Cues eliciting social approach in male albino rats*

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Social approach between male albino rats was best elicited initially by a combination of visual and olfactory cues. Later, (1) the frontal aspect of the seen-smelt stimulus became more salient for approach and (2) olfactory cues alone elicited approach. After 20 trials over 2 days, the social approach response extinguished.

The present study examines the relative contributions of olfactory and visual cues to social approach between male albino rats. Recent experiments have shown that intraspecific olfactory cues in rodents play an important role in oneway fear conditioning (King, 1969; Dua, in press), spontaneous alternation (Brill, 1967), and several partial reinforcement effects (McHose & Ludvigson, 1966; Ludvigson & Sytsma, 1967; McHose, Jacoby & Meyer, 1967; Davis & Ludvigson, 1969).

Cairns (1966) developed an associative model for mammalian attachment behaviors. However, the relative contribution of different receptor systems could not be specified; e.g., do visual or olfactory cues elicit social approach? Other factors cited by Cairns as calling for further empirical classification are satiation-extinction effects in social approach due to stimulus exposure. A further aim of the present study is to examine these effects.

The present study examines the role of frontal and rear olfactory and visual cues provided by a mature rat as a stimulus to another mature test rat. The stimulus rats were located randomly in the left or right arm of a T-maze, facing toward or away from the choice point. The treatment conditions are defined in terms of how the stimulus rat was housed in the stimulus compartment: (1) frontal-visual-olfactory (FVO), facing the choice point from behind a clear perspex screen; (2) rear-visual-olfactory (RVO), facing away from the choice point and separated by a clear perspex screen; (3) frontal-olfactory (FO), the same as FVO but with an opaque screen; (4) rear-olfactory (RO), same as RVO but with an opaque screen; (5) control for olfaction (CO), the opaque screen covering an empty stimulus box; and (6) control for visual and olfactory cues (CVO), with a clear screen covering an empty stimulus box.

It was expected that the test rat would go more often to the side containing the

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stimulus rat. In view of lack of previous research, no predictions were made with regard to the differences between the frontal and rear aspects and the relative importance of the visual and olfactory cues.

METHOD

The Ss were 120 male albino rats raised under colony conditions to 60 days and then allocated randomly four to a cage, where they were held for the duration of the experiment. Cages were paired and screened off from other pairs, one cage within each being for rats assigned to act as stimulus rats and the other for test rats.

A T-maze having the following internal dimensions was used: a startbox (10 x 4 x 5 in.), a goalbox (5 x 4 x 5 in.) on either side of the choice point, and attached to each goalbox, a stimulus compartment (10 x 4 x 5 in.). The floor was of stainless steel, the walls of wood, and the roof of perspex. The internal surfaces of the walls and roof were painted midgray. At the choice point was a set of three guillotine doors, each 2 in. wide. The first, of clear perspex, closed off the stem of the startbox. The others, painted midgray and set at 60 deg to the first, closed off the entrance to either goal compartment. Between each goal- and stimulus box was a guillotine door, which was of clear or gray-painted perspex, depending on the treatment condition.

Of the 120 rats, 60 were used as test rats and 60 as stimulus rats. The 60 test rats were divided at random into six groups of 10 rats each: FVO, RVO, FO, RO, CO, and CVO, as defined previously. In the 2 weeks leading up to testing, the stimulus rats were trained to hold one of two positions in the stimulus compartment, facing toward or

away from the choice point. Initially, the stimulus animals, when 2 h water deprived, were placed in a stimulus compartment for about 3 sec. If no movement occurred, the S was rewarded with a drop of water upon removal. During the training of stimulus animals, the time in the stimulus compartment was gradually increased. Any stimulus rat that would not hold a fixed position for 20 sec at the end of training was rejected. A further criterion was that no audible signals were emitted. However, only about 5% were rejected on both grounds.

The test rats were placed on a daily feeding schedule of 1 h, 2 weeks prior to testing. For the 3 days leading up to testing, each rat was handled for 5 min and spent 3 min alone in the apparatus. In testing, the stimulus rat had an equal chance of being in either stimulus compartment, randomly determined, on each of 10 trials per day over 4 days. When 23 h hungry, the test rats had 3 min of exploration alone in the maze, followed by 10 trials with a stimulus rat, the intertrial interval being 180 sec.

On each test trial the appropriate condition was preset and the test rat placed in the stem of the T-maze facing the first door. Raising this door started a chronoscope which stopped when the rat entered either arm. If no response occurred within 20 sec, the rat was removed to the holding cage. Following a response, the animal remained for 5 sec in the chosen arm before removal. At the end of each trial the maze was wiped over with a fresh, moist cotton cloth.

Each trial was scored either toward the stimulus (adient), in the opposite direction from the stimulus (abient), or remaining in the stem (no R). In CO and CVO, no stimulus rat was present, so the "correct" arm was determined by the sequence of the experimental groups. Within each day, performance of each rat was summed separately for the adient, the abient, and the no-R categories.

RESULTS

The number of adient, abient, and no-R responses was determined for each group of rats for each of the days. Analyses of variance were carried out on each of the three response categories on each of the

Table 1
Group Means Summed Over 10 Trials for Days 1 and 2 of Testing

Treatment Condition	Day 1			Day 2		
	Adient	No R	Abient	Adient	No R	Abient
FVO	5.44	1.78	2.78	7.00	0.56	2.44
RVO	6.33	1.22	2.44	5.11	2.56	2.33
FO	4.78	0.22	5.00	5.11	0.67	4.22
RO	3.89	2.11	4.00	4.00	1.78	4.22
CO	3.00	3.44	3.56	2.78	3.11	4.11
CVO	3.67	3.33	3.00	2.78	3.44	3.78

Table 2
Significance of Differences Between Treatment Means for Day 1 Adient, Day 2 Adient, and Day 2 Abient Responses

DAY 1 ADIENT	Treatment Condition	Smaller Mean					
		RVO	FVO	FO	RO	CVO	CO
Larger Mean	RVO	-	n.s.	.05	.01	.01	.01
	FVO	-	n.s.	.05	.01	.01	.01
	FO	-	-	n.s.	n.s.	n.s.	.01
	RO	-	-	-	n.s.	n.s.	n.s.
	CVO	-	-	-	-	n.s.	n.s.
	CO	-	-	-	-	-	n.s.
DAY 2 ADIENT	Treatment Condition	FVO	RVO	FO	RO	CO	CVO
Larger Mean	FVO	-	.01	.01	.01	.01	.01
	RVO	-	-	n.s.	n.s.	.01	.01
	FO	-	-	n.s.	n.s.	.01	.01
	RO	-	-	-	n.s.	.01	.05
	CO	-	-	-	-	-	n.s.
	CVO	-	-	-	-	-	-
DAY 2 ABIENT	Treatment Condition	FO	RO	CO	CVO	FVO	RVO
Larger Mean	FO	-	n.s.	n.s.	n.s.	.05	.05
	RO	-	-	n.s.	n.s.	.05	.05
	CO	-	-	-	n.s.	n.s.	.05
	CVO	-	-	-	-	n.s.	.05
	FVO	-	-	-	-	-	n.s.
	RVO	-	-	-	-	-	-

days over all the six groups. Thus there were 12 analyses over the four test sessions, but only Days 1 and 2 had significant effects. The F ratio was significant on Day 1 adient ($F = 3.78$, $p < .01$), Day 2 adient ($F = 8.83$, $p < .01$), and Day 2 abient ($F = 2.56$, $p < .05$). The mean number of abient, adient, and no-R responses on Days 1 and 2 is listed in Table 1. Within each significant analysis further testing of the differences between individual means was done with the Scheffé test. Table 2 presents the results of these tests at both the 5% and 1% levels of confidence. The means in Table 2 are in decreasing order.

DISCUSSION

It is clear from the results that on Days 1 and 2 the test rat showed a tendency to go towards the stimulus rat. A study of the significance of differences between means reveals the relative importance of various cues. For the Day 1 adient means, Table 2 shows that the rat has a preference for the seen, smelt stimulus, regardless of the direction it was facing. In the olfactory groups, only frontal aspects elicited approach and then not strongly. Auditory signals were ruled out as Dua (in press) had previously shown that they played no significant role between Wistar rats under test conditions. Further, any stimulus rats emitting signals audible to E had been rejected during their initial training.

By Day 2 adient the pattern of significance in Table 2 shows considerable change. The initial preference for the frontal aspect of the seen, smelt stimulus strengthened, while that for the rear

decreased. This latter aspect was equivalent to frontal-olfactory, which showed stronger elicitation. The rear-olfactory also became capable of eliciting approach, though less strongly than FO. Table 2 shows that while olfactory groups do not produce more than the control level of abient responses, the visual-olfactory groups produce significantly less. The same pattern is present in Day 1 abient scores, but the effect is not significant.

After Day 2 all three responses fell to a random level. This shows that there is some

satiation or extinction of the stimulus rat in eliciting the approach response (Cairns, 1966).

In general, it seems that initially the visual-olfactory components elicit approach regardless of how the stimulus is facing, but olfaction alone is ineffective. However, later the visual-olfactory components retain their capacity to elicit approach with the front aspect increasing in strength, and olfaction becomes capable of eliciting approach. With an increasing number of trials, all components lose their effectiveness to elicit approach.

REFERENCES

- BRILL, M. Parameters of odor-trail avoidance in the spontaneous alternation of the rat. Unpublished doctoral dissertation, University of Cincinnati, 1967.
- CAIRNS, R. B. Attachment behavior of mammals. *Psychological Review*, 1966, 73, 409-426.
- DAVIS, R. B., & LUDVIGSON, H. W. The "depression effect" and the problem of odor control. *Psychonomic Science*, 1969, 14, 93-94.
- DUA, J. K. Role of olfactory and visual cues in the acquisition of avoidance. *Journal of Experimental Psychology*, in press.
- KING, M. G. Stimulus generalization of conditioned fear in rats over time: Olfactory cues and adrenal activity. *Journal of Comparative & Physiological Psychology*, 1969, 69, 590-600.
- LUDVIGSON, H. W., & SYTSMAN, D. The sweet smell of success: Apparent double alternation in the rat. *Psychonomic Science*, 1967, 9, 283-284.
- MCCHOSE, J. H., & LUDVIGSON, H. W. Differential conditioning with nondifferential reinforcement. *Psychonomic Science*, 1969, 6, 485-486.
- MCCHOSE, J. H., JACOBY, L. L., & MEYER, P. A. Extinction as a function of number of reinforced trials and squad competition. *Psychonomic Science*, 1967, 9, 401-402.

Cage activity in cottontail rabbits

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Cage activity of two cottontail rabbits was measured twice daily (morning and night) under six levels of ambient illumination (dark, less than 1.0, 2.5, 5.0, 25.0, and 50.0 fc). Analysis of variance indicated that the Ss were significantly more active at night than in the morning under all levels of illumination. In addition, the Illumination by Time of Day interaction was significant. Increasing levels of illumination produced decreasing cage activity at night, but did not significantly affect cage activity in the morning. Results are discussed as providing further generalization of earlier findings with nocturnal Virginia opossum and diurnal California antelope ground squirrels.

Cone and Cone have reported that the effects of ambient illumination on the cage activity of Virginia opossum (1968) and of California antelope ground squirrels (1969) are not independent of the phase of the organism's circadian cycle. In the nocturnal opossum, increasing illumination produced a decrease in nighttime activity and an increase in daytime activity. The same increases in illumination produced a decrease in daytime activity but had no

effect on nighttime activity in the diurnal ground squirrel. The present study was designed to investigate the effects of increasing illumination at two times of day on the cage activity of a twilight-active (or crepuscular) animal, the American cottontail rabbit (*Sylvilagus floridanus*). Lord (1964) demonstrated that under natural illumination conditions the nocturnal activity of penned cottontail rabbits does not begin abruptly with sunset