1967

# Classically conditioned licking and acquired orienting as a function of qualitatively different UCS values : acquisition, shifting and extinction

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# CLASSICALLY CONDITIONED LICKING AND ACQUIRED ORIENTING AS A FUNCTION OF QUALITATIVELY DIFFERENT UCS VALUES: ACQUISITION, SHIFTING AND EXTINCTION

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A thesis submitted in partial fulfillment
of the requirements for the degree of Master of Arts
in psychology in the Graduate School of the
University of Richmond
August, 1967

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Supervising Professor

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# ACKNOWLEDGEMENTS

The author takes pleasure in acknowledging the advice and supervision given to him by Dr. Richard L. Patten during the course of this investigation and during his tenure as a student at the University of Richmond. The author would also like to acknowledge the assistence given by Dr. William H. Leftwich and Dr. Austin E. Grigg.

To Mom and Dad

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## Chapter I

## INTRODUCTION

The laws of classical conditioning are being called upon by contemporary learning theorists (e.g., Miller, 1948; Spence, 1956; Amsel, 1958; Mowrer, 1960) to assume a major theoretical role in accounting for instrumental behavior. However, a review of the literature, which is presented later in this paper, indicates that parametric analysis of appetitive classical conditioning variables is very much needed.

Recently, several investigators have reported successfully classically conditioning a new response system, the licking response in rats. Debold, Miller & Jensen (1965), employing a surgically implanted unconditioned stimulus (UCS) delivery, have reported reliable conditioning. Patten & Deaux (1966) have also conditioned the licking response.

Patten & Rudy (1967) discovered that rats undergoing classical conditioning of the licking response acquire behavior of turning toward and approaching the conditioning stimulus (CS) during classical conditioning, whereas, pseudoconditioning and no-UCS control groups showed habituation of unconditioned "orienting" toward the CS.

The purpose of the present study was two-fold: (A) to study classically conditioned licking in rats as a function of a qualitative UCS difference, defined as 15% sucrose concentration and 0% concentration (plain tap water); (B) to study acquired orienting as a function of these UCS values. Several aspects of conditioned performance were investigated: (1) the effect of UCS intensity on level of responding during acquisition; (2) the effect of UCS intensity on rate of approach to terminal level of responding; (3) a possible learning-performance distinction in appetitive classical conditioning; (4) rate of extinction as a function of the different acquisition UCS values.

<u>Review of relevant literature</u>

There have been several studies (Kleshchov, 1936; Gantt, 1938; Makarychev, 1941; Ayrapetyants, 1955) relating classical salivary conditioning to UCS intensity (amount of food). These studies indicate that conditioning is a positive function of UCS intensity. Warstler & Ost (1960), employing three levels of UCS (concentration of acetic acid) intensity, have reported conditioned salivation to be a positive function of UCS intensity. Coleman, Patterson & Gormezano (1966), employing different levels of saccharin concentration, were unable to find any reliable difference between concentration levels in classically conditioned jaw movements of rabbits. The direction of the difference, however, was positive. Thus, the only study (Coleman, Patterson & Gormezano, 1966) employing levels of "sweetness" as the UCS intensity variable found no difference in conditioning between levels of concentration. There is no data on classically conditioned licking as a function of either quantitative or qualitative differences in UCS value.

# Chapter II

# METHOD

## Subjects

Twenty female albino rats of the Wistar strain, between 125 and 145 days old at the beginning of deprivation and handling were used as Ss.

## Apparatus

The apparatus employed in this study was essentially the same as used in a previous study (Patten & Rudy, 1967) with the major exception that a compound CS (light + tone) was used in the present study.

Conditioning took place on a raised 31 in. x 35 in. open platform. The CS consisted of a 550 cps, 35 db tone and the light (.34 foot candles at 10 in.) from a darkened 15 watt bulb. (The CS was centered on the edge of a long side of the platform.) The UCS (.40 ml of a 15% sucrose solution or plain tap water) was delivered through a small 1/8 in. diameter drinking tube mounted on a leather and stretch-nylon headset. The sucrose solution was prepared fresh every 3 days. The mouth of the drinking tube was located approximately 1/8 in. in front of S's mouth. A Hunter contact relay in series with an electric circuit through S's body detected each contact its tongue made with the UCS tube. The circuit through S's body formed by connecting one contact to the drinking tube, and a second to a stainless steel pin implanted in the skin of S's back. Each lick emitted by S momentarily closed the contact relay circuit causing an event marker pen to deflect making a mark on moving paper, thus giving an objective recording of licking. CS duration, interstimulus interval, and UCS duration were controlled electrically by Hunter interval timers. The UCS was delivered by an infusion pump. The timing and recording instruments were housed in an adjacent soundproof room. An electric fan served as a noise dampener. During each experimental session the room was dark except for slight illumination from a 7 watt blue incandescent bulb mounted on the E's recording desk. This light source was shielded from S's view by a black cloth mounted between the bulb and the conditioning platform. E was seated in the room to record orienting responses and to control the timing of intertrial intervals (ITIs). S was free to move on the platform, subject only to slight restraint from a body harness which held the headset, contact wires and UCS tubing in place. The wires and vinyl UCS tubing were suspended from above to prevent S becoming entangled.

Experimental design

The experimental design for acquisition can be represented as a mixed two factor design, having two levels (15% and 0%) of a between-subjects UCS Intensity factor. The within-subjects factor, Sessions, consisted of 14 levels. The Ss were randomly assigned to the 15% and 0% experimental groups.

During the shift phase, 1/2 of the 15% and 0% Ss were shifted to the other concentration value, The analysis of shift effects constitutes a 2 x 2 factorial with the two factors being pre-shift and post-shift concentration.

The design for extinction may be schematized as a mixed two factor design, having four levels of a between-subjects UCS Intensity factor. The within-subjects factor, Trial Blocks, consisted of 5 levels.

Response measures

Two measures of licking were taken: the number of licks made in the 3 sec. interval prior to CS-onset (pre-CS-licking), and the number of licks made during the first 3 sec. of CS-on (CS-licking).

Two measures of conditioned orienting were used. One, a "facing" response, was recorded for those trials on which S faced the CS during the first 3 sec. of CS-on. To qualify as a facing response, an acute angle between S's line of sight and a line extending from the CS to S's near eye was required. The second, a "transition" response, was recorded during the CS scoring interval for those trials on which S moved his head and both feet laterally toward the CS, or, if already facing the CS, when S moved toward the CS across prescribed areas marked on the platform. Using the CS as a center point, five semi-circles were drawn around the CS. These semi-circles had radii of 5, 10, 15, 20, and 25 inches. To make a transition response, S had to move his head and both feet toward the CS across at least one of these lines during the first 3 sec. of CS-on. Trials on which S was already in the area of the platform closest to the CS, and thus could not possibly make a transition, were subtracted from the number of trials used to compute the percentage of transitions for that S.

Each S's percentage of orienting responses over blocks of 5 trials was computed. An arcsine transformation of the percentage was performed in order to normalize the distributions of scores. The arcsine values for each of the 5 daily percentage scores were then averaged to determine each S's mean daily score; this score was used in the statistical analysis of orienting measures.

Habituation

All Ss were put on a 23 hr. water deprivation schedule beginning 5 days prior to acquisition and maintained on this schedule throughout the entire study. Purina food pellets were available at all times in the home cages. Ss were handled and habituated to the headset and experimental room for 5 days prior to acquisition. After each training session, Ss were allowed to drink water in their home cages for 30 minutes. All Ss were housed in individual cages throughout the entire study. The stainless steel contact pin was implanted in the skin of each S's back on the first day of acquisition, and was not removed until after the last extinction trial.

Acquisition

Subjects were administered 25 CS-UCS pairings (25 trials) on each of 14 daily conditioning sessions. The 15% Ss and 0% Ss were run alternately, with each S being run at the same time each day.

CS duration during acquisition was 4 sec., the UCS being delivered during the last second of CS duration. ITIs were presented in a modified random schedule of 45, 50, and 55 sec., with a mean value of 50 sec. The schedule was modified so that the same ITI occurred no more than 3 times in succession.

Shifting

The possibility of a learning-performance distinction in conditioned licking and acquired orienting was examined by employing the shifting procedure recommended by Spence (1953). On day 15, five 15% Ss (Group 15-0) were switched to the 0% conditioned, and five 0% Ss (Group 0-15) were switched to the 15% condition. Five Ss (Group 15-15) continued to receive the 15% concentration and five Ss

(Group 0-0) continued receiving the 0% concentration. All Ss received 6 days of training under shifted conditions. This phase was examined using a 2 x 2 factorial design. Pre-shift UCS intensity effects on learning were determined by examining row differences, and UCS intensity effects on performance were determined by inspection of column differences.

Extinction

After post-shift training, all Ss were subjected to two days of experimental extinction. On the first day of extinction, all Ss received 5 CS-UCS pairings followed by 25 presentations of CS-alone. Day 2 extinction consisted of 25 CS-alone trials. After the 25 CS-alone trials on extinction Day 2, Ss in Groups 15-15 and 0-0 were given 5 presentations of the UCS-alone. The 5 UCS trials were followed by 5 additional presentations of the CS. ITIs for both UCS-alone and CS-alone presentations was the same as that used in acquisition. The latter procedure was introduced as an additional technique for examining the possibility of a learning-performance distinction in extinction of the licking response.

# Chapter III

# RESULTS

## Licking Behavior

The initial design for this experiment called for the use of the customary difference score (responding in the CS-UCS interval minus responding in the pre-CS interval) as a measure of conditioned licking (e.g., Warstler & Ost, 1960; Miller, 1961; Debold, Miller & Jensen, 1965; Ost & Lauer, 1965; Patten & Deaux, 1966). However, preliminary analysis indicated that a more accurate picture of conditioned licking could be presented by discarding the difference score measure and presenting the results of pre-CS-licking and CS-licking independently. This decision was based on a correlation analysis of CS and pre-CS-licking. The correlation between CS and pre-CS-licking, after partialing out the correlation of each measure with days, resulted in non-significant correlations in both the 15% condition and 0% condition (r=.07 and r=.05 respectively). Since the use of a difference licking score as an indicant of conditioned licking is based on the assumption of a correlation between pre-CS and CS-licking, it was felt that the use of a difference licking score could not be justified.

Pre-CS-licking

Mean pre-CS-licking scores over blocks of 50 trials (two daily sessions) are plotted in Fig. 1 for Group 0% and Group 15%.

The performance of Group 0% and Group 15% over the first 14 sessions was compared in a mixed analysis of variance. The results of this analysis (Appendix A, Table I) indicated a significant Groups x Sessions interaction, $F(13,234)=1.91$; $p<.05$. Inspection of Fig. 1 indicates that this interaction reflects increased pre-CS-licking by 0% Ss over the 14 sessions, whereas 15% Ss showed no increase in pre-CS-licking over the 14 sessions. Statistical evaluation of simple effects supported this observation: a significant Sessions effect was found for Group 0%, $F(13,234)=3.12$; $p<.001$, but not for Group 15%, $F(13,234)=1.08$; $p>.05$.

Mean pre-CS-licking scores for the switched conditions are plotted in Fig. 1 for the four subgroups. The values in

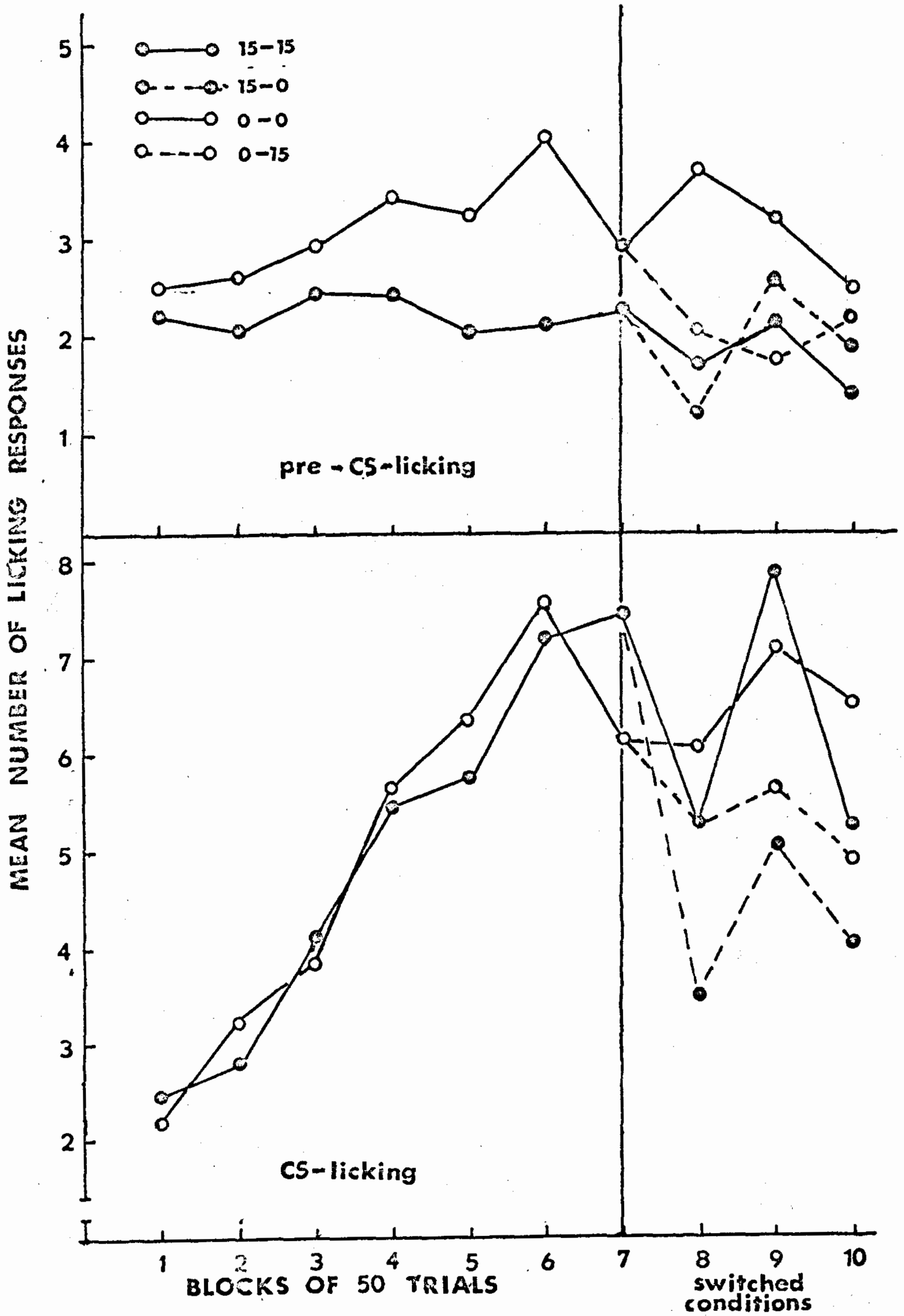


Figure 1. Mean number of pre-CS and CS licks during acquisition and shifting for all groups.

each of the four cells of Table 1 present the mean pre-CS-licking values for each of the four subgroups over the post-shift sessions.

A 2 x 2 factorial design was used for statistical analysis of the subgroup means. With reference to Table 1, the effect of acquisition UCS intensity on learning would be reflected by differences between row means, the logic being that if learning is affected by UCS intensity, this effect will influence the level of responding to the new UCS after the shift. Performance effects of UCS intensity are reflected by differences between column means, which indicate the level of responding to the intensity of the UCS employed at the time of measurement. The results of this analysis (Appendix A, Table II) indicated: (1) no learning effect of pre-shift UCS intensity on post-shift performance to the two UCS intensities (i.e., a nonsignificant row effect, $F(1,16)=2.86$; $p>.05$); (2) the absence of a performance effect of UCS intensity during post-shift training (i.e., a nonsignificant column effect, $F(1,16)=2.01$; $p>.05$); (3) no significant row x column interaction, $F(1,16)<1$.

An analysis of pre-CS-licking within the two switched

TABLE 1

Mean number of pre-CS licks over post-shift sessions

| Acquisition UCS Value | Post-Shift UCS Value 15% | Post-Shift UCS Value 0% | Means Reflecting "Learning" |
|---|---|---|---|
| 15% | 1.75 | 1.96 | 1.86 |
| 0% | 2.07 | 3.20 | 2.64 |
| Means Reflecting "Performance" | 1.91 | 2.58 | |

groups was performed to assess the within-S effect of the concentration shift. The individual difference scores used in this analysis were obtained by subtracting each S's mean post-shift score from its mean terminal acquisition score (the mean value for blocks 6-7 in Fig. 1). The results of t-test on the difference scores indicated no reliable within-S effect of the concentration shift for either Group 15-0, $t(4)=.82$; $p>.05$, or for Group 0-15, $t(4)=1.59$; $p>.05$.

Summarizing the results of the shifting procedure on pre-CS-licking: no effect of shifting was found on either group that experienced the shift. Thus no basis for a learning-performance distinction in pre-CS-licking was found.

Mean pre-CS-licking scores for the two extinction sessions are plotted in Fig. 2 over five blocks of five trials. A separate mixed analysis of variance was performed for each extinction session (Appendix A, Tables III and IV). Nonsignificant Groups x Trial Blocks interactions were found for both extinction sessions [$F(12,64)<1$ for both sessions], indicating that none of the four subgroups differed in rate of extinction.

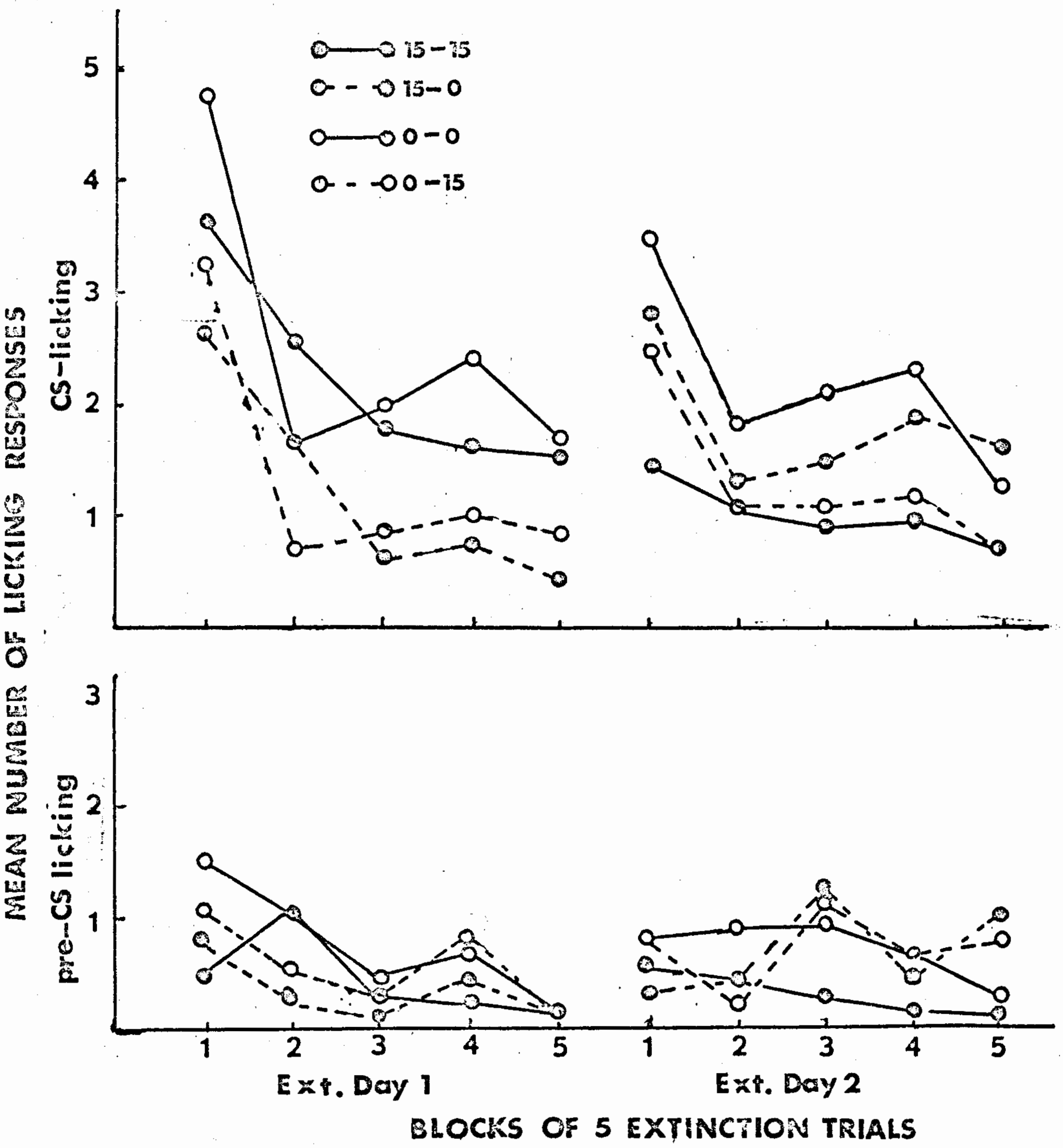


Figure 2. Mean number of pre-CS and CS licks during two days of extinction.

In order to assess the effect of the five UCS-alone presentations on Groups 15-15 and 0-0, licking difference scores were obtained by subtracting each S's mean licking score over the last five extinction trials from its mean licking score over the five CS presentations which followed the UCS-alone trials. The results of this analysis indicated that pre-CS-licking was not reliably effected by UCS-alone presentations, although both Groups 15-15 and 0-0 increased their pre-CS-licking after the UCS-alone trials, $t(4)=1.70$ and $2.30$; $p>.05$, respectively. A between-groups analysis of variance was performed to determine if there was any difference between Groups 15-15 and 0-0 in amount of pre-CS-licking after the UCS-alone trials. The results of this analysis (Appendix A, Table V) indicated no difference between the two groups in amount of pre-CS-licking recovery, $F(1,8)=1.14$; $p>.05$.

In summary: no reliable effect of UCS-alone presentations on pre-CS-licking was obtained for either Group 15-15 or 0-0, and no difference was found between the two groups in amount of pre-CS-licking following the UCS-alone presentations.

CS-licking

Mean CS-licking scores over blocks of 50 trials (two daily sessions) are plotted in Fig. 1 for Groups 0% and 15%.

CS-licking performance of Group 0% and Group 15% over the first 14 sessions was compared in a mixed analysis of variance (Appendix A, Table VI). The results of this analysis indicated no reliable difference in CS-licking due to concentration, $F(1,18)<1$. A nonsignificant Groups x Sessions interaction, $F(13,234)<1$, indicated that the two concentration groups did not differ in rate of approach to terminal level of responding. Thus, no difference in acquisition of CS-licking was found between the two groups.

Mean CS-licking scores for the switched conditions are plotted in Fig. 1 for the four subgroups. The values in the four cells of Table 2 present the mean CS-licking scores for each of the four subgroups over the post-shift sessions.

A 2 x 2 factorial design was employed for statistical analysis of the means of these subgroups (Appendix A, Table VII). The results of this analysis indicated a significant row x column interaction, $F(1,16)=5.54$; $p<.05$. With reference to Fig. 1, it appears that the obtained inter-

TABLE 2

Mean number of CS licks over post-shift sessions

| Acquisition UCS Value | Post-Shift UCS Value | | Means Reflecting "Learning" |
|---|---|---|---|
| | 15% | 0% | |
| 15% | 6.00 | 4.21 | 5.11 |
| 0% | 5.27 | 6.69 | 5.68 |
| Means Reflecting "Performance" | 5.34 | 5.45 | |

action was due to a disruption of the licking performance in Groups 15-0 and 0-15. A t-test analysis of row and column simple effects was performed to statistically evaluate this observation. The results of this analysis indicated that: (1) Group 15-0 had a lower level of post-shift CS-licking than did Group 15-15, $t(16)=2.93$; $p<.05$; (2) Group 0-15 had a lower level of post-shift CS-licking than did Group 0-0, $t(16)=2.35$; $p<.05$; (3) the level of post-shift CS-licking for Group 15-0 fell below the level of Group 0-0, $t(16)=4.06$; $p<.01$. Thus the fact of shifted UCS regardless of shift direction produced a decrement in CS-licking.

An analysis of CS-licking within the two switched groups was performed to assess the within-*S* effect of the concentration shift. The individual scores employed in these analyses were obtained by subtracting each *S*'s mean post-shift score from its mean terminal level of responding (the mean value for blocks 6 and 7 in Fig. 1). The results of a t-test on the difference scores indicated a within-*S* decrease in licking for Group 15-0, $t(4)=3.88$; $p<.05$. No reliable within-*S* shift effect was found for

Group 0-15, t(4)= .63; p>.05.

The post-shift results clearly indicate that a change in UCS intensity has a disruptive effect on CS-licking performance for Group 15-0. The results are not as clearcut for Group 0-15 since no within-S effect was observed in this group. However, since the between-Ss results of the Group 0-15 vs. Group 0-0 comparison indicated a decrement in CS-licking for Group 0-15, it appears that shifting UCS intensity also disrupted CS-licking performance in this group.

Mean CS-licking scores for the two extinction sessions are plotted in Fig. 2 over five blocks of five trials for the four subgroups.

A separate mixed analysis of variance was performed for each extinction session (Appendix A, Tables VIII and IX). No Groups x Trial Blocks interaction was found in either analysis, indicating that there were no group differences in rate of extinction [F(12,64)<1 for both sessions].

The effect of UCS-alone presentations on CS-licking was also evaluated by use of difference ts. A significant increase in CS-licking for Ss in Group 15-15, t(4)=3.80; p<.05 and for Ss in Group 0-0, t(4)=2.88; p<.05, was found following UCS-alone presentations, A between-groups analysis of variance (Appendix A, Table X) was performed to determine if there was any difference between the two groups in amount of CS-licking recovery after UCS-alone presentation. This analysis indicated no difference between the two groups in amount of CS-licking recovery, $F(1,18)<1$.

Considering the relationship between pre-CS and CS-licking, the results indicated that pre-CS and CS-licking were being affected somewhat differently by the concentration variables. The following differences should be noted:

(1) a Groups x Sessions interaction during acquisition was obtained for pre-CS-licking, whereas no such interaction was found in CS-licking. This indicated that the effect of trials on the two groups differed during pre-CS-licking, 0% Ss showing a greater increase over sessions in pre-CS-licking, but the CS-licking of both groups reacted similarly to the sessions variable.

(2) shifting UCS concentration resulted in a decrement in CS-licking performance for both Groups

15-0 and 0-15, regardless of the direction of the shift, but had no effect on either group during pre-CS-licking.

(3) presentation of UCS-alone trials following extinction resulted in a reliable recovery of CS-licking, but did not reliably effect pre-CS-licking.

## Orienting Behavior

### Facings

Mean daily arcsine facing scores for each group over blocks of 50 trials are plotted in Fig. 3, with corresponding percentage values indicated on the ordinate. Inspection of Fig. 3 over the first 14 sessions indicates that 15% Ss made a greater number of facings than 0% Ss. However, this apparent difference in facings between the two groups was not supported by statistical analysis. A mixed analysis of variance (Appendix A, Table XI) performed over the first 14 sessions indicated no reliable difference in facing responses between the two conditions, $F(1.18)= 3.74$; $.05<p<.10$. A nonsignificant Groups x Sessions inter-

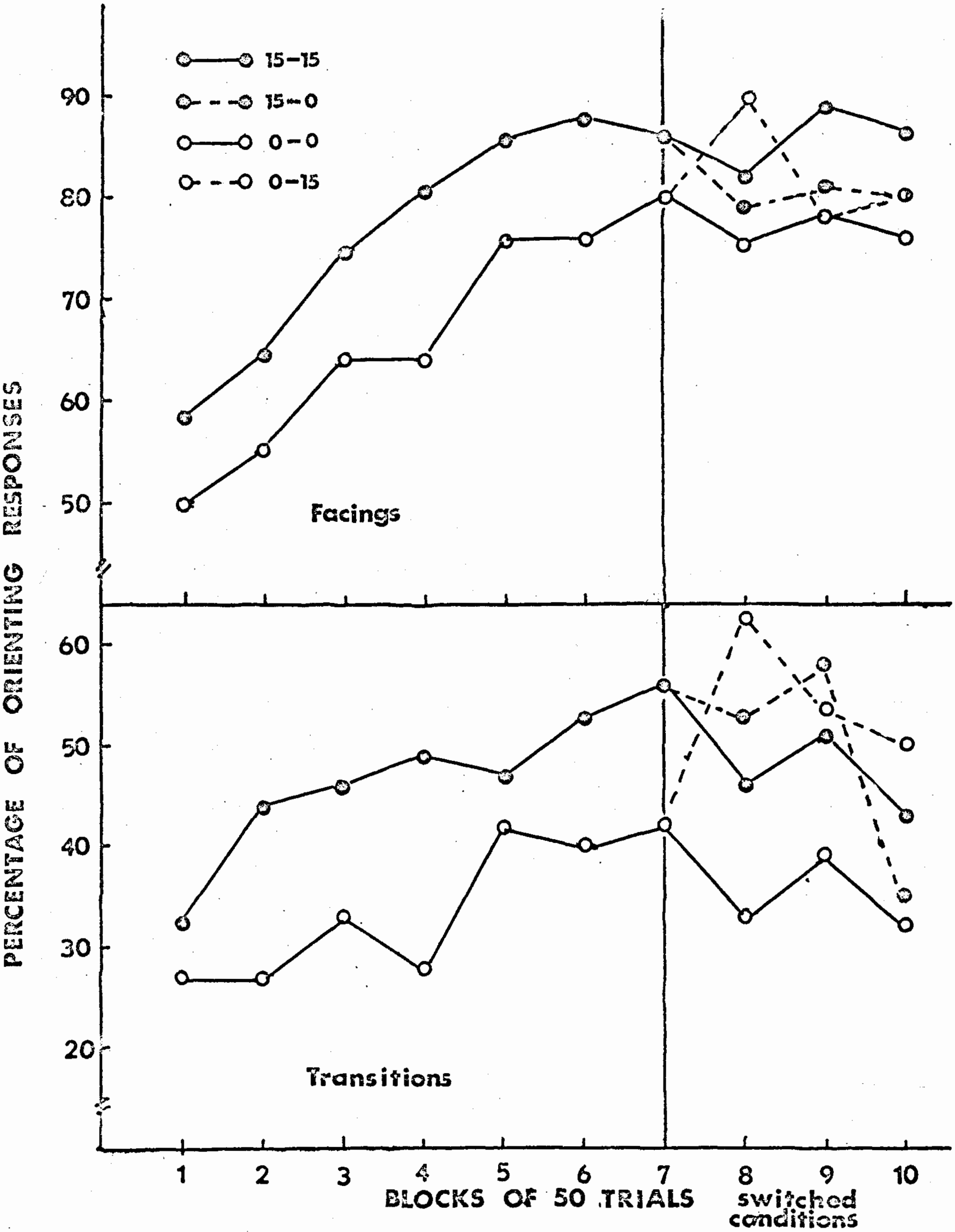


Figure 3. Orienting responses (both facings and transitions) during acquisition and shifting for all groups.

action indicated that the two concentration groups did not differ in rate of approach to terminal level of responding, $F(13,234)<1$.

Mean daily arcsine facing scores for the switched conditions are plotted in Fig. 3 for the four subgroups. The values in the four cells of Table 3 present the mean arcsine values of facing responses for each of the four subgroups over the six post-shift sessions.

A 2x2 analysis of variance design was used for the statistical analysis of the subgroups' means. The results of this analysis (Appendix A, Table XII) indicated: (1) no learning effect of pre-shift UCS intensity on post-shift performance to the two UCS intensities (i.e., a nonsignificant row effect, $F(1,16)<1$); (2) the absence of a performance effect of UCS intensity during post-shift training (i.e., a nonsignificant column effect, $F(1,16)=1.01$; $p>.05$; (3) no significant row x column interaction, $F(1,16)<1$.

An analysis of facing responses within the switched groups was performed to assess the within-S effect of the concentration shift. The individual scores used in these analyses were obtained by subtracting each S's mean post-

TABLE 3

Mean percentage of facings over post-shift sessions
Arcsine Transformed

| Acquisition UCS Value | Post-Shift UCS Value | | Means Reflecting "Learning" |
|---|---|---|---|
| | 15% | 0% | |
| 15% | 2.42 | 2.13 | 2.28 |
| 0% | 2.27 | 2.20 | 2.23 |
| Means Reflecting "Performance" | 2.34 | 2.17 | |

shift score from its mean acquisition terminal level of responding (the mean value for blocks 6 and 7 in Fig. 3). The results of t-test on the difference scores indicated that: Group 15-0 Ss experienced a reliable decrease in facings, $t(4)=3.31$; $p<.05$, and Group 0-15 showed a significant within-S increase in number of facing responses, $t(4)=3.43$; $p<.05$.

Summarizing the results of the shifting procedure on facing responses, it should be noted that: (1) no evidence was obtained from the between-groups 2 x 2 factorial for a learning or performance effect; (2) Group 15-0 showed a within-S decrease in facings; (3) Group 0-15 showed a within-S increase in facings.

Mean arcsine facing scores for the two extinction sessions are plotted in Fig. 4 over five blocks of five trials for the four subgroups, with corresponding percentage values indicated on the ordinate.

A separate mixed analysis of variance was performed over each extinction session.(Appendix A, Tables XIII and XIV). The results of these analyses indicated that none of the four subgroups differed in rate of extinction. Nonsignifi-

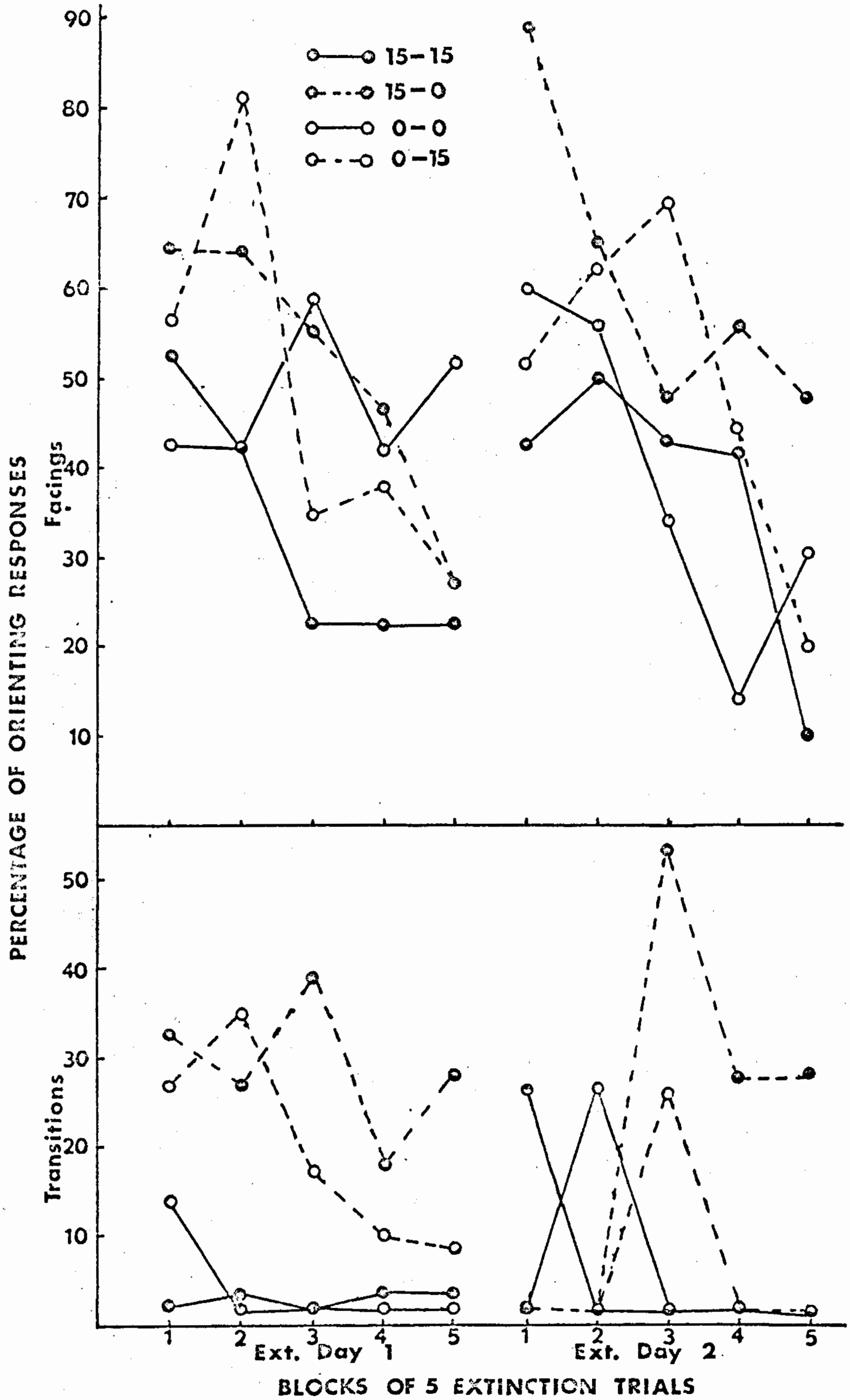


Figure 4. Orienting responses (both facings and transitions during two days of extinction.

cant Groups x trial blocks interactions were found for both extinction sessions ($F(12,64)<1$ and $F(12,64)=1.27$; $p>.05$, respectively for the two sessions).

Transitions

Mean daily arcsine transition scores for each group over blocks of 50 trials are plotted in Fig. 3.

Transition performance of Group 0% and Group 15% over the first 14 sessions was compared in a mixed analysis of variance. The results of this analysis (Appendix A, Table XV) indicated no reliable difference in transitions due to the concentration variables, $F(1,18)=2.10$; $p>.05$. A nonsignificant Groups x Sessions interaction, $F(13,234)<1$, indicated that the two groups did not differ in rate of approach to terminal acquisition response level.

Mean daily arcsine transition scores for the post-shift sessions are plotted in Fig. 3 for the four subgroups. The values in the four cells of Table 4 present the mean arcsine values of transition responses for each of the subgroups over the six post-shift sessions.

A 2 x 2 factorial design was employed for statistical analysis of the subgroup means. The results of this

TABLE 4

Mean percentage of transitions over post-shift sessions
Arcsine Transformed

| Acquisition UCS Value | Post-Shift UCS Value 15% | 0% | Means Reflecting "Learning" |
|---|---|---|---|
| 15% | 1.92 | 2.01 | 1.96 |
| 0% | 1.95 | 1.43 | 1.70 |
| Means Reflecting "Performance" | 1.94 | 1.72 | |

analysis (Appendix A, Table XVI) indicated: (1) no learning effect of pre-shift UCS intensity on post-shift performance to the two UCS intensities (i.e., a nonsignificant row effect, $F(1,16)=2.20$; $p>.05$); (2) the absence of a performance effect of UCS intensity during post-shift training (i.e., a nonsignificant column effect, $F(1,16)=1.35$; $p>.05$); (3) no row x column interaction, $F(1,16)=2.70$; $p>.05$.

Analysis of transition responses within the switched groups (Groups 15-0 and 0-15) was performed to assess the within-S effect of the concentration shift. The individual difference scores employed in these analyses were obtained by subtracting each S's mean post-shift score from its mean terminal acquisition response level (the mean value for trial blocks 6 and 7 in Fig. 3). The results of t-test on the difference scores indicated that the Ss in Group 0-15 significantly increased their transition responses, $t(4)=2.40$; $p<.05$. Ss in Group 15-0 were not reliably affected by the shift, $t(4)=.02$; $p>.05$.

Summarizing the results of the shifting procedure on transition responses, it should be noted that: (1) no evidence was obtained from the post-shift data for a learning-performance distinction in the transition measure; (2) Group 0-15 showed a within-S increase in transitions; (3) Ss in Group 15-0 were not reliably affected by the shift.

Mean arcsine transition extinction scores over five blocks of five trials for the four subgroups are plotted in Fig. 4, with corresponding percentage values indicated on the ordinate.

A separate mixed analysis of variance (Appendix A, Tables XVII and XVIII) was performed on each extinction session. The results of these analyses indicated that none of the four subgroups differed in rate of extinction. Non-significant Groups x trial blocks interactions were found for both sessions ($F(12,64)<1$ and $F(12,64)=1.10$; $p>.05$ respectively for both sessions).

Summarizing the results obtained from the orienting measures: no between-groups differences were found for any of the measures taken; a within-S increase in both facings and transitions was found for Group 0-15; Ss in Group 15-0 showed a decrease in facings when UCS value was shifted.

# Chapter IV

# DISCUSSION

The acquisition licking data of the present study differs in several respects with the findings of previous studies of UCS intensity in appetitive classical conditioning.

The results of pre-CS-licking during acquisition showed that Group 0% Ss increased their level of pre-CS-licking over sessions, whereas level of pre-CS-licking for Ss in Group 15% remained constant across all sessions. This finding is at variance with Warstler & Ost (1960) results which indicated no effect of UCS intensity (acetic acid) on amount of salivation during a 15 sec. pre-CS interval. It should be noted that the dogs in the Warstler & Ost study were only given 100 CS-UCS pairings. The increase in pre-CS responding obtained in the present study did not begin to appear until Ss had received approximately 200-250 CS-UCS pairings.

If CS-licking is considered indicative of CR strength, the results of the present appear to indicate that UCS intensity has no effect on CR strength. Such a finding would be inconsistent with the results of salivary conditioning studies (Kleshchov, 1935; Gantt, 1938; Makarychev, 1941; Ayrapetyants, 1955) which reveal conditioning to be a positive function of UCS intensity (amount of food), and with the Warstler & Ost (1960) finding of a positive relationship between salivary conditioning and acetic acid concentration. A problem arises, however, in comparing the results of the present study with Gantt (1938) and the Russian studies. It cannot be determined from sources available to present investigator what measure they used as the indicant of CR strength. If the positive relationship between CR and UCS intensity reported by these investigators is based on a difference score measure of the CR, this comparison may not be justified. The Warstler & Ost (1960) study nicely illustrates the problem involved. These investigators found a positive relationship between salivary secretion rate during the CS-UCS interval and three levels of acetic acid concentration (.3%, 1.5% and 7.5%). However, when they corrected this measure, by use of a difference score, for any influence of pre-CS interval response rate, they found a reversal of the relationship between the 1.5% and 7.5% concentrations. This reversal of functional relationship would appear to need further clarification as to whether the reversal was due to an increase in pre-CS response rate over trials by the 7.5% Ss or a decrease in pre-CS response rate over trials by the 1.5% Ss, or a combination of both or these factors.

By presenting the pre-CS and CS-licking results independently, the problem involved in interpretation of findings based on a difference score measure of CR strength have been avoided.

It may be fruitful to regard classical conditioning not merely as a process of increasing strength of responding to the CS, but as comparable to a discrimination training situation in which the experimenter associates distinctive stimuli with rewarding ($S^D$) and nonrewarding ($S^{\Delta}$) states of affair. Thus the present finding that 0% Ss increased their pre-CS response rate over sessions, whereas no such increase was found for 15% Ss, may indicate that 15% Ss developed stronger conditioning than 0% Ss in the sense of a more well defined discrimination between ($S^D$) and ($S^{\Delta}$)

states of affairs.

The problem still remains as to what measure should be employed as an indicant of the strength of conditioning. If, as in the present study, pre-CS as well as CS measures change over conditioning trials, the appropriate measure should reflect the conditioning effect in pre-CS responding as well as conditioning effects in CS responding, irrespective of the direction, increasing or decreasing of the performance change.

A possible overall measure of conditioning may be constructed by adding the absolute pre-CS change over a block of trials to the absolute CS change for the same block of trials. The two experimental groups could then be compared on the overall conditioning effects of the independent variable. Before it can be decided whether or not the pre-CS performance of the two experimental groups in the present study reflect conditioning changes, non-conditioning control groups, receiving UCS-alone trials, will have to be run. Pre-CS responding in the control _S_s would be measured over identical intervals for both experimental and control _S_s. Differences in pre-CS performance between the comparable conditioning and control groups would be taken as indicating conditioning effects in pre-CS licking.

The type analysis mentioned above has not previously been employed. The absence in the present study of the appropriate non-conditioning control groups prevents the analysis from being carried out on the present data; however, the need for this type of analysis could be seen only after the present data was obtained.

Once the suggested overall analysis has been carried out, the systematic evaluation of UCS intensity effects on the components comprising the overall conditoning effect (e.g., pre-CS, CS-responding, and the relationship between the two) can be carried out.

Indeed, classical conditioning appears to be more complex, and more interesting, than has previously been suspected.

The results obtained from shifting UCS values indicated that shifting had no effect on pre-CS-licking, but resulted in a disruption in CS-licking for both switched conditions. This finding is consistent with findings from other studies in which consummatory responding was investigated under a shifting procedure. Hulse (1962) found that animals given lick training under continuous reward showed significant loss in licking when reward (saccharin concentration) was shifted form either a high to a low concentration, or when it was shifted from a low to a high concentration. Premack & Hillix (1962) also reported a disruption in consummatory responding when sucrose concentration was shifted from either 4% to 32%, or when it was shifted from 16% to32%.

Hulse (1962) interprets the post-shift disruption of licking in terms of a stimulus generalization decrement which prevails when S experiences the new concentration for the first time. This interpretation assumes that a learning factor is involved, i.e., conditioned licking fails to generalize to the new cue situation which results when reward is changed. The present investigator, however, would prefer an alternate interpretation which would take into account what an ethologist, Barnett (1963), has called "neophobia" or "bait shyness." A "neophobic" reaction in rats is characterized by a disruption of behavior associated with seeking and consuming food when a novel stimulus is introduced into the feeding environment or when stimulus components of a familiar consummatory environment are merely rearranged. Barnett (1958) has shown that consumption of food by wild rats can be markedly reduced by merely presenting food in a new container. Thus the disruption of licking performance upon switching UCS values would be due to the sudden introduction of novel, food-related stimuli. This interpretation differs from the one offered by Hulse in that the emphasis is on external inhibition (disruption) of conditioned consummatory responding rather than positing a learning factor which fails to generalize. It should be noted that the experimenter in this investigation observed several animals refused to consume the new UCS early in the post-shift phase.

It should be pointed out that switching UCS values did not disrupt pre-CS licking performance.

The finding of no difference in rates of extinction between the concentration groups is consistent with the Warstler & Ost (1962) finding of no difference in rate of extinction of salivary responding between dogs conditioned with three UCS values, and with the summary statement by Beecroft (1966, p. 116) that "there is little evidence that acquisition...UCS intensity affects extinction responding."

The finding that UCS-alone presentations were sufficient to affect a reliable recovery of the CS-licking suggest that, to some extent, the absence of UCS during extinction does not weaken associative connections (i.e., learning) between CS and the licking CR, but rather that licking _performance_ declines also as a result of the absence of UCS during extinction. Extinction after classical conditioning should be studied while maintaining UCS unsystematically, i.e., randomly with no CS-UCS pairings, in the extinction situation.

The orienting measures (facings and transitions) failed to yield significant differences between conditions during acquisition, shifting and extinction. The present investigator, however, is reluctant to conclude that UCS intensity has no effect on orienting. It should be noted that when UCS intensity was shifted, a within-_S_ effect on facings was found for both switched groups and that the direction of the change was positively related to the direction of the UCS change. A significant decrease in transitions was also found for Group 15-0. Even though the between groups comparisons were not quite statistically reliable, it can be seen from Fig. 3 that a positive relationship between orienting and UCS intensity was approached. Unfortunately, more within-_S_ variability was found in this study than had been anticipated when the study was designed. Replication of this study with a larger number of _S_s may yield between group differences in orienting.

# Chapter V

## SUMMARY

Classical conditioning of licking and the development of acquired orienting were studied as a function of a qualitative UCS difference, defined as 15% sucrose concentration and 0% concentration (plain tap water). Several aspects of conditioned performance were investigated: The effect of UCS intensity on performance level during acquisition, the effect of UCS intensity on rate of approach to terminal level of responding during acquisition, a possible learning-performance distinction in appetitive classical conditioning, and rate of extinction as a function of the different acquisition values.

Two measures of licking were employed--pre-CS and CS-licking. It was found that pre-CS and CS-licking were affected differently by the concentration variables. The following differences were noted:

(1) a Groups x Sessions interaction during

acquisition was obtained for pre-CS-licking, whereas no such interaction was found in CS-licking. This indicated that the effect of training sessions on pre-CS-licking differed in the two UCS groups, with 0% Ss showing a greater increase in pre-CS-licking over session. The CS-licking of both UCS groups reacted similarly to the Sessions variable.

(2) a shift in UCS concentration resulted in a decrement in CS-licking performance for Groups 15-0 and 0-15, but had no effect on pre-CS-licking.

(3) presentation of UCS-alone trials following extinction resulted in a reliable recovery of CS-licking, but did not reliably effect pre-CS-licking. No differences between groups were found in rate of extinction either in pre-CS-licking or CS-licking.

The results of the licking measures were considered as indicative of a similarity between classical conditioning and discrimination training. A measure of total conditioning performance was suggested.

Two measures of orienting were employed, "facings" and "transitions." No between-groups differences were found for any of the measures taken; however, a within-Ss increase in both facings and transitions was found for Group 0-15. In addition, Group 15-0 showed a significant decrease in facings when UCS value was shifted down. Thus the present data provide some evidence for a positive relationship between acquired orienting and UCS "quality."

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# APPENDIX A

Summary tables of Analysis of Variance

Table I Summary Table of Analysis of Variance of Pre-CS-licking over Sessions 1-14.

| Source | df | ms | F | P |
|---|---|---|---|---|
| Between | 19 | | | |
| Concentration (C) | 1 | 50.18 | 4.18 | >.05 |
| Error | 18 | 12.01 | | |
| Within | 260 | | | |
| Trials (T) | 13 | 3.12 | 2.45 | <.05 |
| C x T | 13 | 2.42 | 1.91 | <.05 |
| Error | 234 | 1.27 | | |

Table II Summary Table of Analysis of Variance of Pre-CS Shift Effects.

| Source | df | ms | F | P |
|---|---|---|---|---|
| Rows (R) | 1 | 2.86 | 1.99 | >.05 |
| Columns (C) | 1 | 2.01 | 1.39 | >.05 |
| R x C | 1 | 1.27 | <1 | |
| Error | 16 | 1.44 | | |
| Total | 19 | | | |

Table III Summary Table of Analysis of Variance of Pre-CS-licking, Extinction Day 1.

| Source | df | ms | F | P |
|---|---|---|---|---|
| Between | 19 | | | |
| Concentrations (C) | 3 | 1.40 | <1 | |
| Error | 16 | 3.20 | | |
| Within | 80 | | | |
| Trials (T) | 4 | 5.70 | <1 | |
| C x T | 12 | 8.20 | <1 | |
| Error | 64 | 14.50 | | |

Table IV Summary Table of Analysis of Variance of Pre-CS-licking, Extinction Day 2.

| Source | df | ms | F | P |
|---|---|---|---|---|
| Between | 19 | | | |
| Concentration (C) | 3 | 1.96 | $<1$ | |
| Error | 16 | 3.12 | | |
| Within | 80 | | | |
| Trials (T) | 4 | 1.70 | $<1$ | |
| C x T | 12 | 11.70 | 1.10 | $>.05$ |
| Error | 64 | 10.56 | | |

Table V Summary Table of Analysis of Variance of UCS-alone Presentations on Pre-CS-licking.

| Source | df | ms | F | P |
|---|---|---|---|---|
| Concentration | 1 | 1.61 | 1.14 | $>.05$ |
| Error | 8 | 1.13 | | |
| Total | 9 | | | |

Table VI Summary Table of Analysis of Variance of CS-licking over Sessions 1-14.

| Source | df | ms | F | P |
|---|---|---|---|---|
| Between | 19 | | | |
| Concentration (C) | 1 | 5.96 | $<1$ | |
| Error | 18 | 27.05 | | |
| Within | 260 | | | |
| Trials (T) | 13 | 73.90 | 30.53 | $>.001$ |
| C x T | 13 | 2.08 | $<1$ | |
| Error | 234 | 2.24 | | |

Table VII Summary Table Analysis of Variance of CS-licking Shift Effects.

| Source | df | ms | F | P |
|---|---|---|---|---|
| Rows (R) | 1 | 1.66 | < 1 | |
| Columns (C) | 1 | .06 | < 1 | |
| R x C | 1 | 20.21 | 5.54 | < .05 |
| Error | 16 | 3.65 | | |
| Total | 19 | | | |

Table VIII Summary Table Analysis of Variance of Extinction Day 1.

| Source | df | ms | F | P |
|---|---|---|---|---|
| Between | 19 | | | |
| Concentration (C) | 3 | 3.69 | 2.71 | > .05 |
| Error | 16 | 1.36 | | |
| Within | 80 | | | |
| Trials (T) | 4 | 5.63 | 1.03 | > .05 |
| C x T | 12 | .17 | < 1 | |
| Error | 64 | 4.34 | | |

Table IX Summary Table Analysis of Variance of Extinction Day 2.

| Source | df | ms | F | P |
|---|---|---|---|---|
| Between | 19 | | | |
| Concentration (C) | 3 | 1.57 | < 1 | |
| Error | 16 | 1.60 | < 1 | |
| Within | 80 | | | |
| Trials (T) | 4 | 1.59 | | |
| C x T | 12 | .95 | < 1 | |
| Error | 64 | 2.07 | | |

Table X Summary Table Analysis of Variance of UCS-alone on CS-licking.

| Source | df | ms | F | P |
|---|---|---|---|---|
| Concentration | 1 | .73 | $<1$ | |
| Error | 8 | 1.13 | | |
| Total | 9 | | | |

Table XI Summary Table Analysis of Variance of Facings over Sessions 1-14.

| Source | df | ms | F | P |
|---|---|---|---|---|
| Between | 19 | | | |
| Concentration (C) | 1 | 3.76 | 3.74 | $.05<p<.10$ |
| Error | 18 | 1.01 | | |
| Within | 260 | | | |
| Trials (T) | 13 | 1.12 | 13.49 | $<.001$ |
| C x T | 13 | .05 | $<1$ | |
| Error | 234 | .08 | | |

Table XII Summary Table Analysis of Variance of Facings Shift Effects.

| Source | df | ms | F | P |
|---|---|---|---|---|
| Rows (R) | 1 | .01 | $<1$ | |
| Columns (C) | 1 | .15 | 1.01 | $>.05$ |
| R x C | 1 | .07 | $<1$ | |
| Error | 16 | .13 | | |
| Total | 19 | | | |

Table XIII Summary Table Analysis of Variance of Facings Extinction Day 1.

| Source | df | ms | F | P |
|---|---|---|---|---|
| Between | 19 | | | |
| Concentration (C) | 3 | .77 | 5.50 | <.01 |
| Error | 16 | .14 | | |
| Within | 80 | | | |
| Trials (T) | 4 | .93 | 1.79 | >.05 |
| C x T | 12 | .44 | 1 | |
| Error | 64 | .52 | | |

Table XIV Summary Table Analysis of Variance of Facings Extinction Day 2.

| Source | df | ms | F | P |
|---|---|---|---|---|
| Between | 19 | | | |
| Concentration (C) | 3 | 1.50 | 2.23 | > .05 |
| Error | 16 | .67 | | |
| Within | 80 | | | |
| Trials (T) | 4 | 1.95 | 6.01 | <.01 |
| C x T | 12 | .41 | 1.27 | >.05 |
| Error | 64 | .32 | | |

Table XV Summary Table Analysis of Variance of Transitions over Sessions 1-14.

| Source | df | ms | F | P |
|---|---|---|---|---|
| Between | 19 | | | |
| Concentration (C) | 1 | 6.34 | 2.10 | >.05 |
| Error | 18 | 3.02 | | |
| Within | 260 | | | |
| Trials (T) | 13 | .47 | 3.05 | <.01 |
| C x T | 13 | .08 | < 1 | |
| Error | 234 | .15 | | |

Table XVI Summary Table Analysis of Variance of Transitions Shift Effect.

| Source | df | ms | F | P |
|---|---|---|---|---|
| Rows (R) | 1 | .38 | 2.20 | >.05 |
| Columns (C) | 1 | .23 | 1.35 | >.05 |
| R x C | 1 | .46 | 2.70 | >.05 |
| Error | 16 | .17 | | |
| Total | 19 | | | |

Table XVII Summary Table Analysis of Variance of Transitions Extinction Day 1.

| Source | df | ms | F | P |
|---|---|---|---|---|
| Between | 19 | | | |
| Concentration (C) | 3 | 1.61 | 4.02 | >.05 |
| Error | 16 | .40 | | |
| Within | 80 | | | |
| Trials (T) | 4 | .10 | <1 | |
| C x T | 12 | .35 | <1 | |
| Error | 64 | .39 | | |

Table XVIII Summary Table Analysis of Variance of Transitions Extinction Day 2.

| Source | df | ms | F | P |
|---|---|---|---|---|
| Between | 19 | | | |
| Concentration (C) | 3 | 1.45 | 2.16 | >.05 |
| Error | 16 | .67 | | |
| Within | 80 | | | |
| Trials (T) | 4 | .36 | <1 | |
| C x T | 12 | .43 | 1.10 | >.05 |
| Error | 64 | .39 | | |

## APPENDIX B

Individual scores over 25 blocks of acquisition trials: pre-CS-licking, CS-licking, facings and transitions.

Pre-CS-Licking

Group 0% and 15%: 360 trials

| | Blocks of Trials | | | | | | |
|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Group 15% | | | | | | | |
| 1 | .48 | 3.08 | 1.00 | 1.60 | 1.24 | 1.32 | 1.44 |
| 2 | 2.16 | 5.08 | 3.80 | 2.00 | 2.00 | 2.00 | 2.12 |
| 3 | 1.56 | 2.08 | 5.16 | 3.76 | 5.00 | 3.52 | 3.32 |
| 4 | 3.16 | 2.00 | 2.12 | 1.64 | 2.88 | 2.76 | 4.48 |
| 5 | 2.04 | 5.04 | 3.28 | 3.04 | 3.44 | 3.64 | 3.88 |
| 6 | 2.50 | 1.14 | 2.00 | 2.08 | 2.00 | 2.04 | .92 |
| 7 | 2.50 | 2.12 | .88 | .60 | 2.16 | .72 | 3.24 |
| 8 | 2.24 | 2.96 | 2.34 | 2.04 | 2.16 | 2.76 | 2.44 |
| 9 | .96 | .36 | 1.12 | .68 | .76 | 1.36 | 1.48 |
| 10 | .64 | 3.28 | 1.40 | 1.76 | 3.32 | 4.96 | 4.32 |
| Group 0% | | | | | | | |
| 1 | .92 | 5.64 | .40 | 3.00 | 3.04 | 2.16 | 2.96 |
| 2 | 4.12 | 3.60 | 3.20 | 1.72 | 3.64 | 2.32 | 4.56 |
| 3 | 2.52 | 3.16 | 3.00 | 3.64 | 4.16 | 5.48 | 2.16 |
| 4 | 1.96 | 5.08 | 4.64 | 5.08 | 3.92 | 5.44 | 7.20 |
| 5 | .88 | .60 | 1.32 | 1.32 | 1.64 | 1.68 | 1.96 |
| 6 | 3.15 | 3.52 | 5.56 | 5.56 | 3.68 | 3.48 | 4.28 |
| 7 | 3.56 | 3.12 | 4.24 | 4.24 | 3.92 | 3.28 | 5.72 |
| 8 | 1.48 | .76 | 2.92 | 2.92 | 1.52 | 1.96 | 3.96 |
| 9 | 1.76 | 2.88 | 1.68 | 1.68 | .68 | 1.68 | 4.08 |
| 10 | .52 | 1.60 | .20 | .20 | 1.20 | 2.72 | 3.72 |

Pre-CS-Licking

Group 0% and 15%: 360 trials

| | Blocks of Trials | | | | | | |
|---|---|---|---|---|---|---|---|
| | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
| Group 15% | | | | | | | |
| 1 | .88 | .84 | .80 | .84 | 2.16 | .52 | 2.48 |
| 2 | 1.64 | .84 | 1.20 | 1.16 | 2.57 | .92 | 1.76 |
| 3 | 3.08 | 1.42 | 1.72 | 1.92 | 2.20 | 1.80 | 1.52 |
| 4 | 4.88 | .68 | 3.96 | .88 | 1.48 | 1.72 | 2.78 |
| 5 | 2.06 | 3.08 | 3.08 | 1.20 | 4.02 | 2.06 | 4.28 |
| 6 | 3.84 | 1.16 | 3.12 | .96 | 1.96 | 2.28 | 1.76 |
| 7 | .88 | .12 | 2.48 | 1.52 | 3.28 | 2.12 | 2.80 |
| 8 | 2.28 | 2.80 | 3.48 | 3.32 | 2.64 | 2.12 | 5.08 |
| 9 | 1.04 | 1.28 | 2.24 | 2.96 | 1.88 | 2.20 | 2.44 |
| 10 | 2.16 | 3.72 | 4.60 | 4.32 | 2.72 | 4.36 | .48 |
| Group 0% | | | | | | | |
| 1 | 1.53 | 2.88 | 2.88 | 1.36 | 1.12 | 1.36 | .64 |
| 2 | 3.20 | 4.72 | 5.12 | 4.01 | 3.16 | 3.64 | 3.28 |
| 3 | 3.96 | 3.16 | 2.88 | 6.20 | 3.16 | 4.80 | 5.28 |
| 4 | 5.88 | 2.44 | 7.00 | 7.12 | 6.29 | 4.80 | 5.04 |
| 5 | 3.88 | 1.67 | 3.00 | 3.56 | 4.16 | 2.16 | 1.64 |
| 6 | 2.72 | 3.08 | 4.20 | 8.76 | 7.96 | 4.52 | 2.92 |
| 7 | 2.12 | 3.25 | 3.68 | 5.74 | 2.52 | 3.08 | 1.80 |
| 8 | 2.84 | 1.52 | 4.16 | 3.04 | 5.68 | 3.40 | 1.80 |
| 9 | 1.76 | 3.08 | 4.76 | 2.60 | 4.12 | 3.20 | 1.44 |
| 10 | 1.52 | 1.48 | 2.48 | .80 | 1.52 | 1.60 | 1.20 |

CS-Licking

Group 0% and 15%: 360 trials

| | Block of Trials | | | | | | |
|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Group 15% | | | | | | | |
| 1 | 2.16 | 5.80 | 2.08 | 3.04 | 3.52 | 3.32 | 3.44 |
| 2 | 1.92 | 4.24 | 3.28 | 2.48 | 4.12 | 2.90 | 4.68 |
| 3 | 1.96 | 2.56 | 5.32 | 4.20 | 6.04 | 2.64 | 4.56 |
| 4 | 2.88 | 2.72 | 3.84 | 2.72 | 3.04 | 4.52 | 7.80 |
| 5 | 1.12 | 5.92 | 3.40 | 5.20 | 5.88 | 5.80 | 4.72 |
| 6 | 2.44 | 1.76 | 2.64 | 2.80 | 2.64 | 2.82 | 6.00 |
| 7 | 2.00 | 1.28 | 1.40 | 1.48 | 2.80 | 1.76 | 6.68 |
| 8 | 3.40 | 4.76 | 3.20 | 3.44 | 5.36 | 8.32 | 7.48 |
| 9 | 1.08 | 1.36 | 1.24 | 1.80 | 1.88 | 2.40 | 3.08 |
| 10 | .92 | 1.82 | 1.52 | 2.72 | 4.72 | 8.12 | 8.28 |
| Group 0% | | | | | | | |
| 1 | .72 | 6.08 | .72 | 2.56 | 4.72 | 4.76 | 5.32 |
| 2 | 2.96 | 3.52 | 3.72 | 1.60 | 3.80 | 3.40 | 6.04 |
| 3 | 1.44 | 3.28 | 2.88 | 5.28 | 3.04 | 6.16 | 7.20 |
| 4 | 1.28 | 6.24 | 5.24 | 8.08 | 6.72 | 5.96 | 8.76 |
| 5 | .44 | .76 | 1.04 | 1.16 | 1.67 | 2.88 | 1.92 |
| 6 | 2.56 | 2.80 | 3.25 | 5.84 | 4.00 | 4.48 | 7.04 |
| 7 | 3.00 | 2.04 | 2.80 | 4.96 | 3.68 | 3.92 | 8.16 |
| 8 | 1.48 | .48 | 2.24 | 5.00 | 4.24 | 4.84 | 7.76 |
| 9 | 1.56 | 2.32 | 2.56 | 1.60 | .84 | 2.28 | 5.44 |
| 10 | .40 | 1.28 | .20 | 1.28 | 2.52 | 5.60 | 7.44 |

CS-Licking

Group 0% and 15%: 360 trials

| | Blocks of Trials | | | | | | |
|---|---|---|---|---|---|---|---|
| | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
| Group 15% | | | | | | | |
| 1 | 4.52 | 3.80 | 3.40 | 3.60 | 4.60 | 6.00 | 5.24 |
| 2 | 4.52 | 4.44 | 8.06 | 7.72 | 7.24 | 7.50 | 5.12 |
| 3 | 3.80 | 2.52 | 4.84 | 6.04 | 6.00 | 8.20 | 6.28 |
| 4 | 10.92 | 4.88 | 11.40 | 11.28 | 8.88 | 9.96 | 11.78 |
| 5 | 3.40 | 4.40 | 4.64 | 4.00 | 7.16 | 3.48 | 5.74 |
| 6 | 7.08 | 7.00 | 6.76 | 7.12 | 9.20 | 10.00 | 6.80 |
| 7 | 3.04 | 3.12 | 6.72 | 4.20 | 9.24 | 9.78 | 8.24 |
| 8 | 7.82 | 9.08 | 8.76 | 13.80 | 10.76 | 6.48 | 9.40 |
| 9 | 1.40 | 2.44 | 3.00 | 3.76 | 3.30 | 4.24 | 5.32 |
| 10 | 7.36 | 7.82 | 9.40 | 8.44 | 8.88 | 12.76 | 8.12 |
| Group 0% | | | | | | | |
| 1 | 3.28 | 4.56 | 3.52 | 5.68 | 6.16 | 4.32 | 3.08 |
| 2 | 6.00 | 6.60 | 8.20 | 7.96 | 8.28 | 6.88 | 7.48 |
| 3 | 4.96 | 6.12 | 8.64 | 10.88 | 8.96 | 8.88 | 8.36 |
| 4 | 6.20 | 4.24 | 9.16 | 9.80 | 6.68 | 9.80 | 8.92 |
| 5 | 3.50 | 4.44 | 4.08 | 3.68 | 6.44 | 3.32 | 3.56 |
| 6 | 4.32 | 6.32 | 8.00 | 9.68 | 9.20 | 5.76 | 8.44 |
| 7 | 3.04 | 4.12 | 3.52 | 6.12 | 3.20 | 16.44 | 6.56 |
| 8 | 6.36 | 7.16 | 11.56 | 9.48 | 11.28 | 11.12 | 5.68 |
| 9 | 4.52 | 7.12 | 6.36 | 4.68 | 8.72 | 5.74 | 3.92 |
| 10 | 5.64 | 6.80 | 7.00 | 8.60 | 5.76 | 4.60 | 1.00 |

Facings

Group 0% and 15%: 360 trials

| | Blocks of Trials | | | | | | |
|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Group 15% | | | | | | | |
| 1 | 2.03 | 3.08 | 2.64 | 2.91 | 2.64 | 3.08 | 3.08 |
| 2 | 1.36 | 1.36 | 1.70 | 1.36 | 1.52 | 1.78 | 1.19 |
| 3 | 1.28 | 1.35 | 1.87 | 1.09 | 2.05 | 2.38 | 2.05 |
| 4 | 2.12 | 1.79 | 2.30 | 2.29 | 2.03 | 1.87 | 2.56 |
| 5 | 1.44 | 1.54 | 1.18 | 1.27 | 1.53 | 1.69 | 2.21 |
| 6 | 1.69 | 1.86 | 1.95 | 2.04 | 2.04 | 1.84 | 1.96 |
| 7 | 1.86 | 1.82 | 2.13 | 2.39 | 1.69 | 2.13 | 2.47 |
| 8 | 1.86 | 1.69 | 2.21 | 2.22 | 1.35 | 2.64 | 2.21 |
| 9 | 1.76 | 1.70 | 1.81 | 1.69 | 1.36 | 1.96 | 1.78 |
| 10 | 1.95 | 1.64 | 1.37 | 2.73 | 2.22 | 2.21 | 2.47 |
| Group 0% | | | | | | | |
| 1 | 1.27 | 1.18 | 1.61 | 1.27 | 1.61 | 1.26 | 1.09 |
| 2 | 1.86 | 1.61 | 1.61 | 1.45 | 1.61 | 1.97 | 1.95 |
| 3 | 1.35 | 1.95 | 1.69 | 2.29 | 1.95 | 2.38 | 2.74 |
| 4 | 1.52 | 1.86 | 1.69 | 1.77 | 1.89 | 2.38 | 1.69 |
| 5 | 1.53 | 1.43 | 1.35 | 1.79 | 1.56 | 1.35 | 1.61 |
| 6 | 1.78 | 1.61 | 1.69 | 1.52 | 2.05 | 1.78 | 2.22 |
| 7 | 1.69 | 1.43 | 1.86 | 1.87 | 2.25 | 2.11 | 1.60 |
| 8 | 2.12 | 1.32 | 2.13 | 1.88 | 1.71 | 2.30 | 1.95 |
| 9 | 1.61 | 2.05 | 1.69 | 1.61 | 1.18 | 1.69 | 2.03 |
| 10 | 1.35 | 1.95 | .90 | 1.71 | 1.69 | 2.21 | 1.67 |

Facings

Group 0% and 15%: 360 trials

| | Blocks of Trials | | | | | | |
|---|---|---|---|---|---|---|---|
| | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
| Group 15% | | | | | | | |
| 1 | 3.08 | 3.08 | 3.08 | 3.08 | 3.08 | 3.08 | 3.08 |
| 2 | 1.36 | 1.78 | 1.28 | 2.56 | 2.13 | 2.73 | 1.52 |
| 3 | 2.12 | 2.64 | 2.34 | 2.47 | 1.87 | 2.30 | 2.03 |
| 4 | 3.08 | 3.08 | 2.91 | 1.81 | 2.82 | 2.47 | 2.91 |
| 5 | 2.64 | 2.47 | 2.21 | 2.77 | 2.38 | 2.47 | 2.91 |
| 6 | 2.21 | 2.56 | 1.95 | 2.47 | 2.13 | 2.38 | 2.12 |
| 7 | 2.56 | 2.38 | 2.03 | 1.95 | 2.04 | 2.13 | 2.38 |
| 8 | 1.53 | 1.76 | 1.62 | 2.05 | 2.03 | 1.71 | 2.21 |
| 9 | 1.96 | 2.56 | 2.29 | 2.04 | 2.29 | 2.38 | 2.05 |
| 10 | 2.03 | 2.73 | 2.73 | 2.91 | 2.56 | 2.56 | 2.38 |
| Group 0% | | | | | | | |
| 1 | 1.98 | 1.62 | 2.29 | 2.04 | 2.47 | 1.95 | 2.12 |
| 2 | 1.86 | 2.47 | 2.73 | 2.47 | 2.04 | 2.13 | 2.33 |
| 3 | 1.87 | 2.12 | 2.09 | 2.56 | 2.56 | 2.29 | 2.74 |
| 4 | 2.13 | 2.57 | 2.14 | 2.64 | 2.56 | 2.48 | 2.12 |
| 5 | 1.21 | 1.90 | 1.78 | 2.39 | 2.12 | 2.47 | 2.21 |
| 6 | 1.99 | 1.54 | 1.55 | 1.78 | 2.21 | 2.13 | 2.10 |
| 7 | 2.03 | 2.38 | 2.78 | 2.44 | 2.17 | 2.29 | 2.47 |
| 8 | 1.52 | 2.29 | 2.21 | 1.52 | 1.76 | 2.12 | 2.12 |
| 9 | 1.62 | 1.79 | 1.69 | 1.69 | 1.69 | 1.61 | 1.86 |
| 10 | 2.56 | 2.21 | 2.13 | 1.87 | 1.70 | 2.73 | 1.87 |

Transitions

Group 0% and 15%: 360 trials

| | Blocks of Trials | | | | | | |
|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Group 15% | | | | | | | |
| 1 | 1.84 | 2.60 | 2.64 | 2.64 | 2.91 | 3.08 | 3.08 |
| 2 | .92 | 1.02 | 1.09 | 1.09 | .58 | .67 | .67 |
| 3 | 1.43 | .66 | .75 | 1.22 | .75 | 1.36 | .66 |
| 4 | 2.01 | .83 | 2.28 | 1.63 | 1.29 | 1.19 | 1.57 |
| 5 | .91 | 1.01 | 1.01 | .93 | 1.19 | 1.19 | 1.19 |
| 6 | 1.11 | 1.15 | 1.31 | 1.53 | .93 | 1.36 | 1.70 |
| 7 | 1.11 | .93 | 1.32 | 1.18 | 1.55 | 1.23 | 1.35 |
| 8 | 1.11 | 1.43 | 1.61 | .93 | 1.27 | 1.54 | 1.52 |
| 9 | 1.27 | 1.09 | 1.61 | .75 | 1.10 | 1.45 | 1.44 |
| 10 | 1.27 | .93 | .75 | 1.54 | 2.21 | 2.05 | 1.76 |
| Group 0% | | | | | | | |
| 1 | .84 | .82 | .57 | .75 | .45 | 1.03 | .75 |
| 2 | 1.19 | .93 | 1.17 | 1.14 | 1.19 | 1.52 | 1.67 |
| 3 | 1.30 | 1.37 | 1.08 | 1.46 | 1.11 | 1.66 | 1.19 |
| 4 | .75 | 1.10 | .93 | .66 | 1.03 | .92 | .66 |
| 5 | 1.13 | 1.35 | 1.18 | 1.19 | 1.62 | 1.09 | 1.36 |
| 6 | 1.37 | .75 | .93 | 1.28 | .94 | 1.00 | .92 |
| 7 | .93 | 1.11 | 1.69 | 1.53 | 1.27 | 1.56 | 1.35 |
| 8 | 1.61 | 1.27 | .83 | 1.62 | 1.87 | 2.10 | 1.61 |
| 9 | 1.19 | 1.01 | 1.01 | 1.11 | 1.27 | .93 | 1.29 |
| 10 | .66 | 1.27 | 1.27 | .27 | .75 | .05 | .59 |

## Transitions

### Group 0% and 15%: 360 trials

| | Blocks of Trials | | | | | | |
|---|---|---|---|---|---|---|---|
| | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
| **Group 15%** | | | | | | | |
| 1 | 3.08 | 3.08 | 3.08 | 3.08 | 3.08 | 3.08 | 3.08 |
| 2 | .45 | .58 | .58 | .22 | .22 | .05 | 1.23 |
| 3 | 1.01 | 2.05 | 1.03 | 1.87 | 1.01 | 2.37 | 1.95 |
| 4 | 3.08 | 3.08 | 1.85 | 1.54 | 2.28 | 2.05 | 2.03 |
| 5 | 1.87 | 1.79 | 1.69 | 2.56 | 2.38 | 2.04 | 2.12 |
| 6 | 1.17 | 1.61 | 1.53 | 1.36 | 1.27 | 1.01 | 1.36 |
| 7 | 1.36 | 1.35 | 1.43 | 1.37 | 1.18 | 1.75 | 1.36 |
| 8 | 1.11 | 1.01 | 1.19 | .75 | 1.38 | 1.27 | 1.39 |
| 9 | 1.60 | 1.86 | 1.19 | 1.44 | 1.55 | 2.03 | .75 |
| 10 | 1.61 | 2.22 | 2.56 | 2.13 | 1.61 | 1.95 | .49 |
| **Group 0%** | | | | | | | |
| 1 | 1.02 | 1.38 | 1.97 | 1.33 | 1.87 | 1.65 | 1.52 |
| 2 | 1.45 | 2.05 | 2.13 | 1.54 | 1.85 | 1.36 | 1.70 |
| 3 | 1.63 | 1.66 | .77 | 1.05 | 1.89 | 1.18 | 1.87 |
| 4 | 1.01 | 1.68 | .40 | .92 | .92 | 1.36 | .77 |
| 5 | .84 | 1.61 | 1.25 | 2.04 | 1.55 | 1.96 | 1.86 |
| 6 | .93 | 1.92 | .75 | .75 | 1.40 | 1.08 | 1.13 |
| 7 | 1.77 | 1.95 | 2.21 | 2.13 | 1.35 | 1.73 | 1.87 |
| 8 | .51 | 2.13 | 1.84 | 1.44 | 1.61 | 1.89 | 1.78 |
| 9 | .58 | .31 | 1.11 | .75 | .59 | 1.27 | 1.00 |
| 10 | .92 | .49 | .84 | 1.18 | .23 | .57 | .76 |

APPENDIX C

Individual scores over 150 post-shift trials; pre-CS-licking, CS-licking, facings and transitions.

Post-Shift-Licking

Pre-CS-licking

| Group 15-15 | | Group 15-0 | |
|---|---|---|---|
| 1 | 1.10 | 1 | 1.24 |
| 2 | 2.43 | 2 | 2.53 |
| 3 | 1.82 | 3 | 1.31 |
| 4 | 1.84 | 4 | 1.77 |
| 5 | 1.56 | 5 | 2.95 |

| Group 0-15 | | Group 0-0 | |
|---|---|---|---|
| 1 | 1.51 | 1 | 2.41 |
| 2 | 2.64 | 2 | 3.26 |
| 3 | 1.96 | 3 | 5.55 |
| 4 | 1.62 | 4 | 4.00 |
| 5 | 2.65 | 5 | .80 |

CS-licking

| Group 15-15 | | Group 15-0 | |
|---|---|---|---|
| 1 | 6.07 | 1 | 2.90 |
| 2 | 5.05 | 2 | 4.24 |
| 3 | 7.50 | 3 | 4.24 |
| 4 | 7.30 | 4 | 4.02 |
| 5 | 4.09 | 5 | 5.63 |

| Group 0-15 | | Group 0-0 | |
|---|---|---|---|
| 1 | 5.06 | 1 | 5.03 |
| 2 | 6.30 | 2 | 5.70 |
| 3 | 3.55 | 3 | 7.90 |
| 4 | 6.52 | 4 | 8.90 |
| 5 | 4.93 | 5 | 5.93 |

Post-Shift-Orienting

Facings

| Group 15-15 | | Group 15-0 | |
|---|---|---|---|
| 1 | 2.46 | 1 | 3.02 |
| 2 | 2.85 | 2 | 2.10 |
| 3 | 2.56 | 3 | 1.93 |
| 4 | 1.93 | 4 | 1.84 |
| 5 | 2.30 | 5 | 1.76 |

| Group 0-15 | | Group 0-0 | |
|---|---|---|---|
| 1 | 2.43 | 1 | 2.12 |
| 2 | 2.44 | 2 | 2.70 |
| 3 | 2.45 | 3 | 2.36 |
| 4 | 2.15 | 4 | 1.91 |
| 5 | 1.86 | 5 | 1.91 |

Transitions

| Group 15-15 | | Group 15-0 | |
|---|---|---|---|
| 1 | 1.50 | 1 | 2.92 |
| 2 | 2.29 | 2 | 1.60 |
| 3 | 1.88 | 3 | 1.92 |
| 4 | 1.67 | 4 | 1.84 |
| 5 | 2.31 | 5 | 1.76 |

| Group 0-15 | | Group 0-0 | |
|---|---|---|---|
| 1 | 1.62 | 1 | 1.10 |
| 2 | 1.70 | 2 | 1.66 |
| 3 | 2.45 | 3 | .93 |
| 4 | 2.15 | 4 | 1.57 |
| 5 | 1.86 | 5 | 1.90 |

## APPENDIX D

Individual scores over blocks of five extinction trials: pre-CS-licking, CS-licking, facings, transitions and UCS-alone presentations.

Pre-CS-Licking

Total number of licks per 5 trials

| | Blocks of Trials | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| Group 15-0 | | | | | | | | | | |
| 1 | 0 | 0 | 2 | 0 | 2 | 1 | 0 | 9 | 0 | 0 |
| 2 | 5 | 3 | 1 | 7 | 3 | 0 | 0 | 14 | 15 | 15 |
| 3 | 4 | 3 | 0 | 5 | 0 | 0 | 3 | 6 | 2 | 2 |
| 4 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 5 | 6 | 4 | 1 | 1 | 0 | 4 | 8 | 4 | 9 | 9 |
| Group 15-15 | | | | | | | | | | |
| 1 | 1 | 9 | 3 | 0 | 0 | 3 | 0 | 0 | 0 | 0 |
| 2 | 2 | 5 | 2 | 2 | 1 | 6 | 4 | 2 | 1 | 1 |
| 3 | 4 | 2 | 0 | 1 | 0 | 2 | 6 | 3 | 1 | 1 |
| 4 | 2 | 0 | 2 | 4 | 1 | 2 | 3 | 4 | 2 | 2 |
| 5 | 3 | 11 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| Group 0-15 | | | | | | | | | | |
| 1 | 1 | 0 | 4 | 0 | 0 | 0 | 0 | 3 | 0 | 0 |
| 2 | 18 | 8 | 2 | 5 | 0 | 2 | 5 | 16 | 9 | 9 |
| 3 | 8 | 4 | 2 | 15 | 3 | 6 | 0 | 9 | 8 | 8 |
| 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 5 | 0 | 0 | 0 | 0 | 0 | 9 | 2 | 0 | 3 | 3 |
| Group 0-0 | | | | | | | | | | |
| 1 | 10 | 2 | 0 | 1 | 3 | 6 | 2 | 0 | 0 | 0 |
| 2 | 1 | 3 | 0 | 1 | 0 | 0 | 5 | 10 | 0 | 0 |
| 3 | 5 | 5 | 10 | 17 | 0 | 8 | 3 | 0 | 3 | 3 |
| 4 | 21 | 16 | 0 | 0 | 0 | 3 | 12 | 14 | 4 | 4 |
| 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

CS-Licking

Total number of licks per 5 trials

| | Blocks of Trials | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| Group 15-0 | | | | | | | | | | |
| 1 | 23 | 14 | 7 | 1 | 2 | 18 | 0 | 0 | 6 | 7 |
| 2 | 5 | 4 | 4 | 4 | 1 | 12 | 3 | 18 | 7 | 16 |
| 3 | 10 | 9 | 0 | 0 | 0 | 12 | 4 | 13 | 20 | 0 |
| 4 | 13 | 0 | 6 | 6 | 8 | 15 | 1 | 0 | 0 | 16 |
| 5 | 13 | 18 | 0 | 7 | 0 | 13 | 26 | 6 | 14 | 0 |
| Group 15-15 | | | | | | | | | | |
| 1 | 12 | 6 | 2 | 10 | 0 | 4 | 3 | 1 | 0 | 0 |
| 2 | 14 | 5 | 7 | 0 | 4 | 6 | 2 | 1 | 4 | 2 |
| 3 | 22 | 30 | 6 | 8 | 7 | 18 | 15 | 17 | 20 | 7 |
| 4 | 23 | 9 | 24 | 15 | 24 | 6 | 1 | 5 | 5 | 8 |
| 5 | 21 | 14 | 6 | 6 | 0 | 3 | 7 | 1 | 0 | 0 |
| Group 0-15 | | | | | | | | | | |
| 1 | 29 | 3 | 0 | 0 | 0 | 21 | 1 | 9 | 0 | 0 |
| 2 | 26 | 8 | 10 | 5 | 4 | 1 | 5 | 14 | 4 | 8 |
| 3 | 13 | 6 | 10 | 18 | 5 | 7 | 7 | 1 | 2 | 6 |
| 4 | 13 | 0 | 0 | 1 | 7 | 12 | 1 | 0 | 0 | 0 |
| 5 | 0 | 0 | 0 | 1 | 5 | 21 | 15 | 13 | 23 | 3 |
| Group 0-0 | | | | | | | | | | |
| 1 | 29 | 28 | 11 | 13 | 2 | 19 | 1 | 4 | 0 | 0 |
| 2 | 10 | 17 | 10 | 7 | 4 | 21 | 19 | 16 | 23 | 17 |
| 3 | 23 | 17 | 16 | 27 | 27 | 21 | 15 | 15 | 23 | 3 |
| 4 | 47 | 16 | 13 | 13 | 6 | 19 | 10 | 19 | 11 | 7 |
| 5 | 10 | 7 | 0 | 0 | 2 | 6 | 0 | 0 | 0 | 6 |

Facings

Extinction Day 1

| | Blocks of Trials 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Group 15-0 | | | | | |
| 1 | 1.77 | 2.21 | 2.21 | 1.77 | 2.21 |
| 2 | 3.08 | 1.77 | 1.77 | 2.21 | .05 |
| 3 | 1.77 | 1.77 | .93 | .05 | 1.37 |
| 4 | 1.37 | 1.77 | 2.21 | 2.21 | .05 |
| 5 | 1.37 | .93 | 1.37 | 1.37 | 1.77 |
| Group 15-15 | | | | | |
| 1 | .93 | .05 | .93 | .93 | .93 |
| 2 | .93 | 1.37 | .93 | .93 | 1.37 |
| 3 | 1.77 | 2.21 | 1.37 | 1.77 | .93 |
| 4 | 1.37 | 1.77 | 1.77 | 1.37 | 1.77 |
| 5 | 3.08 | 1.77 | .05 | .05 | .05 |
| Group 0-15 | | | | | |
| 1 | 1.37 | 2.21 | .05 | .93 | .93 |
| 2 | 1.37 | 3.08 | 3.08 | 2.21 | .93 |
| 3 | 3.08 | 1.37 | .93 | 2.21 | 1.77 |
| 4 | 1.37 | 3.08 | 2.21 | .05 | .93 |
| 5 | 1.37 | 1.77 | .05 | 1.37 | .93 |
| Group 0-0 | | | | | |
| 1 | 1.37 | .93 | 1.30 | 1.37 | .93 |
| 2 | .93 | 1.77 | 1.77 | 1.77 | 1.37 |
| 3 | 1.37 | 2.21 | 1.77 | .93 | 3.08 |
| 4 | 1.77 | .93 | 1.77 | 1.37 | 1.37 |
| 5 | 1.77 | 1.37 | 3.08 | 1.77 | 1.37 |

Facings

Extinction Day 2

| | Blocks of Trials | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| Group 15-0 | | | | | |
| 1 | 3.08 | 1.77 | 2.21 | 2.21 | 2.21 |
| 2 | 2.21 | 1.77 | 2.21 | 1.77 | 1.37 |
| 3 | 3.08 | 1.37 | .93 | 1.77 | .93 |
| 4 | 3.08 | 1.37 | .93 | 1.37 | 1.37 |
| 5 | 1.37 | 3.08 | 1.37 | 1.37 | 1.77 |
| Group 15-15 | | | | | |
| 1 | .93 | .93 | 1.37 | .93 | .05 |
| 2 | .93 | 3.08 | .93 | 1.77 | .05 |
| 3 | 1.77 | 2.11 | 2.21 | 1.77 | 1.37 |
| 4 | 1.27 | .05 | 1.77 | 1.77 | .05 |
| 5 | 2.21 | 1.77 | .93 | .93 | 1.77 |
| Group 0-15 | | | | | |
| 1 | 2.21 | 1.77 | 2.21 | 2.21 | .93 |
| 2 | 1.77 | 1.77 | 1.77 | 1.37 | .93 |
| 3 | 1.37 | 1.77 | 1.37 | .93 | 1.37 |
| 4 | 1.77 | 1.77 | 2.21 | 1.37 | .05 |
| 5 | .93 | 2.21 | 1.37 | 1.37 | 1.37 |
| Group 0-0 | | | | | |
| 1 | 2.21 | 1.77 | .93 | 1.37 | 3.08 |
| 2 | 2.21 | 1.37 | 1.77 | 1.37 | 1.37 |
| 3 | 1.77 | 2.21 | 1.37 | .93 | 1.37 |
| 4 | 1.37 | .93 | .93 | .05 | .05 |
| 5 | 1.37 | 2.21 | .93 | .05 | .05 |

Transitions

Extinction Day 1

| | Blocks of Trials | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| Group 15-0 | | | | | |
| 1 | .93 | .05 | 1.50 | 1.90 | 1.50 |
| 2 | 1.37 | 1.37 | 1.50 | 1.37 | .93 |
| 3 | 1.05 | 1.77 | .93 | .05 | 1.37 |
| 4 | 1.37 | 1.37 | 1.90 | .05 | .05 |
| 5 | 1.37 | .93 | .93 | .93 | 1.77 |
| Group 15-15 | | | | | |
| 1 | .05 | .05 | .93 | 1.05 | .93 |
| 2 | .05 | 1.37 | .05 | 1.43 | .48 |
| 3 | .93 | .05 | 1.05 | 1.50 | .93 |
| 4 | .05 | .93 | .93 | 1.05 | .05 |
| 5 | .05 | .05 | .05 | .05 | .05 |
| Group 0-15 | | | | | |
| 1 | 1.77 | 2.21 | .93 | .05 | .93 |
| 2 | .05 | .93 | 2.21 | 2.21 | .93 |
| 3 | 1.77 | 1.77 | .93 | .93 | .05 |
| 4 | 1.37 | .05 | .05 | .05 | .05 |
| 5 | .93 | 1.37 | .05 | .05 | .93 |
| Group 0-0 | | | | | |
| 1 | 1.77 | .05 | 1.37 | .93 | .93 |
| 2 | .05 | 1.37 | .93 | .93 | .05 |
| 3 | .05 | .93 | .93 | .05 | .05 |
| 4 | .93 | .05 | .05 | .93 | .93 |
| 5 | .93 | .05 | .05 | 1.37 | .93 |

Transitions

Extinction Day 2

| | Blocks of Trials | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| Group 15-0 | | | | | |
| 1 | 3.08 | .05 | 3.08 | 2.05 | 1.99 |
| 2 | .05 | 1.37 | 1.37 | 1.37 | .93 |
| 3 | .05 | 1.37 | .93 | 1.37 | .93 |
| 4 | .93 | .05 | .93 | .05 | 1.05 |
| 5 | .05 | .05 | 1.37 | .93 | .93 |
| Group 15-15 | | | | | |
| 1 | 3.08 | .05 | .05 | .05 | .05 |
| 2 | .93 | .05 | .93 | .93 | .05 |
| 3 | .05 | .93 | .05 | .05 | .93 |
| 4 | 1.37 | .05 | 1.37 | 1.37 | .05 |
| 5 | .05 | .05 | .05 | .05 | .05 |
| Group 0-15 | | | | | |
| 1 | .93 | 1.37 | .93 | .05 | .05 |
| 2 | .93 | 1.37 | .93 | .93 | .93 |
| 3 | 1.93 | .93 | 1.05 | .93 | .93 |
| 4 | 1.77 | .05 | 1.50 | 1.37 | 1.37 |
| 5 | .93 | .05 | .93 | 1.37 | 1.37 |
| Group 0-0 | | | | | |
| 1 | .05 | 1.77 | .05 | 1.37 | .05 |
| 2 | .93 | .93 | 1.37 | .93 | .93 |
| 3 | .93 | .93 | .93 | .93 | 1.37 |
| 4 | 1.05 | .93 | .05 | .05 | .05 |
| 5 | .93 | .93 | .93 | .93 | .05 |

UCS-Alone

Total number of licks for 5 trials

Pre-CS-licking

| Group 15-15 | | Group 0-0 | |
|---|---|---|---|
| 1 | 3 | 1 | 7 |
| 2 | 13 | 2 | 38 |
| 3 | 17 | 3 | 14 |
| 4 | 6 | 4 | 25 |
| 5 | 9 | 5 | 4 |

CS-licking

| Group 15-15 | | Group 0-0 | |
|---|---|---|---|
| 1 | 32 | 1 | 11 |
| 2 | 13 | 2 | 12 |
| 3 | 7 | 3 | 31 |
| 4 | 31 | 4 | 20 |
| 5 | 22 | 5 | 4 |

# VITA

Jerry W. Rudy, the author, grew up in Petersburg, Virginia. After graduating from Petersburg High School in 1960, he entered The George Washington University and was awarded his BA degree in psychology in June, 1963. In September, 1965, he entered the University of Richmond and began work toward the degree of Master of Arts in psychology. He expects to be awarded his MA degree in August, 1967. In September, 1967, he will begin work toward a doctoral degree in Experimental Psychology at the University of Virginia.