operant behavior, and that responses occurring at intermediate points in this range will show varying strengths of relationship to eliciting stimuli, on the one hand, and reinforcement contingencies, on the other.

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NOTE

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Maternal aggression: A failure to replicate¹

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Endroczi et al (1958) reported that only lactating rats in the presence of their young would kill frogs. This "maternal aggression" could be suppressed by injections of oestrone. No aspect of that study was confirmed in the experiments reported here. Nonfrog-killing rats were not induced to kill by lactation and the presence of their young. A significant number of naive virgin female rats did kill frogs and the frog-killing response was not suppressed by oestrone.

The tendency for females of many species to behave aggressively toward any intruder during the period that they are nursing young is a well recognized but little investigated phenomenon (Beach, 1948, p. 99; Barnett, 1968). It has been suggested by Moyer (1968) that maternal aggression is one of several kinds of aggressive behavior and that it has a physiological basis which is distinct from other types of aggression. Some support for the unique physiological basis of this particular kind of aggression is provided by the experimental work of Endroczi, Lissak, & Telegdy (1958). They indicate that frog-killing behavior in the albino rat is specific to the lactating mother, in her home cage, and with her litter present. This behavior showed a gradual suppression with the weaning period of the litter.² According to these authors, neither male rats, nor nonlactating female rats will attack a frog placed in its cage. It was further demonstrated (Endroczi et al, 1958) that the maternal aggression of the rat was

dependent on a particular hormone balance. Oestrone treatment for 10 days eliminated frog killing without interfering with the care of the young, and the suppressive effects of the oestrone on frog killing could be reversed by injections of hydrocortisone. The descriptive nature of these data preclude a more quantitative analysis of the treatment effects.

This study is an attempt to replicate the above findings with more precise measures of aggressive behavior.

EXPERIMENT 1

Subjects

Eleven female albino rats (Sprague-Dawley), between 95 and 110 days of age, were used. Stimulus animals were a frog (*Rana pipiens*, female, 76 mm long) and a female albino mouse.

Apparatus

Subjects lived in standard Hoeltge cages (7 x 7 x 9.5 in.) with a Plexiglas top through which E could make observations. Latencies and response durations were recorded on a multipen event recorder which was activated by a panel of switches controlled by E.

Procedure

Subjects were adapted to the cages for 48 h and then given a 7-min pretest with the stimulus animals. Each S was presented with a frog and a mouse. The order of presentation was counterbalanced across the S population but remained constant for each rat for both the pre- and posttest conditions. The interval between presentations was 3-5 min. The following behavioral measures were made during test periods: (a) duration of sniffing of the stimulus animal (S faced the stimulus animal at a distance of less than 2 in. and simultaneously moved its whiskers

Table 1

Entries are in seconds except for investigation which was calculated in terms of per cent of time investigating prior to kill because Ss could have killed with different latencies.

	Measures taken prior to pregnancy and after parturition						
	Frog Means		t		Mouse Means		t
	F	Pre	Post	t	Pre	Post	t
Latency 1st Bite	46.0*	377.7	183.6	3.18*	402.7	75.0	10.61*
Biting Duration	9.4**	.3	28.0	2.68**	.6	5.3	2.49**
Investigation	5.0**	4.5%	8.3%	2.04	17.5%	29.4%	1.77

* $p < .01$

** $p < .05$

Table 2
Entries are in seconds except for investigation which was calculated in terms of per cent of time investigating prior to kill because Ss killed with different latencies.

	Measures taken before and after oestrone or water injection											
	Frog Means			Oestrone Mouse Means			Frog Means			Water Mouse Means		
	Pre	Post	t	Pre	Post	t	Pre	Post	t	Pre	Post	t
Latency 1st Bite	158.4	20.8	3.03*	307.8	305.8	.04	90.4	56.4	.69	323.5	248.2	1.19
Biting Duration	29.1	45.3	.68	.8	2.3	.75	17.8	14.5	.78	.4	2.2	2.04
Investigation	13.5%	18.7%	.86	25.0%	24.2%	.08	16.2%	30.0%	1.23	24.2%	19.2%	1.21

* $p < .05$

up and down), (b) latency of first bite of the stimulus animal, (c) duration of biting behavior, (d) latency of kill (defined as permanent immobilization of stimulus animal), and (e) whether S attempted to eat a stimulus animal that it had killed. Ss which killed frogs in the pretest were assigned to Experiment 2. No mice were killed during either experiment.

After the pretest, 11 nonkillers were placed in the colony room and subjected to the standard laboratory conditions to induce pregnancy. On the 14th day of their gestation period, these pregnant animals, remaining in their home cages, were returned to the experimental room. They were kept there for 10 days prior to the posttest conditions, which were the same as those used in the pretest. Each rat was tested with her litter present 48 h after parturition.

Results

No rat in this experiment killed either a frog or a mouse. Analyses of variance (subjects by sessions by stimuli) for each measure revealed that there was a significant change in all measures between the sessions. There were no significant interactions. Results are given in Table 1 and will be discussed below.

EXPERIMENT 2

Contrary to the findings of Endroczi et al (1958), preliminary experiments in our laboratory indicated that a significant number of naive virgin female rats killed frogs. Experiment 1 showed that lactating rats in the presence of their young did not kill frogs. It was therefore considered possible that the killing observed by Endroczi et al was a form of predatory aggression, and the oestrone injections blocked this tendency to predation.

Experiment 2 tested this hypothesis by determining the effects of oestrone injections on the frog-killing response of virgin female rats, using the same oestrone dosage as used by the previous investigators.

Procedure

Twenty female albino rats (Sprague-Dawley), between 95 and 110 days of age, were used as Ss. All of these Ss killed a frog during the 7-min pretest. The procedures for this experiment were exactly the same as those for Experiment 1 with the following

exceptions: 24 h following the pretest procedure, the oestrone group was given a subcutaneous injection of 500 I.U./100 gm body weight of oestrone (aqueous suspension) and the control group received a comparable volume of distilled water. Each S's injection was given at the same hour each day for a period of 10 days. The animals remained in the experimental room during the treatment period. The posttest observations were made 4 h following the 10th injection and the O did not know which injections the animals had received.

Results

Analyses of variance (groups by sessions by stimuli) for each measure revealed significant main effects for stimulus animal for latency to first bite ($F = 53.0$, $p < .01$) and duration of biting ($F = 13.0$, $p < .01$). This indicates that the rats had a significantly greater tendency to attack frogs than mice. Relevant results are presented in Table 2.

In the posttest only one S did not kill the frog. That S was in the control group. An analysis of variance of latency to kill revealed a significant main effect for treatment ($F = 5.7$) and for sessions ($F = 43.7$). However, the absence of a significant Session by Drug interaction ($F = 1.5$) indicates that the difference between the two groups was not due to the oestrone treatment, but to the fact that the groups were unmatched on kill latency on pretesting. The mean latencies for pretest were: oestrone group, 282.1 sec; water group, 172.8 sec. Posttest means were: oestrone group, 90.0 sec; water group, 40.7 sec.

On the pretest 60% of the oestrone group and 70% of the water group attempted to eat the killed frog. On the posttest 100% of the oestrone group and 80% of the water group did so.

DISCUSSION

The results of these two experiments do not in any respect confirm the findings of Endroczi et al (1958). Lactation and presence of the young did not increase the frog-killing tendency in any of the rats. Further, a significant number of naive virgin female rats kill frogs. More recent experiments in this laboratory have shown that the

rat is a highly predatory animal and that the frog is a favored prey. If the Ss are adapted to the situation, almost 100% of hooded and albino, male and female, rats will kill frogs placed in their cages.³

The decrease in latency to first bite and the increase in duration of biting produced during the posttest in Experiment 1, cannot be construed as an increase in hostility. The rat made no attempt to kill the stimulus animals and did not behave in a manner which would keep the stimulus animals away from the nest. The rats repeatedly attempted to pick up the stimulus animals and bring them to the nest. If the stimulus animal left the nest after having been placed there by the mother rat, she would immediately attempt to retrieve it just as she did with her pups. This reaction of mother rats toward mice is well described by Karli (1956). The increased biting then represents maternal care rather than maternal aggression.

The reasons for the differences in findings in these experiments and the previous ones by Endroczi and his colleagues are obscure. It appears clear, however, that a different technique must be found for investigating maternal aggression.

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NOTES

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