SHOCK-ELICITED AGGRESSION AS A FUNCTION OF SHOCK MODALITY

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SHOCK-ELICITED AGGRESSION AS A FUNCTION OF SHOCK MODALITY

An Abstract

Presented to

the Graduate Council of

Austin Peay State University

In Partial Fulfillment

of the Requirements for the Degree

Master of Arts

in Psychology

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by

James Louis Tramill

December, 1976

ABSTRACT

A study was designed to investigate the effectiveness of three different types of shock modality in a shock-elicited aggression situation. Twenty-four male albino rats served as subjects and were randomly assigned to three equal groups. One group received ac shock, a second group received full-wave filtered dc shock, while a third group received half-wave dc shock. Measurements were recorded for both number of aggressive responses and total time spent in aggressing. All subjects were tested in the single-subject, restrained situation.

Results of statistical analysis indicated that the subjects receiving dc half-wave shock showed a significantly larger number of aggressive <u>responses</u>. No differences were found in the time of aggression analyses.

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To the Graduate Council:

I am submitting herewith a Thesis written by James Louis Tramill entitled "Shock-Elicited Aggression As a Function of Shock Modality". I recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Arts, with a major in Psychology.

Major Professor

We have read this thesis and recommend its acceptance:

Second Committee Member

Third Committee Member

Accepted for the Council:

Dean of the Graduate School

ACKNOWLEDGMENTS

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TABLE OF CONTENTS

LIST OF FIGURES

CHAPTER I

INTRODUCTION

The phenomenon of shock elicited aggression has received considerable research attention during the last decade. The vast majority of studies in this area have been concerned with the manipulation of variables such as sex of subject, various deprivation states, and intensity of shock. When electric foot-shock is delivered to paired rats, a sterotyped fighting reaction results (O'Kelly and Steckle, 1939). Current interest in this phenonmenon has been spured by the 1962 publication of a report by Ulrich and Azrin. Ulrich and Azrin (1962) reported that when exposed to foot shock, paired rats typically assume an upright posture, bare their teeth, and strike vigorously at each other with their forepaws. Ulrich and Azrin (1962) determined that shock-induced fighting in rats was a function of both enclosed floor area and shock intensity. Manipulating the sex of the subject, strain, previous familiarity with other subjects, and number of subjects present during shock did not alter this stereotyped pattern of fighting. Optimal conditions for inducing fighting were defined as two rats confined in an experimental chamber exposed to a 2mA foot shock.

Subsequent to these initial findings reported by Ulrich and Azrin (1962) other research was begun to further describe the factors involved in modulating this behavior. Several investigations have sought to demonstrate shock-induced aggression in various species of mammals. For example, Ulrich and Azrin (1962) found that paired hamsters show a fighting response to shock, similar to the rat, whereas the guinea pig does not. Azrin, Hutchinson, and Hake (1963) found that 3mA foot shock could initiate reflexive fighting between paired squirrel monkeys.

Another line of research has involved manipulating the modality of aversive stimulation. Ulrich and Azrin (1962) reported that electrode shock to the back of the animal as well as foot-shock could elicit the fighting reflex. They also indicated that intense heat also produced the stereotyped fighting though the development of competing responses during the presentation of heat rendered this pain stimulus somewhat undesirable for pain-aggression studies. However, no fighting was elicited by intense noise or moderate cold. Azrin, Hake, and Hutchinson (1965) found that squirrel monkeys responded aggressively as a result of tail pinches.

Prior to the 1968 publication of the Azrin, Rubin, and Hutchinson article, most shock-elicited aggression studies relied upon subjective evaluation of which postures and movements were considered to be aggressive. Ideally a single subject should be observed with automatic recording of aggressive responses. Unfortunately, the findings of Ulrich and Azrin (1962) indicated that lone rats would not aggress toward an inanimate object in response to foot shock. Azrin, Hutchinson, and Sallery (1964) had successfully demonstrated that aggression toward inanimate objects could be elicited in squirrel monkeys by applying foot shock. (These results lead Azrin et al. (1964) to speculate that squirrel monkeys were inherently more aggressive than domesticated rats.) Combining the findings of previous studies Azrin et al. (1968) created a situation in which biting attack would likely occur in response to shock. In this procedure restrained rats received unavoidable tail shocks of 5mA intensity with a 200msec duration every 10 sec. for 20 min. The tail shocks to restrained rats did elicit biting attacks on inanimate targets, thus making the Azrin et al. (1964) speculation on the inherent distinction between rats and squirrel monkeys invalid.

Although Ulrich and Azrin (1962) reported that shock-induced fighting was independent of sex, some investigators have found that sex and age of the subject are related to the frequency of reflexive aggression. Milligan, Powell, and Borasio (1973) found no significant sex difference of shock-elicited aggression (SEA) in Sprague-Dawley rats but did find that Long-Evans males exhibited significantly higher SEA frequencies than females. Milligan et al. (1973) also found that castrated Sprague-Dawley males had significantly lower SEA frequencies than the control group. This difference was diminished by testosterone replacement therapy of the castrate group. Hutzell and Knutson (1972) reported that shock-elicited fighting and shock-elicited biting were differentially affected by sex of hooded rats obtained from the University of Iowa colony. Males displayed significantly more fighting than females, but frequency of shock-biting of an inanimate target was independent of the sex of subject. Inconsistent with these findings are those reported by Powell, Silverman, Francis, and Schneiderman (1970). Powell et al. (1970) reported that sex was not related to shock-elicited aggression in Sprague-Dawley rats. Milligan et al. (1973) suggest possible explanations of these inconsistencies regarding the effects of sex on shock-elicited aggression. One explanation is that of procedural and methodological differences employed by investigators. Another explanation suggested is "that different kinds of aggression exist, each controlled by partially overlapping but largely independent physiological systems".

Age of the subject has also been investigated. Hutchinson, Ulrich, and Azrin (1965) found that reflexive fighting behaviors of rats increase with age and that castration produced lowered fighting probability in adult subjects, whether castrated before or after puberty. Powell and Creer (1969) indicated that maturation interacted with prior experience with both shock and fighting with Sprague-Dawley rats.

Several studies have sought to determine the effect of housing conditions on the shock-elicited aggression paradigm. Creer (1974) demonstrated that housing rats six to a cage for 60 days apparently influenced the shock-induced aggression when the animals were later paired and tested within the shock chamber. Creer argued that communal housing served to produce greater inconsistency in fighting over sessions. Creer (1975) extended his earlier study to specifically investigate shock-induced aggression as a function of housing rats in single or communal cages for varying periods of time prior to testing. Variability in fighting frequencies was reported. Communal caging of subjects for 21 or 28 days before testing produced a particularly deleterious effect on frequency of aggressive contacts. Contrarily, Hutchinson et al. (1965) found that rats housed in communal cages demonstrated higher fighting frequencies than those housed singularly. Stabilization of the aggression parameter, however, occured more rapidly for isolates than for communally housed subjects. Obviously, the effects of housing on shock-induced aggression remain somewhat unclear.

Additional studies have concerned themselves with the effects of specific deprivation states and related drive states on shock-elicited aggression. Cahoon, Crosby, Dunn, Herrin, Hill, and McGinnis (1971) found when food deprivation is paired with shock, subjects show a higher rate of aggression than do non-deprived subjects. Hamby and Cahoon (1971) reported that shock-elicited aggression was functionally related to the level of water deprivation. The effects of food and water deprivation shown by these investigators appears to be curvilinear with aggression being relatively less influenced by more extensive deprivation. In a related study, Bisbee and Cahoon (1973) found that small amounts of lithium chloride (a nausea-inducing drug) increased aggressive responding to shock, while larger levels inhibited aggression.

Powell et al. (1970) determined that previous experience with shock and fighting resulted in increased fighting frequencies in the shock-aggression situation. Also, rats that received trials spaced over several sessions fought more frequently than rats that received the same number of shocks within a single session.

Expanding on the initial statement by Ulrich and Azrin (1962) on the relationship between shock intensity and shock aggression, several investigators have considered the specific effects of manipulating shock duration and shock intensity on reflexive fighting. Azrin, Ulrich, Hutchinson, and Norman (1964) found that the elicitation of fighting by foot-shock was a direct function of the duration of the shocks: the longer the shock, the greater the probability of fighting. However, continued delivery of foot-shocks partially reversed this relation. Brief shock durations became progressively more effective during continued shock presentation. Creer and Powell (1971) demonstrated that shock of various intensities (0.5, 1.0, 2.0, 3.0, and 4.0mA) induced similar fighting frequencies when rats were paired together for several sessions. A general increase in rates of fighting over sessions was also indicated for all but the 0.5mA stimulus intensity.

Dreyer and Church (1968) attempted to quantitatively specify the functional relationship between shock intensity and duration on probability of shock-elicited fighting.

They reported that the probability of fighting was a linear function of the logarithm of both shock intensity and duration. An increase in the logarithm of the intensity produced approximately twice as great an increase in fighting as an equivalent increase in duration of the shock.

Despite the rather straight-forward appearing results of the Ulrich and Azrin (1962), Azrin et al. (1964), Creer and Powell (1971), and Dreyer and Church (1968) studies, inconsistancies appear in the literature as to the optimal intensity for production of shock-induced aggression. Ulrich and Azrin (1962) reported that the optimal level of foot shock was 2mA. Powell, Francis, Braman, and Schneiderman (1969) reported 4.0mA as the optimal intensity of foot shock for inducing aggression in paired rats, however, Creer and Powell (1971) reported no differences in fighting using 1.0, 2.0, 3.0, and 4.0mA.

Various types of power supplies have been used to provide the footshock in shock-induced aggression studies. Some investigators have used constant-current ac power supplies (e.g. Dryer and Church (1968), Powell et al. (1969), Powell and Creer (1969), Creer and Powell (1971), while other investigators have used constant-current dc power supplies (e.g. Berry and Jack (1971), Hutzell and Knutson (1972), and Knutson and Hynan (1972). In reviewing the literature, it was found that many investigators specify the intensity of shock but fail to specify either the type of shock or the vendor of the shock source.

Follick and Knutson (1974) compared ac, dc, and ac rectified current shock at various intensities (ac at .4, .7, 1.5, and 2.3mA; dc at .5, 1.0, 2.0, and 3.0 mA; and ac rectified at .4, .7, 1.5, and 2.3mA) to assess differential influences on foot shock-induced fighting of paired rats. At the lower levels of intensity, the dc shock resulted in greater fighting than the equivalent ac or ac rectified shocks. While at higher levels, no differences among shock types were reported. These results indicate that, at least in lower shock intensities, shock type is a variable in shock-induced aggression research with rats.

The findings of Follick and Knutson (1974) raise the possibility that the modality of shock employed by an investigator could very well influence shock-induced aggression differentially and be functionally related to the apparent disparity in the literature. It should also be noted that this study was conducted in the open-field situation using paired rats. As already mentioned, this procedure relies quite heavily upon subjective evaluation of the subjects' postures for the measurement of aggression.

Hence, it would seem quite profitable to investigate the effects of different types of shock modality in the restricted, single-animal situation. The present study was designed with this purpose in mind.

CHAPTER II

METHOD

Subjects

The subjects were 24 male Holtzman albino rats approximately 110 days old at the experiment's onset. Although experimentally naive with respect to shock-elicited aggression precedures, all rats had previously served as subjects in a food-deprivation study. All animals were housed in individual cages with water and food available on an ad libitum basis.

Apparatus

A rat restraining device similar to that described by Azrin et al. (1968) served as the apparatus in shock-elicited aggression testing. This equipment consisted of an opaque plastic tube, measuring 21.5 cm in length and 7.5 cm in diameter, mounted on a plexiglas sheet. The plexiglas sheet was, in turn, stabilized on a wooden platform. However, the plexiglas sheet was easily removed from the wooden platform to facilitate placement of the subject into the tube and to permit easy removal of any fecal material and urine that accumulated during testing. A 1.5 cm hole at the enclosed end of the tube allowed the subject's tail to be extended from the apparatus and secured to a wooden restraining rod by means of adhesive tape. The other end of the tube was open. The front of the apparatus was surrounded by a square cardboard enclosure to avoid external distraction of the subject during testing. This enclosure was high enough to permit sufficient light to enter.

Tail shock was delivered to each subject via tail electrodes (two pieces of No. 14 copper wire attached to the tail-restraining rod). Three types of shock were employed: 1) ac, 2) full-wave, filtered dc, and 3) half-wave or pulsating dc. A Jackson (Model 665-J-Z) mA meter was used to monitor shock intensity.

The aggression target consisted of omnidirectional lever (Model 80111) purchased from the Lafayette Instrument Co., Lafayette, Indiana. This lever was mounted on the wooden platform, perpendicular to the open end of the restraining tube. When the tube was in place on the platform the lever extended across the mid-portion of the open end of the tube. The lever was 1.5 cm from the tube and required a movement of 1.0 cm to activate an attached microswitch. Closure of the microswitch, in turn, activated: 1) a Standard Electric Timer; and 2) a Lafayette (Model 5707 PS) impulse counter, thus allowing both total time of aggression and number of aggressive responses to be recorded for each subject.

Procedure

At the beginning of the experiment, the subjects were randomly assigned to one of three equal groups: Group AC (ac shock), Group DC-HW (half-wave dc shock), and Group DC-FW (full-wave, filtered dc shock).

Prior to taping the restraining rod to the animal's tail, electrode paste was applied to the electrodes. The subject was then positioned in the tube such that its nose was approximately one cm from the target rod. Each subject experienced a five minute habituation period in the restraining tube prior to the administration of shock. A 10 minute period of shock administration immediately followed this habituation period. During this time each subject was exposed to a series of 300msec. duration 1.50mA shocks administrated at 3 second intervals. Thus, each subject experienced a total of 200 shocks.

Testing was done over a two-day period with one-half of each group being tested each day. The subjects to be tested on a given day were randomly determined. The order for running subjects was randomized each day.

CHAPTER III

RESULTS

Prior to analysis all data was converted to $\log_{10}$ $(X_i + 1)$ scores. Group mean scores for the time measure appear in Figure 1. Analysis of variance performed on this data failed to yield significance, $F\ (2,21) = 1.39$, $p > .25$.

Group mean scores for the response measure appear in Figure 2. Analysis of variance performed on this data indicated that shock modality had a significant effect, $F\ (2,21) = 6.80$, $p < .01$. The Newman-Keuls procedure was employed to ascertain specific effects. The results of this analysis indicated that Groups AC and DC-FW did not differ significantly from each other. However, the mean of Group DC-HW was found to be significantly ($p < .01$) higher than both Groups AC and DC-FW. Thus, the graphical impression (see Figure 2) that Group DC-HW was more aggressive is supported by the statistical analysis.

CHAPTER IV

DISCUSSION

Although the graphical results (see Figures 1 and 2) indicate that more aggressiveness was shown by DC-HW subjects on both measures, this pattern of results achieved statistical significance only for the response data. The lack of significance for the time measure was due, at least in part, to the large amount of within-group variance. This finding has been noted in a number of previous studies (Azrin et al., 1963; Cahoon et al., 1971). It would appear that competing reactions (such as turning around, etc.) may be responsible for this increased within-group variability. Obviously, further research needs to be conducted to find some way to reduce this variability. Thus, it may be that number of responses is a more sensitive measure of aggression than time.

The results of the present study also strongly suggest that dc half-wave shock is the best modality for use in the single-rat, restrained situation. However, it should be noted that the AC subjects also displayed extreme amounts of vocalization and behavior during shock sessions. This behavior, however, was frequently directed toward the source of the shock (i.e. the tail), not the target object, and therefore, resulted in competing responses on the part of the animals. If there were some manner by which this behavior could be directed outward toward the target, it appears quite possible that this shock modality would be as effective as the dc half-wave modality. On the other hand, it was also observed that the ac shock resulted in more debilitation of the animal than did the other shock modalities. This observation would caution against the use of this shock modality in multiple-session experiments.

A speculative explanation of the increased aggressiveness shown by the DC-HW subjects may be found in the nature of the shock. It would appear that it is more painful to the animal to receive a burst of shocks than one steady stream of current (as in the DC-FW condition). However, if too many bursts are received (as in the AC condition) then this appears to interfere with the aggressive response and leads the animal to engage in competing responses. The dc half-wave modality, however, appears to present the shock in such a pattern as to optomize aggressiveness.

Follick and Knutson (1974) in comparing ac, dc, and ac rectified shock modalities at four intensity levels reported significant differences in amounts of aggressiveness between shock types only at lower intensities. Their results showed that dc footshock resulted in more fighting between paired rats. The ac and ac rectified groups did not differ significantly. At higher levels of intensity, no significant differences were reported. Follic and Knutson's third level of shock intensity was approximately the same (1.5mA) as that used in the present study. They reported no differences at this intensity. On the other hand, significant effects were obtained with this intensity in the present study. The discrepant results can possibly be accounted for in that Follick and Knutson used an open-field situation and the present study employed the single-subject, restrained situation. Obviously, these discrepant findings suggest a fertile area for additional research.

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APPENDIX: FIGURES

Fig. 1 - Group Mean Time of Aggression

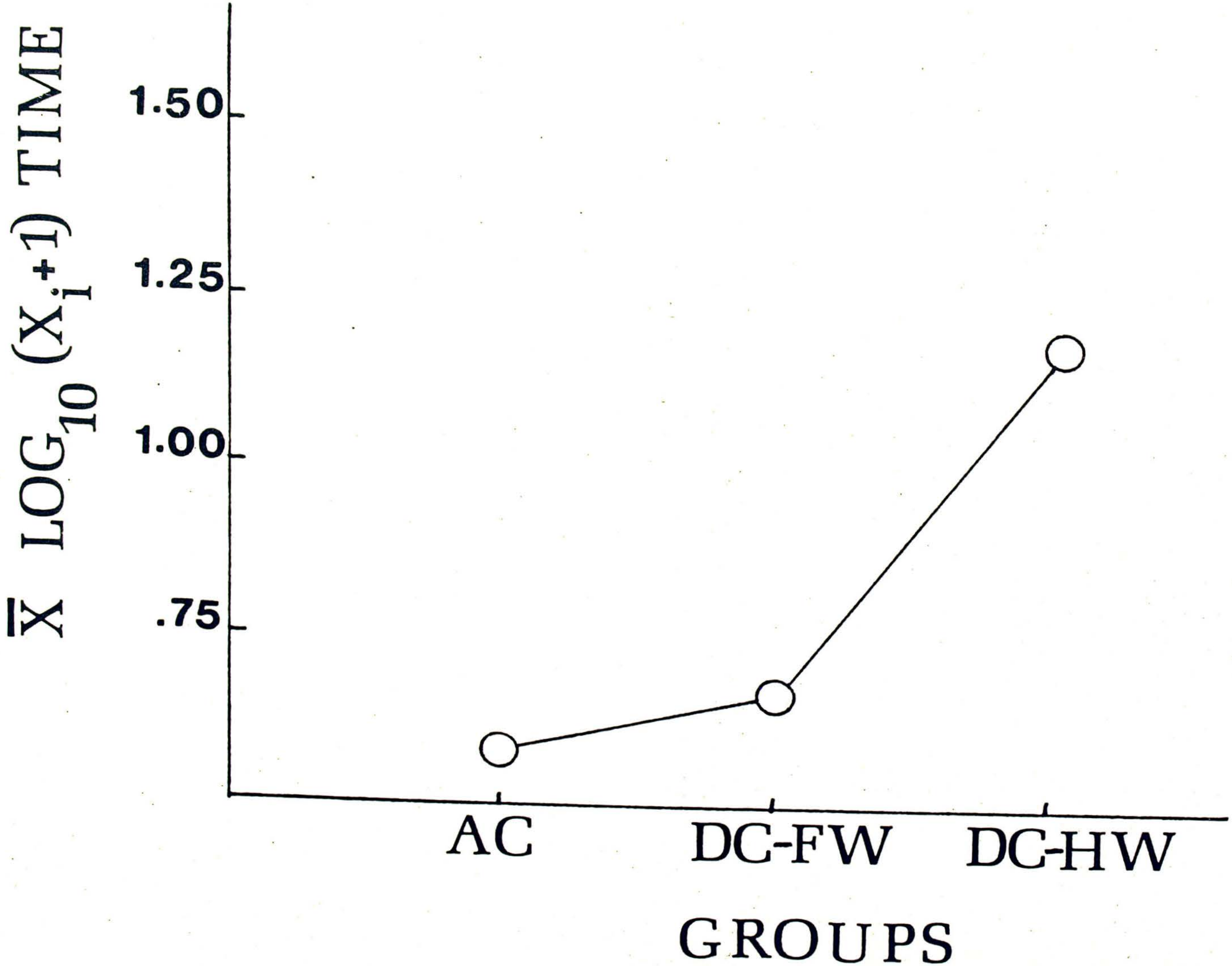
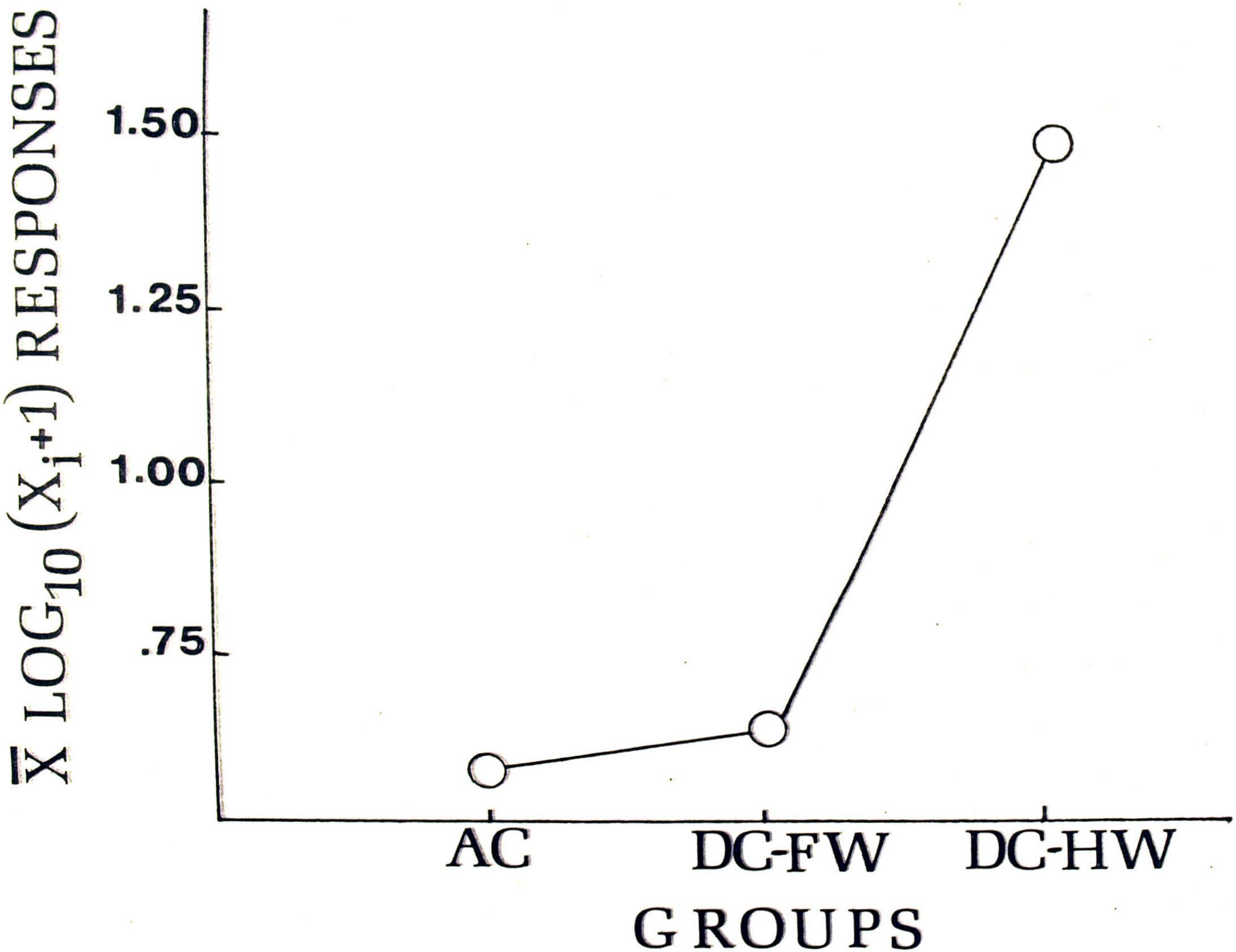

$\bar{X}$ LOG$_{10}$ (X_i+1) TIME
1.50
1.25
1.00
.75
AC
DC-FW
DC-HW
GROUPS

Fig. 2 - Group Mean Aggressive Responses



$\bar{X}$ LOG$_{10}$ (X_i+1) RESPONSES
1.50
1.25
1.00
.75
AC
DC-FW
DC-HW
GROUPS