SUPPRESSION OF OPERANT VS CONSUMMATORY BEHAVIOR¹

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The magnitude and variability of conditioned suppression of bar pressing and dipper licking were compared. In two steady-state experiments, suppression of bar pressing was more profound and more stable from day to day. The two measures of suppression were uncorrelated as indexed by Pearson product-moment correlation coefficients computed for adjacent trials. Correlations within measures (internal consistency) were somewhat higher for the bar-press system except when a high proportion of rats completely suppressed on one of the correlated trials. In a transient state experiment in which possible adventitious punishment of both response systems was eliminated, suppression of bar pressing was again more profound and considerably slower to extinguish.

Conditioned suppression is a reduction of responding when a stimulus previously paired with an aversive event is presented independently of the response. Since Estes and Skinner (1941), most studies have employed an operant, usually bar pressing, as the response to be suppressed. More recently, Leaf and Muller (1965) suggested that licking might have some practical advantages over bar pressing. Licking either a dipper or a drinking tube does not require much shaping and stabilizes rapidly. No response contingencies are required, so instrumentation is relatively simple and inexpensive. Also suppression of licking and bar pressing seem to be affected by many of the same variables (Ayres and Quinsey, 1970; James and Mostoway, 1968; Tenen, 1967). Unfortunately, informal observations of suppression of licking in this laboratory (*c.f.* Tenen, 1967) suggest that suppression of licking may be much more variable both between and within subjects than is suppression of bar pressing. As yet, however, the two response systems have not been directly compared.

The present studies compared directly and under comparable conditions the magnitude and variability of suppression of licking and of bar pressing.

Although the main goal of this research was to answer a specific methodological question, the findings should bear incidentally on a broader theoretical issue; Solomon (1964, pp. 241-242) noted that consummatory behavior should be relatively hard to suppress because of its biological significance. But, after reviewing several instances of dramatic suppression of consummatory behaviors by punishment, he concluded that they may be even easier to suppress than operants and speculated about causal mechanisms. Again, no one seems to have directly compared punishment of operants and consummatory behaviors. So, the present comparison, in a paradigm related to punishment, should provide some information about the issue Solomon raised.

EXPERIMENT 1

METHOD

Subjects

Twelve male albino rats, 90 days old on arrival from Gofmoor Farms, Westboro, Massachusetts, were housed individually and fed freely for about a month. Then they were reduced to 80% of their normal body weights and maintained at 80% for the duration of the study.

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Apparatus

Six Gerbrands operant conditioning chambers were housed in ventilated 2-ft (0.61-m) cubes of 0.5-in. (12.7 mm) plywood lined with acoustical tile. A 2-ft square sheet of masonite covered the floor of each cube. Each chamber had a dipper feeder located 2.75 in. (7 cm) to the left of the response bar (measured center to center) and 3.25 in. (8 cm) below it. The bar itself was located 8 cm above the grid floor. Dipper licking was monitored by Grason-Stadler drinkometers and recorded on print-out counters. (On alternate days bar pressing was recorded instead of licking.) The conditioned stimulus (CS) was the onset of a 1000-Hz 84-db tone and the simultaneous offset of an 87-db white noise normally on for background masking. Scrambled grid shocks of 0.8 mA intensity from six Grason-Stadler E1064 shock sources served as unconditioned stimuli (USs). The shock circuit did not include either the dipper or the bar. Sucrose of 32% concentration made every other day with tap water and presented in 0.1-cc dipper cups was used to maintain responding. Illumination in the chamber was provided by a 28-v cue light centered over the dipper hole and mounted 95 mm above the floor.

Procedure

After two weeks of restricted feeding, all subjects were taught to lick sucrose from the dippers. On the next day they were taught to bar press. Each response produced the dipper for about 3.5 sec for each subject. After bar-press training all subjects received fifty-two 15-min sessions at about the same time on 52 consecutive days. In the first two of these sessions, the dippers were repeatedly raised (making sucrose available) for 3 sec then lowered for 2 sec while subjects licked. (This method of presenting the dippers was used in all the sessions that are hereafter called *licking sessions*.) In the next session, each bar press was reinforced, and in the next three sessions bar pressing was reinforced on a variable interval (VI) schedule with a mean value of 1 min (see Fleshler and Hoffman, 1962). This concluded preliminary training.

The next six sessions were CS-habituation sessions designed to habituate the subjects to the CS and to measure unconditional effects on

both licking and VI-supported bar pressing. Beginning with the first of these sessions, bar-pressing and licking sessions alternated daily throughout the experiment for all subjects. Half the subjects began with a licking session and half with a bar-pressing session. The cue light mounted above the dipper was bright (26 v) on odd days and dim (6 v) on even days. Thus, it was bright during licking sessions and dim during bar-pressing sessions for half the subjects; for the other half this relationship was reversed. In each session, a 2-min CS occurred either in minute 5 and 6, 7 and 8, or 9 and 10 (determined randomly each day). After the six habituation sessions, 30 pairing sessions were given. These were just like the habituation sessions except that a 1-sec 0.8-mA shock US was given in the last second of each CS. During licking sessions the shock always occurred while the dippers were down and inaccessible to the subjects. The purpose of these 30 pairing sessions was to provide (under identical CS and US and session-length parameters) a direct within-subject comparison of conditioned suppression of the two response preparations used in previous work (Ayres, 1966, 1968; Ayres and Quinsey, 1970). After these 30 sessions, 10 more pairing sessions immediately followed. These were just like the previous 30 pairing sessions except that on bar-press days the VI schedule was discontinued; and, instead, each response was reinforced. The purpose of this change was to make the two response preparations more comparable in terms of reinforcement density. Note that, although the bar was present during all sessions, bar presses had no effect on the dipper during licking sessions. A summary of the procedure appears in Table 1.

Treatment of data. The data are presented as Annau-Kamin (1961) suppression ratios, $D/(B + D)$, in which D represents the number of responses occurring during the CS and B the number in the same time interval before the CS. The ratio varies from 0 (maximum suppression) through 0.5 (no effect) to 1.0 (facilitation). Infrequently, animals failed to respond before or during the CS or data were lost through a recording failure. In such cases, the score given to an animal was the average of its two adjacent trials under the appropriate response system. Less than 2% of the scores were so estimated.

Table 1
Outline of Procedure Used in Exp. 1

Condition	No. Sessions	Comment
Dipper training	1	
Bar-press shaping	1	
Lick stabilization	2	
Bar-press stabilization	1	Each bar press reinforced (CRF)
Bar-press stabilization	3	Bar pressing reinforced on VI 1-min schedule
CS-habituation (Trials 1 to 3)*	6	Three lick sessions alternated with three VI bar-press sessions
CS-US pairing (Trials 4 to 18)	30	15 lick sessions alternated with 15 VI bar-press sessions
CS-US pairing (Trials 19 to 23)	10	Five lick sessions alternated with five CRF bar-press sessions

Note.—Sessions in the top half of the table are described as “preliminary training” in text.

*Trial numbers refer to those given in Fig. 1, 2, and 3.

RESULTS

The magnitude of conditioned suppression across trials is shown in Fig. 1A. Two data points are plotted for each trial. The points plotted for Trial 1, for example, show how much CS-elicited suppression occurred to the first CS presented while animals were bar pressing and to the first CS presented while

they were licking. These two data points, of course, were collected in separate sessions. Trials 1 to 3 under each response system were CS-habituation trials. On these trials, bar pressing in the bar-pressing sessions was reinforced on a VI schedule. Trials 4 to 18 were pairing trials. Again, in the bar-pressing sessions, bar pressing was reinforced on a VI schedule. Trials 19 to 23 were also pairing trials, but,

Fig. 1. Panels A and B: conditioned suppression of bar pressing (solid curve in all panels) and licking (dotted curve) in Exp. 1 and 2 respectively. Panels C and D: between-subject variability of suppression of licking and bar pressing in Exp. 1 and 2 respectively.

in the bar-pressing sessions, each bar press was reinforced. The three types of trials are set off by the vertical dotted lines.

The middle of Fig. 1A shows that bar pressing was consistently suppressed more than licking when bar pressing was reinforced on a VI schedule. In terms of absolute response rates, licking was reduced from an average of 133 to 70 responses per minute by the CS. Bar pressing was reduced from 25 to 6 responses per minute. Individual subject records selected for their distinctive patterns and shown in Fig.

2, reveal the same differences seen in Fig. 1A. Only one of the 12 subjects (S-21 in Fig. 2) suppressed more while licking than while bar pressing.

It seemed possible that licking was less suppressed than bar pressing because the reinforcement density was higher in licking sessions than in bar-pressing sessions. To equate the two types of sessions more closely for reinforcement density, each bar press was reinforced beginning with Trial 19 (right side of Fig. 1A). If the differences in suppression

Fig. 2. Conditioned suppression of licking (dotted curve) and bar pressing for selected individual subjects in Exp. 1.

already noted had been due to different reinforcement densities, bar pressing should now become harder to suppress, and the difference in suppression between the two conditions should diminish. Instead, suppression of bar pressing did not change, and suppression of licking weakened further. Thus, it does not appear that differences in reinforcement density caused the difference in suppression.

Regarding the variability of the suppression ratios under each response system, three questions were asked. First, to what extent did the scores on any trial tend to cluster about the mean for that trial (between-subject variability)? Second, to what extent did animals tend to give the same score on every trial (within-subject variability)? Third, to what extent did animals tend to maintain their rank within the group across trials (trial-to-trial correlation)? The second and third questions both deal with the internal consistency of the data. But they are logically independent. It is possible, for example, for the within-subject variability to be the same for two response systems, but for the ranks to be completely inverted from trial to trial under one system and to be completely maintained from trial to trial under the other.

Estimates of the between-subject variability are shown in Fig. 1C. For each trial and for

each response system the standard deviation of individual subject scores about the trial mean is plotted. On trials 8 and 22, the variance of the lick scores was greater than that of the bar-press scores ($p_s < 0.01$ and 0.05 respectively). But on the remaining trials the variances under the two conditions were fairly similar. Thus, direct comparison of the suppression of bar pressing *vs.* licking under comparable conditions did not strongly support our informal observation that the between-subject variability of suppression of licking was higher than that of suppression of bar pressing.

The within-subject variability was assessed by computing for each response system the standard deviation of each subject's daily suppression ratio from its mean ratio over Trials 7 through 18 (see Fig. 1). These trials were selected to eliminate data from the transitional stage in which suppression was acquired and the data collected after the schedule of reinforcement for bar pressing was changed. These standard deviations were higher under the lick condition than under the bar-press condition for all 12 subjects ($p < 0.001$, sign test).

Trial-to-trial Pearson product-moment correlations were computed for arbitrarily selected adjacent bar-pressing trials and adjacent licking trials. These correlations are plotted in Fig. 3A. All those above the horizontal

Fig. 3. Panels A and B: correlation of suppression scores within response systems on selected trials in Exp. 1 and 2 respectively.

dotted line are reliable ($p < 0.05$). Note that the correlations were consistently high for the bar-press response system but rather variable for the lick system. Thus, the trial-to-trial correlations, like the estimates of within-subject variability, suggest greater internal consistency of the data under the bar-press system than under the licking system.

Correlations between systems were also computed for each trial (*e.g.*, bar-press Trial 1 *vs.* lick Trial 1). These ranged from -0.59 to $+0.41$. Only one of 20 was reliable ($p < 0.05$). We might expect the correlations between response systems to be high only when both systems simultaneously are internally consistent. As shown in Fig. 3A, internal consistency was high for both systems on Trials 6 and 7, 8 and 9, 14 and 15, and 15 and 16. Even so, the correlations between systems on these trials were no better than those on other trials. Thus, the low correlation between response systems does not appear to be due entirely to the unreliability of either system alone.

EXPERIMENT 2

Because in Exp. 1 shocks were never given while the dippers were accessible to the subjects during the licking sessions, it is possible that they learned that they would never be shocked while licking in these sessions and that this conditional discrimination contributed to the weak suppression of licking. Experiment 2 tested this possibility. It was just like Exp. 1 except that a new sample of 12 experimentally naive rats was used, and, during the licking sessions, the dippers were always scheduled to be in the up position during the last second of CSs when shocks were given. Thus, adventitious punishment of licking was intentionally permitted.

RESULTS

Figure 1B shows that permitting adventitious punishment in the licking sessions did not eliminate the difference in the suppression of the two response systems. (All 12 subjects suppressed more while bar pressing than while licking.) A comparison of panels A and B in Fig. 1, however, suggests that the effect of the possible adventitious punishment in the licking sessions was to produce more suppression of both response systems. Although this interpretation seems reasonable, it must be noted

that differences in conditioned suppression are sometimes seen in different shipments of animals (Kamin, 1965, p. 120). Perhaps the second shipment (Fig. 1B) just happened to suppress more. If so, they did so reliably ($F = 15.94$, $df = 1, 20$, $p < 0.001$). Other reliable effects in the analysis of variance on the combined data of Fig. 1A and B were the effect of Response System ($F = 63.28$, $df = 1, 20$, $p < 0.001$), and of Trials ($F = 26.81$, $df = 21, 420$, $p < 0.001$). The mean difference between the two response systems was approximately the same in Exp. 1 and 2. The data for animals first habituated to the CS while licking were essentially identical to those for animals first habituated while bar pressing.

To check the possibility that systematic fluctuations in animals' body weights might have caused the differences in the suppression seen under the two response systems, the daily weights of the animals run in Exp. 2 were carefully analyzed. On the average, the animals weighed from 0.1 to 4.2 g more during bar-pressing sessions than during licking sessions. The largest average difference amounted to a 1.5% change in body weight. Besides the fact that these differences were so small, they were reversed on Trials 6, 7, and 18. Inspection of Fig. 1B reveals nothing extraordinary about these trials. It seems unlikely, then, that the differences in suppression can be accounted for in terms of differences in deprivation level under the two response systems.

Estimates of the between-subject variability in Exp. 2 are plotted in Fig. 1D. Suppression of licking was consistently (and frequently reliably) more variable than suppression of bar pressing, but scores for animals bar pressing were so low that they could vary essentially in only one direction.

The within-subject variability was assessed using standard deviations as in Exp. 1. Again, for 11 of 12 subjects the variability was higher for the lick system than for the bar-press system ($p = 0.006$, sign test).

Correlations within response systems are shown in Fig. 3B. The internal consistency of the bar-press scores does not appear to be as good in Exp. 2 as in Exp. 1. The loss of consistency in Exp. 2 may be due to a statistical artifact: in Exp. 2 a high proportion of zero suppression ratios was obtained with the bar-press system. In the computation of 19 of the 20 coefficients, at least half of the scores on at

least one of the correlated trials were zeros. By contrast, in Exp. 1 only two of 20 coefficients were based on scores including six or more zeros. Clearly, if a large proportion of scores on one trial are zeros (or are all the same), there can be no correlation between trials.

As in Exp. 1 correlations between response systems were again very poor, with coefficients ranging from -0.36 to $+0.60$. Only one of 20 was reliable ($p < 0.05$).

EXPERIMENT 3

In Exp. 3, adventitious punishment of both licking and bar pressing was eliminated by giving conditioning trials "off the baseline" (that is, while subjects were not allowed to lick or bar press). Later, CSs without shocks were presented while animals licked or bar pressed, and the extinction of conditioned suppression was measured.

METHOD

Subjects

Forty-six experimentally naive rats, similar to those used in Exp. 1 and 2, were used.

Apparatus

The apparatus was that of Exp. 1 but with two modifications described below.

Procedure

A successive control procedure was used. Thirty-four subjects were tested while licking. They were run in groups of 6 (Group 1), 6 (Group 2), 10 (Group 3) and 12 (Group 4). Each group was from a different shipment of animals and was run at a different time of the year. A separate group of 12 subjects (Group 5) was tested while bar pressing. All 12 were from a single shipment and were tested at the same time of year and subsequent to the four lick groups. Thus, differences in suppression among the groups tested while licking allow us to assess the magnitude of the differences between shipments and time of year. If these differences are small relative to the difference between the bar-press group and the four lick groups, then the large difference must be due to the response system used and not the time of testing or the particular shipment of animals.

Preliminary training consisted of exposure

to 8% sucrose placed in furniture coasters in the home cages and dipper training for all subjects. Each bar press was later reinforced for animals in the bar-press group. During all sessions in which subjects were allowed to lick or bar press, an aluminum sheet held down by spring clips covered the grid floor in the chambers.

After preliminary training, all subjects received two CS-habituation sessions. For the subjects in the licking groups, the dippers were repeatedly raised for 3 sec then lowered for 2 sec throughout each of these 15-min sessions. For the subjects in the bar-press group, each bar press raised the dipper for 3.5 sec. During these sessions, 1-min CS presentations occurred in minutes 6 and 10.

The next two sessions were Pavlovian defense conditioning sessions in which each subject got 10 presentations of a 2-sec CS followed after a 45 to 50 msec delay by a 2-sec 1.6-mA shock. Intervals between CSs were identical for all subjects and ranged from 19 to 208 sec on the first conditioning day and from 24 to 242 sec on the second. During these sessions, the aluminum floor was removed and a four-walled masonite insert with 0.75-in. (19 mm) vertical black and white stripes was placed inside each conditioning chamber. The voltage across the cue light was increased from the normal 6 v to 26 v, and white paper was placed in the bottom of the litter tray to increase reflectance into the box. Since the insert covered the intelligence panel, no licking or bar pressing could occur. Thus, conditioning was conducted off the baseline, and the acquisition of suppression was not measured.

In the next session, all subjects were returned to the defense conditioning apparatus and retained there for 20 min for lick Groups 1 and 2 (see Fig. 4) and for 15 min for all the other groups. The reason this rather unorthodox session was included here was that all of the lick groups described were serving as controls in another study (Ayres and Benedict, 1970) in which experimental groups received off-the-baseline extinction trials during this period.

In the next session, subjects were allowed to recover their baseline response rates so that meaningful suppression measures could be obtained in the following sessions. The dippers were repeatedly raised and lowered for the lick groups until they had made 200 licks. Bar-

Fig. 4. Panel A: extinction of conditioned suppression of licking and bar pressing in Exp. 3. Panel B: between-subject variability of suppression of licking and bar pressing. Panel C: correlation of suppression scores within response systems on selected trials in Exp. 3. Points are plotted between each pair of trials correlated.

pressing animals were allowed to bar press until they too made 200 licks.

The next sessions were test sessions just like the CS-habituation sessions. The extinction of suppression was measured. Different groups received different numbers of test days as shown in Fig. 4.

RESULTS

Figure 4A shows that suppression of bar pressing was more profound and longer lasting than suppression of licking. Over Trials 1 to 4 the mean difference between the bar-press group and the four lick groups combined was statistically reliable ($T = 154$, $p < 0.01$, Wilcoxon ranked sums test). Differences among lick groups were not reliable.

Estimates of the between-subject variability

in Exp. 3 are shown in Fig. 4B. On Trials 1 and 2, the variability in the bar-press groups was extremely low because most of the scores were zeros. Except for these two trials, the between-subject variability of the two response systems appeared to be similar.

The within-subject variability was not calculated in Exp. 3 because it would presumably reflect only the different rates of extinction in the two response systems. However, measures of internal consistency were obtained by correlating the scores from the two trials within each session. These correlations are plotted in Fig. 4C. Again, because of the large number of zero scores, the correlations are low for the bar-press group for the first two trials. But as soon as suppression began to weaken, the internal consistency between trials appeared to be excellent. Correlations for the lick groups were again variable as in the steady state studies. When all four lick groups were combined into one group with an N of 34, the correlations for this group on Trials 1 and 2 and 3 and 4 were 0.52 and 0.63. While these were both reliable ($p_s < 0.01$), they do not appear to be as high as most of the correlations for the bar-press group, which averaged about 0.73 excluding the first point plotted.

DISCUSSION

This research began as an attempt to answer a methodological question. Informal observations had suggested that the variability of conditioned suppression of licking might be high enough to detract from its obvious advantages over bar pressing as a conditioned suppression preparation. But no firm conclusion could be drawn because parameters like session length, CS duration, shock intensity, etc. differed across the experiments on which these suspicions were based (Ayres, 1966, 1968; Ayres and Quinsey, 1970).

In Exp. 1, the two response preparations previously used were directly compared under equal values of a number of parameters. The results showed that licking was harder to suppress and that the within-subject variability of the suppression data was higher under the licking system than the bar-pressing system. The between-subject variability under the two systems, was, however, about the same.

At this point the focus of the research shifted to the issue Solomon (1964) had raised.

He had concluded that consummatory behaviors were easier to suppress than operants. The data from Exp. 1, however, suggested the opposite conclusion. But, even though the CS and US and other parameters were equal for both systems, bar pressing and licking might have differentially resisted suppression for reasons other than that one was a natural consummatory act and the other an arbitrary operant. First, the reinforcement density was much higher under the licking system than under the bar-pressing system. To assess the importance of this difference, the reinforcement density under the bar-press system was dramatically increased for several sessions by reinforcing each response. Still the difference in suppression between systems was not reduced. Next, it was noted that bar pressing could have been adventitiously punished in Exp. 1 but that licking could not. Experiment 2 was conducted to provide equal opportunity for adventitious punishment of both response systems, and Exp. 3 was conducted to eliminate adventitious punishment of both response systems. In both experiments, bar pressing was more profoundly suppressed. Finally, the possibility was considered that systematic fluctuation in the animals' body weights could account for the differences in suppression. Differences in the body weights were found to be small and did not always covary with the differences in suppression.

Although the differences in suppression of licking and bar pressing were shown not to depend on differences in reinforcement density, adventitious punishment, or deprivation levels, the data in no way demand an interpretation in terms of differences in the biological significance of the two response systems. For example, McIntire (1966) found that bar pressing for brain stimulation was harder to suppress than bar pressing for food. He interpreted his results in terms of an attention mechanism. His animals had to leave the bar to get food but not to get the brain stimulation. Hence, they were easier to "distract" when responding for food. In the present experiment, subjects had to leave the bar to get sucrose during the bar-pressing sessions but did not have to leave the dipper during licking sessions. According to McIntire's analysis, the present subjects should have been easier to distract when bar pressing than when licking. Lyon (1964) presented CSs paired with shocks

to pigeons key pecking. Food reinforcement followed after every 150 responses (FR 150 schedule). If the CS occurred early in the FR run, responding was suppressed. But, if the CS occurred late in the FR run, responding was not suppressed. Dardano and Sauerbrunn (1964*a, b*) found similar effects of punishment on FR responding. These results suggest that the terminal links in a response chain leading to reinforcement are harder to suppress than the initial links. In the present study, bar pressing may be considered an initial link, and licking a terminal link, in the response chain leading to food. It is also possible that the present findings as well as those of McIntire, Lyon, and Dardano and Sauerbrunn can be subsumed as instances of the effect of delay in reinforcement for the baseline response. In McIntire's study, reinforcement occurred with shorter delays when bar pressing produced brain stimulation than when bar pressing produced food. And, of course, responses in the terminal links of a response chain are reinforced with shorter delays than are those in the initial links.

The above discussion makes it clear that it is premature to ascribe the obtained differences in suppression between licking and bar pressing to differences in the biological significance of the two systems. Before drawing such a conclusion, one would have to show that the two responses were comparable in every respect except for their biological significance. This would include equating them in terms of delay of reinforcement, baseline response rate, and response effort. Alternatively, one could show that differences between response systems were maintained despite wide variations in these variables. These considerations suggest that the experimental solution of the question Solomon raised may not be as simple as it first appeared.

Because of the difference in the mean levels of suppression under the two response systems, interpretation of the differences in variability of the systems is hazardous. Any differences in variability may have been due to the tendency for means and variances to correlate or to the fact that one response system was so strongly suppressed that its measures could vary in only one direction. Several facts, however, argue against these interpretations, at least with respect to the greater within-subject variability seen under the lick response system in Exp. 1.

First, the between-subject variances were comparable in Exp. 1 in spite of differences between means. Second, a floor effect large enough to restrict within-subject variability would presumably make it difficult for subjects to preserve their rank in the group from trial to trial. However, subjects bar pressing preserved their ranks quite well in Exp. 1 (see Fig. 3A). They did not preserve their ranks, however, in Exp. 2 (see Fig 3B) where a floor effect for the bar-pressing system was more apparent. Note, also, that the between-subject variability was obviously greater (Fig. 1D) for the lick system in Exp. 2, again probably because of the floor effect for the bar-press measures. As a final attempt to get at this question, correlations between the means and within-subject variances (based on Trials 7 to 18 for each experiment) were actually computed for both response systems in Exp. 1 and 2. These correlations were all very low except under the bar-press system in Exp. 2. Here the correlation was 0.79. The different pattern of results of Exp. 1 and 2 suggests that differences in variability between systems in Exp. 2 were artifactually produced by a floor effect for the bar-press system. But it seems probable that the differences in within-subject variability in Exp. 1 were real. Thus, the data suggest that the bar-pressing system is more consistent internally than the licking system and is therefore to be preferred for use in steady state studies of conditioned suppression.

Finally, a surprising finding was that there was no correlation between suppression of bar pressing and suppression of licking. It is easy to dismiss this finding as a result of the high proportion of zero suppression ratios obtained under the bar-press system in Exp. 2. But this argument has little force when applied to the results of Exp. 1. One is left to wonder whether any measure of the alleged underlying Pavlovian conditioned response would correlate well with suppression of bar pressing or licking.

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