DIGGING AS A DEFENSIVE RESPONSE IN THE GOLDEN HAMSTER[1]

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RESUMO

Neste trabalho, foi examinado o papel da estimulação aversiva sobre o comportamento de escavação do hamster dourado. No Experimento 1, hamsters submetidos a choques elétricos prévios tiveram sua latência para iniciar a escavação diminuída em relação à linha de base. No Experimento 2, uma iluminação mais intensa produziu latências menores, uma duração total maior e maior número de surtos de escavação do que uma iluminação fraca. Os resultados apoiam a concepção de que a escavação, em hamsters, possui uma função imediata de defesa.

UNITERMOS: Comportamento animal, hamster, escavação, controle aversivo

ABSTRACT

This study assessed the role of aversive stimulation on digging behavior in the golden hamster. In Experiment 1, hamsters previously submitted to electric shock decreased their digging latency relatively to baseline levels. In Experiment 2, a high level of light produced shorter latencies, higher duration and higher number of bouts of digging than a low level of light. These results are consistent with the hypothesis of digging behavior as an immediate defensive strategy in hamsters.

KEY WORDS: Animal behavior, hamster, digging behavior, aversive control.

A hamster without previous experience promptly displays digging behavior when put on a dirt or sand substrate. The motor pattern includes, among other responses, alternate movements with the front legs, breaking up clods with the teeth when necessary, and throwing bach the accumulated material with a vigorous extension of both rear legs. The hamster's posture, during digging, enables it to take firm hold on the substrate (Cromberg, 1988).

One of the functions of digging is to provide the animal with a relatively permanent system of galleries and underground chambers which serve as a protection against bad weather (hamsters come from desertic areas whith extremely hot and extremely cold ambient temperature), a place to store grain and other food materials and a place to perform, in a relatively secure ways, essential activities such as the care of offsprings.

Digging may also have an immediate defensive function, which has not, to the moment, been systematically studied. Using an experimental device in which bottles filled with sand, as a stimulus for digging, were available, we found that digging by hamsters decreased during continuous exposition to the exposition to the apparatus, and that it increased in conditions of stimulus change: (1) shortly after the daily maintenance routine, which included changing the sand bottles, (2) after a period during which animals stayed away from the apparatus (Cromberg and Ades, 1988). It occurred to us that digging, in such context, could be interpreted as an escape reaction, primed by environmental novelty.

If this "defensive reaction" hypothesis were true, animals should be expected to dig more and faster when submitted to aversive stimulation than when tested in control conditions. In the present research, which was psychoethological in approach (Ades, 1986), hamsters were put into a digging apparatus shortly after receiving an electric shock or under intense levels of illumination, their digging behavior being compared to performance under baseline circumstances.

EXPERIMENT 1 - The facilitating influence of electric shock on digging behavior

Electric stimulation, although quite artificial, has been intensively used to investigate species typical defensive responses such as escape, fighting and burying of objects (Pinel and Treit, 1978; Williams and Scott, 1989). The objetive of our experiment was to see if coud also intensify digging behavior.

Method. The digging apparatus (see detailed description in Cromberg and Ades, 1988) consisted basically of a 30 x 30 x 30 cm Plexiglas box with 4 circular holes in its base, each situated near one of the angles and approximately 6 cm in diameter. 650 ml glass bottles, filled to the top with dry sand, could be attached to the holes and normally elicited digging behavior in hamsters. Amount of sand dug could easely be measured, in this apparatus, by weighing the bottles before and after sessions.

Six male adult hamsters, obtained from the colony of the Department of Experimental Psychology of the University of São Paulo, were kept continuously in the apparatus, with empty bottles. After a week-long period of habituation, they were submitted to three daily, 30-min-baseline sessions. At the beginning of each session, they were removed from the apparatus, placed in a Skinner box for approximately 3 minutes and then brought back to the apparatus, with sand now available. Digging latency and amount dug (in grams) were recorded. During the next two daily test sessions, procedure was the same, except that animals were submitted to electric shock (a 0,4 mA stimulus, approximately 2 sec long in the first test session; approximately 1 sec long in the second one), at the end of their 3-min stay in the Skinner box. Shock was ministred through the bars of the Skinner box, with a FUNBEC model shock generator.

Results. Electric shock induced a significant decrease in latency to dig, median latency being 58,3 s on baseline sessions and 11.5 s on teste sessions (Wilcoxon, $z = 2.201$, $p. < .05$). There was however no significant difference between amount excavated under baseline (median amount dug: 166.7 g) and under control conditions (median amount dug = 122.3 g; Wilcoxon, $z = .943$, $p > .05$).

Discussion. Electric shock promoted the occurrence of defensive responses: animals ran excitedly about in the the Skinner box, and sometimes tried to bite the experimenter's hand, at the time of transportation back to the digging apparatus. The facilitation of digging, on test sessions, can then be plausibly attributed to the defensive motivational state generated by shock. Hamsters burrowed themselves in sand as an escape strategy, as they probably do in the field when in danger. Defensive burrowing is observed in many animals which live on sand substrates, such as spiders and mollusks.

According to another interpretation, faster digging could be the result of non-specific activating properties of electric shock. An enhancing effect on species typical responses by aversive stimuli is sometimes observed: tail-pinch, for instance, induces higher rates of eating, biting and licking behaviors in rats (Szechtman, 1980).

EXPERIMENT 2 - The facilitating effect of high levels of illumination on digging behavior

Our observations of hamsters placed in the digging apparatus outside the laboratory suggested that direct solar illumination could make digging responses more intense and earlier in occurrence. The purpose of Experiment 2 was to try to reproduce and test this phenomenon under laboratory conditions.

Method. 14 male hamsters, also obtained from the Experimental Psychology Department colony, were observed for two daily sessions in the digging apparatus. Group **HL** (**high-low**, n = 7) was tested under a high level of light during the first session, and under a low level of light during the second one; Group **LH** (**low-high**, n = 7) was tested under a low level of light during the first session and under a high level of light during the second one.

The high level of light was provided by a 250 w bulb placed 35 cm above the floor of the digging apparatus. The low level of light was provided by a 60 w bulb inside a lamp shade, placed at approximately 2 m from the apparatus, in such a position that rays fell indirectly on it. Only one of the four bottles was full of humid sand, the other ones remained closed.

Each hamster was placed in the center of the apparatus, with light already on, and there remained for a 5 min session. It was allowed to continue digging, if still performing at the end of this period (this happened only once, with and animal from Group HL).

Records were taken of: (1) digging latency; (2) frequency of digging bouts; (3) total duration of digging. Animals that did not dig during allocated time were given the maximum score for digging latency (320 s) and had zero scores in the other records.

Results. Two independent analyses were performed, one for the first session — Group HL under high level of light x Group LH under low level of light — and another for the second one — Group HL under low level of light x Group LH under high level of light (Table 1).

Digging latencies under low and high levels of light did not differ significantly, in the first session, but were significantly lower under high levels of light, in the second one (Mann-Whitney, $U = 5.0$, $p < .01$).

Under high level of light, there was a greater number of digging bouts, both in the first (Mann-Whitney, $U = 9.50$, $p < .05$) and the second session (Mann-Whitney, $U = 4$, $p < .01$), and a higher total duration of digging, both in the first (Mann-Whitney, $U = 6.50$, $p < .01$) and second session (Mann-Whitney, $U = 1.00$, $p < .01$), than under low level of light.

TABLE 1 - Median digging latency and digging duration (in seconds) and median number of bouts, under low and high levels of light (Experiment 2)

	LEVEL OF LIGHT	
	HOW	HIGH
Session 1		
Digging latency	100	180
Digging duration	6	72
Number of bouts	1	3
Session 2		
Digging latency	245	30
Digging duration	20	106
Number of bouts	1	5

Discussion. Intense illumination, such as the one used in this experiment, generated vigorous and persistent digging behavior. The lack of siqnificant differences between digging latencies under high and low illumination levels, in the first test session, is somewhat puzzling. It was due to the occurrence of freezing responses in some hamsters of Group HL at the very beginning of the session, under strong illumination. It is relevant to note that white rats also do adopt freezing postures, when exposed to intense levels of light. Light can thus elicitate conflicting behavioral tendencies: one to escape, by digging, and one to adopt an immobility posture.

General Discussion

Results of Experiment 1 confirm our previous suggestion about the defensive nature of digging behavior in threatening conditions (Cromberg and Ades, 1988). Digging has probably an adaptative function, since it allows the animals to hide from predators, when foraging far from the nest. Such digging occurs early in ontogenesis: we have observed it in juvenile hamsters which hide into the sawdust of their cages whenever the lid is taken out.

Although far from being a typical sign stimulus, electric shock generates defensive tendencies and potenciates, in our experimental situation, the occurrence of digging behavior. It is interesting to note that such defensive tendencies are not eliminated by environmental change: hamsters seems seems to remain fearful when transported from the Skinner box (in which they were exposed to aversive shock) to the digging apparatus.

Increases in digging rate due to intense light also involve defensive motivation, but probably of a different nature. Burrowing is one of the ways semi-fossorial animals, such as hamsters, have to cope with adverse environmental conditions (excessive heat or light). Test sessions, in Experiment 2, were probably too short for heat — produced by the bulb — to be involved in the production of behavior, but such possibility should be further investigated, in a controlled setup.

To our knowledge, this is the first demonstration of a possible defensive function for digging in hamsters. We believe digging behavior to be an interesting experimental model for the study of defensive strategies in hamsters and some other rodents. Easy to produce under controlled conditions, it retains its relevance as a species-typical behavior and has the kind of complexity that stimulates the putting of new questions.

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