Interspecific odors as cues for runway behavior

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Seven male albino rats and seven male Mongolian gerbils served as Ss in a cross-species test of the odor hypothesis. In both phases of a two-phase experiment, rats followed gerbils on all trials in a straight runway. During the first phase, the relationship between the goal event received by the gerbils and that received by the rats was perfect (i.e., odor-maximizing conditions). During the second phase a 50% contingency was introduced (i.e., odor-minimizing conditions). The results indicated that the rats learned to respond appropriately (fast to reward, slow to nonreward) during the first phase. Responding during the second phase was nondifferential. These results are seen as supporting and extending the odor hypothesis.

Recently, an impressive amount of data has been accumulated indicating that Ss in the runway situation are able to utilize odors emitted by other Ss as cues for appropriate responding. Studies by Ludvigson & Sytsma (1967) and Ludvigson (1969) have shown that rat Ss are capable of learning to respond appropriately on a double-alternation sequence under odor maximizing conditions.

Subsequent studies (Topping & Cole, 1969; Davis, in press) indicate that the odor effect was not limited to rat Ss. Topping & Cole (1969), using a random-trials procedure instead of the previously used double-alternation pattern, reported differential responding (i.e., odor effects) on R and N trials by Mongolian gerbil Ss. A recent study by Davis (in press), using albino mice, has shown that this species also is capable of learning the double-alternation sequence under odor-maximizing conditions, but not under odor-minimizing conditions.

A logical extension of these studies would be to determine if odor cues produced by one species could be used as cues for appropriate responding by another species. The present study was designed to test this hypothesis.

SUBJECTS

The Ss were seven experimentally naive male albino rats (Sprague-Dawley derivatives) from the colony maintained in the King College laboratories. Also, seven experimentally naive male Mongolian

gerbils, obtained from Tumblebrook Farm, Inc., were used as Ss. All Ss were approximately 90 days old at the beginning of the experiment. Beginning a week before the start, and continuing for the duration of the experiment, all Ss were placed on deprivation and maintained at 85% ad lib body weight. The Ss were housed in individual cages with water always available. All Ss were fed at the completion of the daily experimental session.

APPARATUS

The apparatus was a single straight runway (13.70 cm long, 101.60 mm wide, and 88.90 mm high). The startbox (30.48 cm long) was painted white. The run section (76.20 cm long) and goalbox (30.48 cm long) were painted black. Plexiglas guillotine doors separated the startbox from the run section, and the run section from the goalbox. The top of the apparatus was covered with a thin transparent plastic sheet to prevent odor cues from escaping.

Raising the start door activated a microswitch that started a Standard Electric timer. Breaking a photoelectric beam located over the goal cup stopped the timer.

PROCEDURE

Prior to the experiment proper, all Ss received a 5-day pretraining period, which consisted of handling and taming, habituation to the 45-mg Noyes reward pellets, and habituation to the apparatus.

At the end of pretraining, the Ss were assigned randomly to one of seven permanent pairs consisting of one gerbil and one rat each. During both phases of the experiment, the Ss were run in these pairs (i.e., after the completion of its trial the gerbil was returned to its home cage and the appropriate rat was run). During both phases of the experiment, all pairs of Ss received Trial 1 before proceeding to Trial 2, etc. In order to avoid any between-pair odor effects, the apparatus was swabbed out with a standard solution of Lysol and dried with a clean dry sponge prior to the running of each gerbil. During the experiment, all Ss received six trials (three R, three N) per day. On R trials the Ss were allowed 20-sec access to the reward pellets. On N trials the Ss were confined to an empty goalbox for 20 sec.

During Phase 1, the correspondence between gerbil-goal events and rat-goal events was perfect (i.e., odor-maximizing conditions). In other words, if a gerbil was rewarded, then the following rat was also rewarded. The same relationship held true for nonreward trials. A typical sequence of trial administration during Phase 1 is presented in Table 1. The order in which the pairs were run was randomized daily, as was the R-N sequence for each pair for each day. Phase 1 lasted for 12 days or a total of 72 trials.

In Phase 2, which lasted 6 days (36 trials), the correspondence between gerbil-goal events and rat-goal events was reduced to a 50% relationship (odor-minimizing conditions). Therefore, during this phase a rat following a gerbil R trial received R one-half the time and N one-half the time. The same relationship held true for rat trials following N gerbil trials. The determination of rat-goal events was random, with two exceptions: no more than two of the four possible reward sequences (R-R, N-N, R-N, N-R) could occur within a day, and three of each type of sequence had to occur within any 2-day period. An example of reward sequences during 2 days of Phase 2 is shown in Table 2.

RESULTS AND DISCUSSION

Mean speeds (meters per second) for the

Table 1
Typical Daily Schedule for the Administration of R and N Trials During Phase I

S Pairs	Trials					
	1	2	3	4	5	6
1	R-R	N-N	N-N	R-R	N-N	R-R
4	N-N	R-R	R-R	N-N	N-N	R-R
5	N-N	R-R	N-N	R-R	R-R	N-N
3	N-N	N-N	R-R	R-R	N-N	R-R
2	R-R	N-N	N-N	R-R	N-N	R-R
6	R-R	N-N	N-N	R-R	R-R	N-N
7	R-R	N-N	R-R	N-N	N-N	R-R

Table 2
Typical Schedules for the Administration of R and N Trials on 2 Days of Phase II. (Note: Randomization of S pairs is not shown on Day 2 in order to preserve continuity.)

S Pairs	Trials						Trials					
	1	2	3	4	5	6	1	2	3	4	5	6
3	R-R	N-R	N-N	N-N	R-R	R-N	N-R	N-N	N-R	R-N	R-N	R-R
2	R-N	R-N	R-R	N-N	N-R	N-R	N-N	N-N	N-R	R-R	R-N	R-R
7	R-R	R-R	R-N	N-N	N-N	N-R	N-R	N-R	N-N	R-N	R-N	R-R
5	N-N	R-N	N-N	N-R	R-R	R-R	R-R	R-N	N-N	R-N	N-R	N-R
4	N-R	N-N	R-N	R-R	R-N	N-R	R-R	R-N	N-N	N-N	N-R	R-R
1	R-N	N-R	R-N	N-N	N-R	R-R	R-N	N-N	R-R	N-R	R-R	N-N
6	N-R	R-R	N-N	R-N	N-N	R-R	N-R	R-N	N-R	N-N	R-R	R-N

Fig. 1. Mean speeds for rat Ss during Phases I and 2. (Note: Data points for Phase 2 are based on three scores per S.)

rat Ss on R and N trials are presented in Fig. 1. Analyses comparing R vs N speeds (t tests for correlated samples) were performed on Days 1 and 12 of Phase 1, and Day 1 of Phase 2. the results of these analyses indicated that there were no significant differences on Day 1 of Phase 1 ($t = 1.23$, $df = 6$, $p > .30$), and Day 1 of Phase 2 ($t = .65$, $df = 6$, $p > .60$). A significant difference occurred on Day 12 of Phase 1 ($t = 4.55$, $df = 6$, $p < .01$).

The striking difference between R and N speeds that developed during Phase 1 would strongly suggest that the rat Ss were able to use odors emitted by the gerbil Ss as cues for appropriate responding. Additional support for the odor hypothesis is seen in Phase 2 responding. It should be remembered that during this phase the relationship between the goal event for the gerbil and that for the rat was not perfect (i.e., any distinctive cues associated with R and N are no longer effective for the rat Ss). During the initial stages of Phase 2 the R and N speeds become nondifferential due to inappropriate responding. This is more clearly seen in the Phase 2 portion of Fig. 1 by looking at N (rat) speeds following R (gerbil) trials, and R (rat) speeds following N (gerbil) trials. During the later stages of Phase 2, the discrimination acquired during Phase 1 is lost primarily due to an increase in speed following (gerbil) N trials. Presumably this reflects a lack of attention to odor cues on the part of the rat Ss. These results would also support an odor interpretation over

the alternative view that the rat Ss may in fact be discriminating between R and N goal events on the basis of odor or lack of it from the food itself.

Thus, it would appear that the present study supports and extends the generality of the odor hypothesis by showing that one species may use odors emitted by

another species as cues for appropriate responding in the runway. However, there is one notable difference between the present study and previous ones. The R-N discrimination during Phase 1 occurred very quickly and somewhat sooner in the present study than in previous studies (Ludvigson & Sytsma, 1967; Davis, in press). One possible explanation for this rapid discrimination might be that the odors emitted by a different species are highly distinctive and consequently more readily usable as discriminative stimuli. Obviously, further research is needed to clarify the operation of this potentially influential variable both between and within species.

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Behavioral-contrast in mixed schedules of reinforcement*

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Two rats were tested for behavioral contrast on two-component mixed schedules of reinforcement. The results suggest that contrast occurs in mixed variable-interval extinction schedules when the frequency of reinforcement in the variable-interval component is high.

Behavioral contrast may be defined as opposing rate changes in two

components of a multicomponent schedule that accompany changes in the rate of responding and/or reinforcement in one of the components. Contrast has been typically studied in multiple schedules in

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