to avoid the shock altogether. A rapid double-press of the key withheld the shock while a less rapid second press terminated the shock once it had begun. Following presentation of their respective "shock stimuli," however, Ss in the non-avoidance condition received the entire two-second shock regardless of how quickly or how many times they pressed. Key-pressing following presentations of all Ss' "non-shock" stimuli did not activate the shock.

Upon termination of the treatment phase, S was informed that he could remove the shock electrodes and that no further shock would be used.

The test phase of the experiment provided for evaluation of the effects introduced by the two treatment conditions. Except for presentation of the stimulus slides in an order the reverse of the baseline's, no procedural differences existed between the two phases.

RESULTS

Seventeen of 24 non-avoidance subjects shifted in the hypothesized direction while four shifted in the opposite direction. The data of three subjects were excluded from the analysis; in one case because the subject selected his shock stimulus an equal number of times in the baseline and test phases (cf. Siegel, 1956, p. 81) and in two others because the subjects' previous shock histories precluded, with the equipment used, the required "truly painful" shock level. Analysis of the data by a one-tailed Wilcoxon matched-pairs signed-ranks test yielded a T of 39.0 with N = 21, $p < .005$. The hypothesis that subjects in the non-avoidance condition would select their respective shock stimuli less frequently in the test phase of the experiment than in the baseline phase is thus confirmed.

Of 24 avoidance subjects, sixteen shifted as anticipated and four shifted in the opposite direction. The data of four avoidance subjects were excluded from the analysis. In three instances, exclusion was for the subjects' failure to learn the necessary motor avoidance response to the shock, and in the fourth for the subject's previous extensive shock history. These data, by a Wilcoxon matched-pairs signed-ranks test, were also found significantly different with a T of 40.5 and N = 20,

$p < .01$. As expected, subjects in the avoidance condition showed increased selection of their respective shock stimuli in the test phase.

DISCUSSION

The results of the present experiment support the hypothesis that in stimulus selection, as in response selection, avoidability of punishment is a determining factor. The finding that association with non-avoidable punishment decreases the selection of a given stimulus is in agreement with the studies by Smith and Hochberg (1954), Dulany (1957), and Pustell (1957). The non-significant results obtained in the two investigations by Sommer appear to be due to an inadequate punishment procedure employed during training. Sommer "punished" by the withdrawal of a few cents of money, but it is questionable whether this procedure was adequate for the purpose intended.

Of special interest is the fact that, using a training procedure essentially like that employed for the non-avoidance group of this study, Pustell (1957) was able to induce the opposite perceptual reaction. Males in his study manifested an almost unanimous vigilant reaction toward, or increased selection of, their critical stimulus, although the reverse was true of his female subjects. A sex difference does not account for the difference in results between his study and this. Nor does level of shock used, for both studies used one of relatively high intensity. Pustell's "cue-drive" hypothesis accounts for his results in terms of the differential intensity of anxiety which became conditioned to the subjects' critical stimulus. Less intense anxiety, he suggests, was conditioned to the males' critical stimulus than to the females'. This less intense anxiety then imparted a cue function to the critical stimulus, rather than a drive function which more intense anxiety would impart to it. Pustell's explanation may be elaborated one step further. It is suggested that the active efforts to cope with, and attenuate the effects of the shock, observed by that investigator, resulted in the male subjects' vigilant reaction toward the critical stimulus. The ability to thus "avoid" some of the punishment of shock may have lessened the intensity of the anxiety conditioned to the critical stimulus, as assumed by Pustell. Or it may have reinforced the perception of that stimulus, through anxiety-reduction, by enabling the subject to prepare for the punishment. In either case, it is notable that the female subjects in Pustell's study were demonstrably passive about the shock, making no active effort to lessen its effects.

Those studies in which rewarded stimuli compete with non-rewarded stimuli appear to be in basic agreement with the present finding that association with avoidance of punishment increases the selection of a given stimulus. In this regard, it seems reasonable that Allport's subjects, probably able to avoid the punishment associated with the "threatening" figures in the real life situation, would be more likely to attend to those figures than to other, non-threatening figures.

Several qualitative factors are regarded as supportive of a stimulus selection interpretation of the treatment effects, rather than a response selection interpretation. None of the subjects was aware of the purpose of the experiment, the large majority of them naively assuming that it was a test of "how well you see." Indeed, one subject asked to be run a second time since later discussion with others in his company who had also served convinced him that he had not seen what he was "supposed to see." Posttest questioning of the subjects also revealed that few of them could name or verbalize their respective shock stimulus. Most of those who had sought a pattern to the intermittently delivered shocks of the treatment phase submitted a quadrant hypothesis when asked about a rule by which they had been shocked. Despite this inability to name a figure as being related in some way to the occurrence of shock, a substantial number of subjects did mention changes in the apparent clarity of their shock stimulus between the baseline and test phases. Finally, only those few subjects in the avoidance group who were able to name their shock stimulus performed the avoidance response selectively following its presentation during the treatment phase. The large majority of avoidance subjects performed the double-press of the response key to non-shock, as well as shock, stimuli.

The simplest theoretical account of the shifts in stimulus selection corresponds to that employed in describing the acquisition of a motor avoidance response (Solomon & Wynne, 1953). During training of the latter, anxiety generated by shock becomes conditioned to a stimulus which precedes the shock. The anxiety then serves as a drive energizing the motor avoidance response, even after the shock has been avoided successfully for a number of trials. A similar process is seen as operating for the avoidance subjects of the present study. During training, an anxiety reaction elicited by shock becomes conditioned to the subject's shock stimulus. The subject is able, however, to reduce the anxiety as well as avoid the punishment by performing the appropriate avoidance response. Since perception of the shock stimulus is thus "instrumental" in avoiding punishment, selection of that stimulus is increased in the test phase.

For non-avoidance subjects, on the other hand, punishment cannot be avoided and the anxiety simply becomes more strongly conditioned to the subject's shock stimulus. Only in the test phase can the subject avoid the anxiety-eliciting shock stimulus, so that selection of that stimulus is consequently decreased.

The above interpretation revolves solely around what happens with the shock stimulus. In all likelihood, however, a more complete interpretation is required to accurately describe all the processes effecting the shifts in selection of competing stimuli. In view of the low discriminability of the stimulus figures and of the few subjects who were able to name their shock stimulus, anxiety probably generalizes to some extent to the non-shock stimuli. This seems evident with the large number of avoidance subjects who performed the avoidance response to non-shock, as well as shock, stimuli. For avoidance subjects, such anxiety as elicited by the non-shock stimuli is reduced, and reinforcement of the prior perception occurs, when the avoidance response is made. Selection of these stimuli tends, then, to be increased in the test phase, although not to the extent of the shock stimulus.

For non-avoidance subjects, much the same happens in that perception of their non-shock is followed by the absence of punishment and the subsequent reduction of anxiety produced by those stimuli. The reinforcement of those perceptions thus increases their selection in the test phase.

APPENDIX I

Baseline Phase: On the screen, I am going to show you four objects for a very brief period of time. What I would like for you to do is to focus on this spot (focal center) and then to report the position of the object which was clearest to you by writing down the quadrant number where the clearest object was located. This diagram shows you how to designate the quadrants and where the objects will appear.

Each time you have focused your eyes on that spot and you are ready for me to present the objects, just say "ready." Then I'll present them and you can write down the number of the quadrant where the clearest object was located. Please respond as quickly as possible being as accurate as you can. Do you have any questions?

Treatment Phase: In this phase, shock will be used. (Pause while E has S strap electrodes to leg.) Now I'll set the level for you as an individual. I'll start at a low intensity and gradually increase it each time. Tell me when the shock reaches a truly painful level. (Pause while E sets the shock level.)

This time only one object will be presented at a time. So this constitutes the learning part of the experiment. Your task will be pressing this key after each object is presented. You may press as many times as you wish, but you must press it at least once after you have seen each object.

Again, focus on this spot before you say "ready."

Test Phase: (S is told to remove the electrodes and that no more shock will be used.)

In this last part, we'll do the same kind of thing as we did in the first part. Focus on the spot, say "ready," and then I'll present the objects. And as you did before, write down the number of the quadrant where the clearest object appeared.

APPENDIX II

2	1
3	4

APPENDIX III

Subject #__________

A.		B.	
1. ______	25. ______	1. ______	25. ______
2. ______	26. ______	2. ______	26. ______
3. ______	27. ______	3. ______	27. ______
4. ______	28. ______	4. ______	28. ______
5. ______	29. ______	5. ______	29. ______
6. ______	30. ______	6. ______	30. ______
7. ______	31. ______	7. ______	31. ______
8. ______	32. ______	8. ______	32. ______
9. ______	33. ______	9. ______	33. ______
10. ______	34. ______	10. ______	34. ______
11. ______	35. ______	11. ______	35. ______
12. ______	36. ______	12. ______	36. ______
13. ______	37. ______	13. ______	37. ______
14. ______	38. ______	14. ______	38. ______
15. ______	39. ______	15. ______	39. ______
16. ______	40. ______	16. ______	40. ______
17. ______	41. ______	17. ______	41. ______
18. ______	42. ______	18. ______	42. ______
19. ______	43. ______	19. ______	43. ______
20. ______	44. ______	20. ______	44. ______
21. ______	45. ______	21. ______	45. ______
22. ______	46. ______	22. ______	46. ______
23. ______	47. ______	23. ______	47. ______
24. ______	48. ______	24. ______	48. ______

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