The "depression effect" and the problem of odor control[1]

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The possibility that distinctive odor cues contribute to the depression effect typically found in studies of incentive shift is discussed. The results of two experiments are presented in which an attempt was made to control odor cues. The effectiveness of the procedures used, and directions for further research along these lines, are also discussed.

Recent studies by McHose & Ludvigson (1966), and Ludvigson & Sytsma (1967) have pointed to the possibility that rat Ss may, on reward and nonreward trials, exude different odors which may serve as discriminative cues for learned or unlearned reactions either in the same or other Ss. Following this line of reasoning, one would expect that simultaneously shifting all members of a group of Ss from reward to extinction would permit them to discriminate between the two conditions, in part on the basis of odor cues. Viewing a shift from large to small reward as similar to a shift from reward to nonreward, it is quite possible that Ss exude distinctive odors following a reduction in incentive. If this is the case, then the depression effect (undershooting a small-reward control group) typically shown by Ss that have had incentive abruptly reduced from a large to a small amount, may be due, at least in part, to differential odor cues.

EXPERIMENT 1

If differential odors are a contributing factor to the depression effect shown in incentive reduction experiments, then the elimination of such odors should result in a depression effect of lesser magnitude than that shown by Ss that have not had such odors removed. The present experiment attempted to test this prediction.

Method

The Ss were 40 experimentally naive, female rats obtained from the Sprague-Dawley laboratories. The Ss were approximately 90 days old at the beginning of the experiment. Beginning two weeks prior to the start, and continuing for the duration of the experiment, Ss were fed 10 g of Purina Lab chow per day. Water was always available.

The apparatus (more fully described in Ludvigson & Gay, 1966) was a single, 3-ft long, white runway serviced by a 10.5-in.-long gray start box. Photocells were located at 1-ft intervals so as to yield, when reciprocated, start, run, and goal speeds in ft/sec.

Prior to the experiment, the Ss were randomly assigned to four groups (SX, SO, CX, and CO). Groups SX and SO, the "shift" groups, received 30 large-reward acquisition trials (12 45-mg Noyes pellets) followed by an incentive reduction phase of 15 small-reward trials (one pellet). The only difference between Groups SX and SO was that after each S in Group SX had completed a run, the apparatus (floors, sides, and lids) was completely swabbed in an attempt to remove any odors remaining from the preceeding trial. The swabbing procedure consisted of sponging the entire apparatus with clear water, starting at the goal box and working backward to the start box. The apparatus was then dried with a second (dry) sponge. A different sponge was used on each trial for drying purposes. For Group SO the apparatus was swabbed and dried only prior to the running of the first S in the group. It was felt that if any odors were exuded they would be minimized for Group SX, and maximized for Group SO. Groups CX and CO, controls for the depression effect, both received a total of 45 small-reward trials. The swabbing procedure used for Group SX was also used for Group CX. Likewise, Group CO received the same odor maximizing treatment as Group SO.

Prior to training, Ss received a five-day pretraining phase during which they were handled and tamed, habituated to the reward pellets, and habituated to the unbaited apparatus. During training Ss were transported, one group at a time, via a carrying cart from the animal colony to the experimental room. The daily order for running groups rotated with each group being run first every four days. Within a group the Ss were run in a fixed order. Trials were administered at the rate of one per day. All Ss were fed at the completion of the daily experimental session.

Results and Discussion

Figure 1 shows the mean speed (in ft/sec) at terminal acquisition (TA), and during the incentive reduction phase for the start, run, and goal measures. An overall analysis of variance yielded the following significant results. Start speed: Shift vs Control ($F = 5.73$, $df = 1/36$, $p < .05$), and Shift vs Control by Trial Blocks interaction ($F = 4.51$, $df = 5/180$, $p < .05$). Goal speed: Shift vs Control ($F = 7.78$, $df = 1/36$, $p < .01$), Trials ($F = 11.37$, $df = 5/180$, $p < .01$), and Shift vs Control by Trial Blocks interaction ($F = 4.72$, $df = 5/180$, $p < .05$). Thus, although Fig. 1 suggests that the depression effect was attenuated by the swabbing procedure, the statistical analyses do not support this conclusion.

Table 1 shows the mean number of competing responses (stops and retraces) made by the respective groups during the last 15 trials of acquisition, and during the incentive reduction phase. Kruskal-Wallis analyses were used to test overall differences at both acquisition, and incentive reduction. Significant differences ($H = 8.33$, $df = 3$, $p < .05$) were shown only for incentive reduction. Analyses (Mann-Whitney U tests) of the competing responses which occurred during the incentive reduction phase yielded the following significant result: Group SO displayed significantly more competing responses than Group SX [$U(10,10) = 15$; $p < .02$]. In terms of this measure, then, the swabbing procedure was effective in lessening the behavioral changes shown by Group SX during the incentive reduction phase.

Wilcoxon Matched-pairs Signed-ranks tests were used to test differences in pre- and postshift competing behaviors for the respective groups. The only significant difference ($T = 3$, $N = 9$, $p < .02$, two-tailed test) was shown by Group SO.

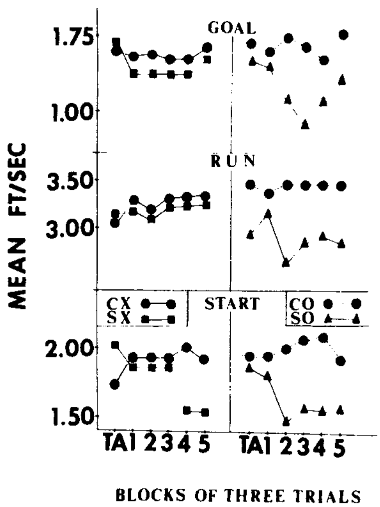

Fig. 1. Experiment 1: Mean speeds at terminal acquisition (TA) and during incentive reduction.

Table 1

Mean Number of Competing Responses During the Last 15 Trials of Acquisition and During the 15 Incentive Reduction Trials

Experiment	Group	Acquisition	Incentive Reduction
	SO	.60	5.30
	SX	.30	1.30
1	CO	.40	.60
	CX	.20	.30
	SO	.22	5.44
	SX	.22	1.66
2	CO	.77	.22
	CX	.66	.44

EXPERIMENT 2

Since Group SX of Experiment 1 displayed some increase in competing behavior and the suggestion of a drop in speed following incentive reduction, there remain two possible inferences. Either these changes occur in the absence of odors from the preceding Ss or not all the odors were removed by the swabbing. If the later alternative were correct, a stronger-than-water solution might be more effective in eliminating the odor cues. Consequently, a standard disinfectant solution readily available in the laboratory was used in a replication of Experiment 1. In addition, the possibility of retaining and transmitting odor cues via E's hands was controlled through the use of gloves. Also, extraneous cues from other Ss present in the experimental room were eliminated by bringing the Ss into the experimental room one at a time, and returning them to their home cage immediately following the daily trial.

Method

The Ss were 36 experimentally naive, female rats obtained from the Sprague-Dawley laboratories. They were approximately 90 days old at the beginning of the experiment. The methodology was identical to Experiment 1 except as regards the swabbing, handling, and transporting procedures. As in Experiment 1, Groups SX and CX had the entire apparatus swabbed prior to the running of each S, but a sponge soaked in disinfectant solution (1 oz Purina disinfectant per gallon of water) was used instead of clear water. The runway was not dried in an attempt to increase the effect of the disinfectant. The same swabbing procedure was used before the running of the first S in Groups SO and CO.

On all trials E wore a medium-weight surgical examination glove on the hand that touched the Ss. For Groups SX and CX a clean glove was used on each trial. For Groups SO and CO the same glove was used for all Ss within a group.

Results

Figure 2 shows the mean speed at terminal acquisition and during the incentive reduction phase. Overall analyses for each of the speed measures yielded no significant differences.

The lower portion of Table 1 shows the mean number of competing responses made by the respective groups during the last 15 trials of acquisition and during the incentive reduction phase. Kruskal-Wallis analyses again showed a significant overall difference ($H = 7.97$, $df = 3$, $p < .05$) only during the incentive reduction phase. The only significant difference shown by subsequent Mann-Whitney U tests was again between Groups SO and SX [$U(9,9) = 15$, $p < .05$].

Pre- and postshift competing response differences were also tested with Wilcoxon T tests. A significant difference ($T = 6$, $N = 10$, $p < .05$, two-tailed test) was again shown only by Group SO.

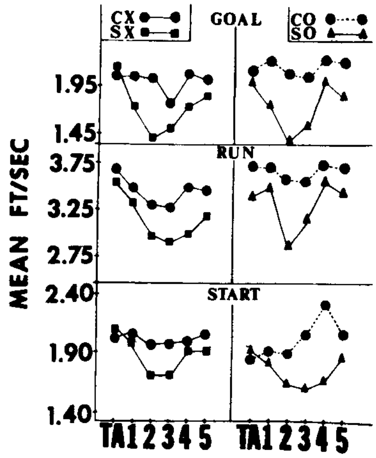

Fig. 2. Experiment 2: Mean speeds at terminal acquisition (TA) and during incentive reduction.

Discussion

As in Experiment 1 swabbing decreased the behavioral change resulting from incentive reduction in that competing responses were reduced. In this study, however, there was no clear suggestion that speed decrements were similarly attenuated. In fact, while not statistically significant, the suggestion conveyed by Fig. 2 is that depression effects did occur under both swab and no-swab conditions, with about equal magnitude.

Since the swabbing did not eliminate the evidence of depression but again only reduced competing behavior, the alternative interpretations remain: either depression occurs in spite of odor or, again, our swabbing was not completely effective. There is a third alternative which is made plausible by the fact that Group SX represents somewhat of a deviation from the expected correlation of competing responses and speed reduction. In Experiment 2, Group SX displayed about as much change in speed as Group SO, yet the former made significantly fewer competing responses than the latter. This pattern of results would be expected if the swabbing did not remove the odor but only spread it more homogeneously throughout the apparatus. The implication of this third possibility is that Ss in Group SX still responded to odor. However, since it was homogeneously distributed they did not stop but only slowed their responses. It would be expected then that actual removal of the odorant would result in an attenuation of the depression in speed as well as a reduction in competing behavior. The problem remains: In the absence of odor is there a depression effect?

REFERENCES

LUDVIGSON, H. W., & GAY, S. E. Differential reward conditioning: S- contrast as a function of the magnitude of S+. Psychonomic Science 1966, 5, 289-290.

LUDVIGSON, H. W., & SYTSMA, D. The sweet smell of success: Apparent double alternation in the rat. Psychonomic Science, 1967, 9, 283-284.

McHOSE, J. H., & LUDVIGSON, H. W. Differential conditioning with nondifferential reinforcement. Psychonomic Science, 1966, 6, 485-486.

NOTE

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