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Stimulus Control and the Effects of Stimulus Change on Aggression in Children

Marilyn S. Arnett

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STIMULUS CONTROL AND THE EFFECTS
OF STIMULUS CHANGE ON AGGRESSION IN CHILDREN

by

Marilyn S. Arnett

A Thesis
Submitted to the
Faculty of The Graduate College
in Partial Fulfillment
of the
Degree of Master of Arts

Western Michigan University
Kalamazoo, Michigan
April 1971
Five children had the opportunity at programmed intervals to shock a rat during daily 10 min sessions. An aggressive response was defined as producing rat shock and reinforcement was not made contingent on any response within the experimental chamber. Response increment occurred for all subjects upon introduction of a visual cue which signaled shock period onset. A discrimination between shock and no-shock periods developed for all subjects and response increment occurred for all subjects due to a change in the manipulanda. Two subjects who initially preferred shocking the rat, also produced visual feedback when available, although average shock rate was maintained during these periods. Subjects initially preferring to not produce shock tended to do so following the withdrawal and re-introduction of visual and auditory stimulus effects produced by the rat when shocked. The production of rat-shock was shown to be neither due to position preference nor cue onset alone. Any programmed stimulus change affected subjects' performance.
ACKNOWLEDGEMENTS

Throughout the conduction and preparation of the present investigation, Dr. Roger Ulrich and the staff of the Behavior Research and Development Center (both past and present) have provided financial, editorial, technical, and moral support. To these people and especially Dr. Ulrich, I am extremely indebted. I am also particularly grateful to Drs. David Lyon and Neil Kent whose advice and assistance proved to be of great value. A special thank you to The Graduate College for fellowship assistance which indeed has made this graduate student's life more enjoyable.

Marilyn S. Arnett
ARNETT, Marilyn Sue, 1946-
STIMULUS CONTROL AND THE EFFECTS OF
STIMULUS CHANGE ON AGGRESSION IN CHILDREN.

Western Michigan University, M.A., 1971
Psychology, experimental

University Microfilms, A XEROX Company, Ann Arbor, Michigan
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INTRODUCTION

Research in the human aggression area has been extensive. For at least thirty years, the dominant hypothesis was best known as the frustration-aggression hypothesis, summarized by Dollard, Doob, Miller, Mowrer, and Sears in 1939. Their position originally suggested that aggression was an inevitable consequence of frustration, although later such ideas were modified to suggest that aggression was a "natural" but not "inevitable" consequence of frustration (Dollard, Doob, Miller, Mowrer, and Sears, 1944). Most investigators at the time (Bandura and Walters, 1963) pursued their research under this assumption. Research investigating antecedent events other than frustration has occurred only more recently.

In 1963, Bandura and Walters outlined an approach to the problem of the definition and study of aggression which allowed for studying the manner aggressive responses are acquired, strengthened, maintained, extinguished, and inhibited, as well as the conditions under which generalization and discrimination occur (Bandura and Walters, 1963, page 366). This definition included essentially that class of pain-producing or damaging-producing responses or those responses associated with painful or injurious production. Research emanating from the experimental analysis of animal aggression produced a similar conclusion, defining aggression as those behaviors which are associated with doing injury to another organism (Ulrich, 1967). Such analyses which have emphasized the respondent characteristics of aggression in the past (Ulrich and Azrin, 1962), later explored many antecedental and consequential variables that
influenced production and maintenance of the response (as summarized by Ulrich in 1967 and 1970).

Findings by both types of investigators have shown many of the same conclusions either by direct observation of human responding in the laboratory or by extrapolating from available animal research data. Aggression occurred as a result of discrimination-learning (Bandura and Walters, 1963; Reynolds, Catania, and Skinner, 1963), modeling (Bandura and Huston, 1961, Bandura, Ross, and Ross, 1961, 1962, 1963), operant and respondent conditioning, (Vernon and Ulrich, 1966; Creer, Hitzing, and Schaeffer, 1966; Stachnik, Ulrich, and Mabry, 1966; Ulrich, Johnston, Richardson, and Wolff, 1963), and reinforcement patterns (Cowan and Walters, 1963; Walters and Brown, 1963) to cite only five examples of paralleled research effort in this area.

To lend the study of human aggression to an experimental analysis design, Ulrich and Symaannek (1971 manuscript) have explored one method for quantifying the human aggression response. This involved the availability of another organism toward which aversive stimulation (shock) could be delivered and the organism's resultant behavior could be observed while the subject was under various motivational conditions. This button or lever press allowed the investigator to observe response rate over time, a highly desirable response quantification. Using this basic design, the present investigation explored the extent to which children would deliver aversive stimuli to another organism in a free-operant situation, based only on their past social learning histories. In this case, no events outside of the experimental chamber were manipulated so as to frustrate or induce aggressive behavior, rather, the probability of
this response occurring without programmed external antecedental or consequential events was explored. This experiment also analyzed the extent to which such responding could be brought under control by an exteroceptive stimulus (visual cue) and whether the availability of alternative responses (other than shocking the rat) would affect rat-shock production.
METHOD

Subjects

Five children served as the experimental subjects; Subject 201, female, 5 years of age; Subject 202, female, 5 years of age; Subject 203, male, 6 years of age; Subject 204, female, 7 years of age; and Subject 205, female, 9 years of age. Each subject was assigned a Hooded Long-Evans rat approximately 100 days old. The rats were individually housed and were supplied with food and water.

Apparatus

The experimental chamber was a sound attenuated room, 1.37m wide x 1.82m long x 2.43m in height, well-ventilated with a fan intake and exhaust system, air-conditioned, lighted by a 100w caged bulb and supplied with "white" noise. The response panel was located on a console, .56m wide x .64m long and 2.08m in height, as shown in Figure 1 on page 25. Located within the console was a rat chamber (D) separated from the subjects by two plexiglas windows. When response switch B was pressed, a red light could be programmed to flash (c). Switch A delivered current to the rat chamber grid. Lights (a) and (b) were used to signal the occurrence of shock to the rat and/or the red flashing light upon operation of the appropriate switch.

Electro-mechanical programming apparatus was located in a control room adjacent to a sound attenuated room which opened to the back of the
console. Shock of 4.5 ma intensity and .13 sec duration was delivered to the grid with a step-up transformer delivering 60 Hz A.C., through a 50K series resistor. The shock was scrambled through an apparatus built after a model by Hoffman and Fleshler (1962).

Data were collected on counters, timers and cumulative recorders.

Procedure

Sessions were 10 min long. On the first day of the experiment, each subject was taken into the chamber and given the following instructions:

"Please come in and sit down in this chair (the experimenter then helped child into chair). You will be in this room for ten minutes and you cannot come out until I come for you. While you are here, you should work by pressing either of these buttons (experimenter demonstrated the operation). For your work, you will earn five pennies which I will give you when you come out (pennies were shown to the subject). Your job is to press the buttons. With the pennies, you can buy the toys and trinkets over here (subject was shown a box of assorted trinkets, toys and gum)."

The chamber door was then closed. The same instructions were given on the following two days and terminated thereafter. After the experiment had progressed three months, reinforcers were changed by substituting a point system. Subjects could choose a more expensive toy from a nearby toy shop and save points over a number of sessions to earn it. Because the children arrived at the laboratory at approximately the same time each day, an extra point (or penny) was given for good behavior in the waiting room. No points or pennies were delivered within the chamber. Experimental sessions were conducted on week days only.

Experimental manipulations were individualized for each subject and each manipulation is summarized on Table 1. Session numbers indicating duration of each condition are shown parenthetically. The opportunity to
produce shock to the rat occurred five times each session for a 1-min duration. The onset of each period was scheduled according to a VI-1 min (variable-interval 1 min). Table 1 appears on pages 21 and 22.

**Phase I: All Subjects**

At shock period onset, shock was delivered to the rat when the subject operated switch A. No programmed environmental changes occurred with the operation of switch B. Changes during this phase included, increasing footshock intensity from 2 ma (condition A) to 4.5 ma (condition B). The rat chamber light was lighted to improve the subject's visibility of the rat (condition C). The 4.5 ma footshock intensity and lighted chamber remained constant throughout all other manipulations.

**Phase II: Subjects 202 and 203**

Condition A of this phase signaled onset and duration of shock periods by lighting the light (a) adjacent to switch A. This indicated to the subjects that switch A operation would produce shock during that period only. For Subject 202, condition B made available the opportunity to produce feedback (red light flash) during shock periods by operating switch B. Condition C signaled shock period and feedback onset for both switches. Feedback was made available to determine if (1) a consequence to a switch B response would maintain that behavior and (2) if the onset of the visual cue adjacent to the switch would control which switch was pressed. Conditions B and C for Subject 203 were opposite, i.e., a visual cue for both switches was introduced, followed by the opportunity to produce feedback.
Phase II: Subjects 201, 204 and 205

The visual cue for shock (switch A) was introduced for all subjects under condition A of this phase. Under condition B, the rat chamber was covered to eliminate visual feedback from the rat. For Subjects 201 and 205, the rat was removed from chamber (chamber remaining covered) under condition C, to eliminate both auditory and visual feedback from the rat. The manipulanda were then changed (condition D, Subjects 201 and 205; condition C, Subject 204) by replacing the buttons with toggle switches. This insured greater reliability in response quantification and served as another environmental change that could affect response rate when other conditions were held constant. Reversals were effected for Subjects 201 and 205 whereby the rat was again present but not visible (condition E) and then present and visible (condition F). The rat was made visible again for Subject 204 under condition D.

Phase III: Subjects 202 and 203.

Response manipulanda were changed for these subjects under condition A of this phase. Subsequent changes were effected for each subject in the reverse order of their introduction; no visual cue for feedback (condition B) followed by no feedback (condition C), Subject 202, and no feedback (condition B) followed by no visual cue for feedback (condition C), Subject 203. No Phase III was run for Subjects 201, 204, and 205.

Phase IV: Subjects 202, 203, and 205.

Under condition A of this phase, Subject 202 was given an auditory stimulus (click) signaling shock period onset. This stimulus was removed (condition B). Condition A for Subjects 203 and 205 was similar, no visual or auditory cues were in effect. The visual cue (light adjac-
cent to switch A) was effected under condition C, Subject 202, and condition B Subjects 203 and 205. Environmental stimuli were now similar to condition A of Phase II for all subjects.

Condition D for Subject 202 and condition C for Subject 205 were the same. The functions of the switches were reversed such that shock to the rat would occur only if switch B was operated. The visual cue remained adjacent to switch A. The cue for shock was changed to switch B for Subject 202 (condition E) and the function was reversed again for Subject 205 (condition D). These changes in switch function were made to determine if responding to shock the rat was a matter of position preference alone. No Phase IV was run for Subjects 201 and 204.
RESULTS

Since rate of responding was not determined by a schedule of reinforcement programmed by the experimenter, the number of responses made is secondary in importance; the emphasized results concern which switch was operated and how frequent responses occurred during both shock and no-shock periods.

Phase I: All Subjects

From the onset of the experiment and nearly at all times throughout, Subjects 202 and 203 preferred to respond on switch A, most frequently during shock periods. Figure 2, on page 26, indicates that during condition A, rate of responding for Subject 202 was greater on switch A than switch B, significantly so following Session 1. There was, however, little discrepancy between rates during shock and no-shock periods. During condition B, when shock intensity delivered to the rat was increased, response rate generally decreased. With the exception of Session 9, however, switch A was still preferred. As shown by the asterisk on Session 11, the rat bled. Upon leaving the chamber she exclaimed, "The rat is bleeding!" and on the following session her response rate on both switches decreased to near zero (.60 responses per minute). On Session 13, the rat chamber light became lighted as the session began. Response rate for that session and the following session was greater, but only during shock periods. Overall response rate did not increase until the final session of this condition when the majority of responses were made on
switch B during no-shock.

Results obtained during each condition for Subject 203 were similar to Subject 202's, the highest frequency of responses again occurred on switch A. There was a larger discrepancy between responses made under shock and no-shock conditions although no programmed audible or visual discriminative stimuli (other than the rat) were present. Rate of responding on switch A, in shock, varied between 69.9 and 24.3 responses per minute throughout all conditions but a consistently higher number of responses was always made on switch A in shock. On Session 11, when the rat bled from footshock, the subject made no comment.

During condition A of this phase, response rate for Subject 201 varied little between switch operation during either shock or no-shock periods. All during condition B, a slight preference for switch B both in shock and no-shock periods was noted. Again, little difference in responding was evident during condition C, although overall response rate had decreased.

Results during condition A for Subject 204 were comparable to Subject 201, although overall response rate was slightly greater. Switch B preference became evident following Session 8 (rat bled) during condition B. Switch B in both shock and no-shock was operated most frequently during condition C for this subject, although the rat received shocks on the average of 35 responses per minute throughout this condition.

General response rate was greater for Subject 204 than any other subject.

Subject 205 began condition A of this phase with a clear preference for switch A, in shock, and a generally high response rate. When shock intensity was increased, responding on both switches, both shock and no-
shock, decreased and with the exception of Session 7, switch A (in shock) was preferred. During condition C, responding occurred on switch A, in shock, only slightly more than those made on switch B, in shock.

Phase II: Subjects 202 and 203

Upon introduction of a visual cue for shock, Subject 202's response rate on switch A during shock periods increased from the previous 2.5 level (Phase I) to 19.29 responses per minute as shown in Figure 3 on page 27. By Session 24, responses on switch A during no-shock decreased to near zero for the following eight sessions. Response rate on switch B remained low in both shock and no-shock periods except on Session 27. Preceding this session when the experimenter brought the subject into the chamber room, she stated, "Do you know why I press only when the light is on? That's the only time the rat jumps." The experimenter ignored the comment, and on that session there was clearly an increase in responses made during no-shock.

When feedback was programmed for Subject 202 on Session 34 (condition B), no instructions were given. Because this subject did not respond on switch B, in shock, for the first six sessions of the phase, the red flashing light was not produced. On Session 40, switch B was sampled during the second shock period, and responses per minute on that switch increased from 0 to 33.8. The high response rate recorded for switch A occurred before the subject sampled switch B and feedback was produced. Response rate on switch A during shock was much less in the second and third shock periods, but increased in the last shock period. An alter-
nation between switch A and switch B during different shock periods was observed for the succeeding three sessions. For the remainder of the phase, response rate on switch B during either shock or no-shock again decreased to near zero. As shown by the shock trend, the number of responses producing shock did not vary greatly from the preceding condition.

On Session 48, a visual cue was programmed for switch B (condition C). Rate on switch B increased for that session, steadily decreased and stabilized at 15 responses per minute on Sessions 53 and 54.

Observation of Subject 203's response rate at the initiation of cue (condition A), showed an increase of 10 responses per minute over Phase I, condition C, on switch A during no-shock periods. By Session 18, and for the remainder of Phase II, the highest rate observed for switch A, (no-shock), was 3.65 responses per minute. Throughout condition A, the subject rarely responded on switch B, the highest rate being 2.62 responses per minute, no-shock on Session 14.

An immediate increase in responses per minute during shock on switch B (from 1.5 to 20.8) occurred when visual cues were programmed for both switches (condition B). Within four sessions, responses to switch B decreased again to the preceding rate. Responses on switch A were less than on switch B on Session 29 but later increased to the previous level. As shown on Figure 2, the rate bled on two successive sessions (33 and 34); responding was decreased for the remainder of the condition. As feedback was available for Subject 203 (condition C) responding on switch B, in shock, increased to 60.8 responses per minute. This rate gradually decreased throughout this condition to 4.28 responses per minute (Session 49). Responding on switch A in shock predominated only on Sessions
44 and 47. Overall response rate decreased.

Phase II: Subjects 204, 205, and 201

Subject 204's pattern of responding remained unchanged from Phase I, condition C, for Sessions 15-18 after the visual cue was introduced (see Figure 4 on page 28). On Sessions 20 and 21 responding during shock period, either switch, virtually ceased. A preference for operating switch A emerged thereafter. Responding on switch B in shock decreased to near zero and remained so for that condition. The chamber window was covered on Session 36 (condition B) and responding occurred only on switch A, predominantly during shock periods for that and the next three sessions. On Session 40, however, and for the rest of the condition, responding ceased.

Response rate, due to the manipulanda change (Session 43, condition C) increased dramatically. Switch A, in shock, was preferred only during the first two sessions and overall response rate decreased until Session 48. After that responding became highly variable, the subject alternating switches between sessions and shock/no-shock periods. The last two sessions of this phase showed a preference for switch B, in shock. The chamber was again uncovered on Session 58 (condition D) but switch B preference occurred only on this session. Responding occurred almost entirely on switch A during shock for the remainder of the condition, averaging 70 shocks per minute to the rat.

On Session 15 of Phase II, condition A (visual cue for shock), Subject 205's response rate on switch A decreased to 10 responses during
the entire session, decreasing again to 0-1 responses per session for the remainder of this condition. Subject 205 clearly pressed switch A only during no-shock periods and avoided shocking the rat by maintaining a response per minute average of 26.5 on switch B in shock. On Session 23, the rat chamber was covered for this subject. Responses on switch A occurred still during no-shock, although it was largely the preferred switch again. Switch B was now predominantly operated during shock and the subject clearly avoided producing shock to the rat. When the rat was removed from the chamber (Session 28), switch preference was eliminated, the response pattern varying in switch preference. This pattern also remained, although at an overall increased rate due to the manipulanda change (condition D). The rat was replaced in the covered chamber (condition E) on Session 42, but now switch A, during shock was operated. Clearly, results were dissimilar to those during the previous experimental condition (B). Following Session 42, response preference was distributed similarly to those in the preceding condition, a high rate shown for each switch both in shock and no-shock.

Data shown in the following condition changed only in terms of a slight decrease in overall response rate. The rat was visible and received 40 shocks per minute on the average.

Visual cue introduction (condition A) for Subject 201 caused little change in response pattern until Session 20 when a preference for Switch B both during shock and no-shock occurred and was maintained. Response rate on switch A nearly ceased. The elimination of visual feedback on Session 33 (condition B) produced no change, switch B was still preferred. By eliminating auditory feedback from the rat's movement and squeals
when shocked, responding decreased, but remained on switch B for five sessions, decreasing to nearly zero for both switches under both periods.

Manipulanda change caused an immediate and dramatic increase in responding, the most frequently occurring responses on switch A. Within four sessions, response rate decreased again, averaging no more than five responses per minute on either switch, in shock and no-shock. On Session 51, the rat was re-introduced (condition E) and responding predominantly occurred on switch A during shock for all sessions except 54.

On Session 58, the chamber was uncovered, rat present (condition F) and responses were made for this and the next three sessions again on switch A. This was shown to vary throughout this phase but in observing total response rate, either a preference for switch A is shown or rate decreased to zero. The exception was Session 77 when shock responses per minute increased to 83.4. The subject had just returned from a two-week vacation.

Phase III: Subjects 202 and 203

Upon introduction of the new response manipulanda (condition A), response rate increased on both switches, both during shock and no-shock for both subjects as shown in Figure 5 on page 29. Response increase is much greater for Subject 202 than 203 however. Subject 202 responded most frequently to produce rat shock. By Session 55, Subject 203's responses were predominantly on switch B, although overall response rate gradually decreased during the remainder of this condition.

In recovering a previous condition for Subject 202 (condition B,
Phase II), the visual cue for switch B was removed (condition B) on Session 67. The opportunity to produce feedback, even without a cue, produced a higher response rate on switch B than switch A during shock for all but three sessions during this condition (67, 70, 74). When feedback was removed for this subject, following Session 77 response rate on switch B decreased again to near zero and data for switch A remained similar to those gathered for the same switch in the preceding condition.

Following the changes in manipulanda for Subject 203, feedback was removed, and the visual cue remained for both switches, recovering an earlier condition (B, Phase II). Essentially, the pattern of responding was similar to that condition, the majority of responses on switch A, although overall response rate decreased during the course of this condition. On Session 70, when the visual cue for switch B was removed, responses per minute on switch B never exceeded 1.38 per minute for either shock or no-shock periods. This pattern of responding again followed closely that obtained during the first manipulation made following Phase I.

Phase IV: Subjects 202, 203, and 205

Subject 202's response rate when the visual cue for shock was removed, was similar to the preceding condition although the discriminating between shock and no-shock periods was less pronounced. Responses occurred majorly on switch A, although overall response rate decreased to near zero (Sessions 95, 99) (see Figure 6 on page 30). On Session 101, an audible relay click signaling shock onset was removed, thus pro-
viding similar experimental conditions to Phase I, condition C. Responses occurred most often on switch A, although overall response rate decreased from the previous condition. As soon as the visual cue for switch A was replaced (condition C, Session 108), data obtained replicated those gathered during Phase II, condition A, and a preference to produce rat shock was clear.

Since the lower switch was rarely operated, it was possible that the top lever was simply preferred, perhaps easier to operate. In order to test this, the functions of each switch were reversed. Responses to switch B would then produce shock to the rat and responses to switch A would produce nothing. As a result, the majority of responses were made on switch B by the second session of this new condition (D). Notwithstanding an overall response decrement, this was constant for the remainder of the condition. On Session 122, the visual cue was introduced for switch B and a slight increase was evident for those last two experimental sessions.

The visual cue for switch A was also removed on Session 77 for Subject 203 replicating conditions during Phase I (C). As before, the discrimination between shock and no-shock was less pronounced during the first portion of this condition. Response rate averaged 59.4 responses per minute from Session 77 through 88 on switch A during shock when overall response rate decreased suddenly from 27 to 8 responses per minute. Following rates were also typically low. Because no reinforcement was delivered within the chamber, it was possible that this decrease might be due to either the longevity of the experiment or the lack of signals for shock period. Therefore, the cue for shock on
switch A was re-introduced (Session 95). A slight increase in responses to switch A during the first few sessions occurred but was not maintained.

At the onset of condition A (removal of visual cues), Phase IV, Subject 205's behavior mirrored that of Phase II, condition F, but only for that session. For the remainder of this condition, no more than one response per minute on either switch was recorded. On Session 59, the removal of the cue produced little change, and on following sessions no more than one response per minute on either switch was recorded.

On Session 66, the cue next to switch A was re-introduced to test if this subject was responding only in the presence of this stimulus. On Session 67 response rate on switch A, in shock, slowly increased with much variation. Asterisks show that on five succeeding sessions the rat bled from footshock. Response rate on switch A increased, however, as high as 139 responses per minute. A notable increase occurred on switch A, Session 74 no-shock. Most of these responses, however, were recorded as response overflow immediately after shock period termination.

Due to the subject's history which had shown nearly zero responses to shock the rat during the initial conditions of this experiment, it was felt necessary to determine if this dramatic increase in shocking the rat was due to position preference. On Session 86, switch function was reversed, the cue remaining next to switch A, and nearly all responses were now made on switch B. On Figure 6, the shock trend illustrates this most clearly. On Session 89, conditions were reversed to normal and a preference for shocking the rat was substantiated.
DISCUSSION

The introduction of the visual cue for switch A produced changes in responding for all subjects. A discrimination developed in each case, and a preference was established for either producing rat shock or avoiding rat shock production. For Subjects 202 and 203, who rarely varied from preferring to deliver rat shock, the opportunity to produce the red flashing light affected this preference, although an overall decrement in shocks delivered was not observed. The data suggest that both the introduction of the cue next to switch B as well as the flashing light were sufficient to increase responding on switch B. These effects, however, were not maintained. Shocking the rat never entirely ceased and often predominated all responses made. This suggests that the ability to produce change in an environment is important and that such sensory feedback may, itself be reinforcing.

The manipulanda change caused an increase in responding for all subjects. Although part of this change could be due to easier operation of the new switches, the following response decrement suggested that again, environmental change was responsible for response increase.

Responding was also brought under tight control of the visual cues. Their presence, especially in relation to switch A, caused response increase when reversed to Phase II, condition A, during the final phase for each subject. In the absence of the cue, responding ceased often for many sessions for all subjects. It should also be noted, that a general decline in overall response rate is evident for each subject as the ex-
periment progressed. This may be attributed to the fact that responding was never controlled by a programmed schedule of reinforcement within the chamber as well as the longevity of the experiment.

Interestingly, Subjects 201 and 205, who initially preferred not to shock the rat, later changed. It is possible that the gradual decrease in feedback from the rat when shocked, and then the subsequent increase in feedback in some way caused adaptation to the original effects of the feedback. It is also possible that the previous conditioning history of these subjects contributed to the initial non-shock behavior, but the situation of daily presence within an experimental setting with no other environmental changes occurring, resulted in the reinforcing effect of shocking the rat. Kish (1966) cites evidence which supports the premise that sensory deprivation may be operating in this instance to cause responses that produce environmental change. Although the children were each exposed to the rat bleeding at various points in the experiment, no conclusive change in responses occurred as a result.

In particular, Subjects 202, 203, and 205 clearly preferred shocking the rat under most conditions. Switch position was not a factor in this preference, nor was the onset of a particular signal the only controlling variable. This would suggest that under the conditions described in this investigation, it was neither necessary to operantly or respondent condition such aggressive behavior and that it, in fact, was reinforcing enough to be majorly responsible for response maintenance over as many as 123 sessions.
TABLE 1

Stimulus Conditions For Each Subject, Each Phase. Number of Sessions Included Under Each Condition is Shown Parenthetically.

<table>
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<td>A. Shock @ 2 ma (1-5)</td>
<td>A. $SD$ for Shock (20-33)</td>
<td>A. New Manipulanda (55-66)</td>
<td>A. No Visual $SD$; Auditory $SD$ for Shock (84-100)</td>
</tr>
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<td></td>
<td>B. Shock @ 4.5 ma (6-12)</td>
<td>B. Feedback (34-47)</td>
<td>B. No $SD$ for Feedback (67-76)</td>
<td>B. Auditory $SD$ Removed (101-107)</td>
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<td></td>
<td>C. Chamber Light On (13-19)</td>
<td>C. $SD$ Both Switches (48-54)</td>
<td>C. No Feedback (77-83)</td>
<td>C. Visual $SD$ Shock (108-115)</td>
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<td>D. Visual $SD$ and $SD$ Switch A (116-121)</td>
<td></td>
<td>D. Visual $SD$ Switch B (116-121)</td>
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<tr>
<td></td>
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<td>E. $SD$ and Shock Switch B (122-123)</td>
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</tbody>
</table>

<p>| #203    | A. Shock @ 2 ma (1-4) | A. $SD$ for Shock (14-28) | A. New Manipulanda (50-60) | A. No $SD$'s (77-94) |
|         | B. Shock @ 4.5 ma (5-8) | B. $SD$ for Both Switches (29-34) | B. No Feedback (61-69) | B. $SD$ for Shock (95-112) |
|         | C. Chamber Light On (9-13) | Feedback (35-49) | C. No $SD$ for Feedback (70-76) | |</p>
<table>
<thead>
<tr>
<th>SUBJECT</th>
<th>PHASE I</th>
<th>PHASE II</th>
<th>PHASE III</th>
<th>PHASE IV</th>
</tr>
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<tbody>
<tr>
<td>#201</td>
<td>A. Shock @ 2 ma (1-4)</td>
<td>A. SD for Shock (14-26)</td>
<td>B. Rat Not Visible (27-32)</td>
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<tr>
<td></td>
<td>B. Shock @ 4.5 ma (6-10)</td>
<td>C. Rat Absent from Chamber (33-42)</td>
<td>D. New Manipulanda (43-50)</td>
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<tr>
<td></td>
<td>C. Chamber Light On (10-13)</td>
<td>E. Rat Present; Not Visible (51-57)</td>
<td>F. Rat Visible (58-91)</td>
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</tr>
<tr>
<td>#204</td>
<td>A. Shock @ 2 ma (1-5)</td>
<td>A. SD for Shock (15-35)</td>
<td>B. Rat Not Visible (36-42)</td>
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</tr>
<tr>
<td></td>
<td>B. Shock @ 4.5 ma (6-10)</td>
<td>C. New Manipulanda (43-57)</td>
<td>D. Rat Visible (58-68)</td>
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<tr>
<td></td>
<td>C. Chamber Light On (11-14)</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>#205</td>
<td>A. Shock @ 2 ma (1-3)</td>
<td>A. SD for Shock (13-22)</td>
<td>B. No SD's (56-65)</td>
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</tr>
<tr>
<td></td>
<td>B. Shock @ 4.5 ma (4-9)</td>
<td>C. Rat Absent from Chamber (28-34)</td>
<td>B. SD for Shock (65-85)</td>
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<td>C. Chamber Light On (10-12)</td>
<td>D. New Manipulanda (35-41)</td>
<td>C. Shock Switch B (86-88)</td>
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<tr>
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<td>E. Rat Present; Not Visible (42-47)</td>
<td>D. Shock Switch A (89-91)</td>
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<td>F. Rat Visible (48-55)</td>
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</tbody>
</table>
FIGURE LEGENDS

Figure 1  Schematic of console located within experimental chamber. Response manipulanda are indicated at "A" and "B"; white lights available for programming as visual cues at "a" and "b"; red flashing feedback light at "c" and rat chamber at "D." The high chair in front insured good visibility of rat chamber and feedback light.

Figure 2  Responses per minute, for each session during each condition of Phase I is shown for all subjects. Responses on switch A are circles; switch B are triangles. Closed symbols indicate shock period, open symbols indicate no shock period. Asterisks indicate that the rat bled during that session due to footshock.

Figure 3  Responses per minute and response trend of shocks delivered to rat for each session during each condition of Phase II are shown for Subjects 202 and 203. Responses on switch A are circles; switch B are triangles. Closed symbols indicate shock period, open symbols indicate no-shock period. Asterisks indicate the rat bled during that session due to footshock. Responses per minute and response trend of shocks delivered to rat for each session during each

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FIGURE LEGEND — Continued

condition of Phase II are shown for Subjects 201, 204, and 205. Responses on switch A are circles; switch B are triangles. Closed symbols indicate shock period, open symbols indicate no-shock period. Asterisks indicate the rat bled during that session due to footshock.

Figure 5 Responses per minute and response trend of shocks delivered to rat for each session during each condition of Phase III are shown for Subjects 202 and 203. Responses on switch A are circles; switch B are triangles. Closed symbols indicate shock period, open symbols indicate no-shock period. Asterisks indicate the rat bled during that session due to footshock.

Figure 6 Responses per minute and response trend of shocks delivered to rat for each session during each condition of Phase IV are shown for Subjects 202, 203, and 205. Responses on switch A are circles; switch B are triangles. Closed symbols indicate shock period, open symbols indicate no-shock period. Asterisks indicate the rat bled during that session due to footshock.
FIGURE 2

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FIGURE 4

SESSIONS

S#204

S#201

S#205
<table>
<thead>
<tr>
<th>SESSIONS</th>
<th>RESPONSES / MINUTE</th>
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</thead>
<tbody>
<tr>
<td>S#202</td>
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<tr>
<td>S#205</td>
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<tr>
<td>S#203</td>
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</tbody>
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REFERENCES


Stachnik, T. J., Ulrich, R. E., and MaBry, J. H. Reinforcement of intra-


