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SELF-INJURIOUS BEHAVIOR: SHAPING "HEAD-BANGING" IN MONKEYS[1]

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Head-banging, a common phenomenon among the mentally retarded, was shaped, brought under stimulus control, extinguished, and re-established in two monkeys through reinforcement and discrimination procedures of operant conditioning. The behavior was stable and led to lacerations, a condition that qualifies head-banging as self-injurious. The principles of the analysis of behavior used here may well be of value in the etiology and treatment of some human head-banging.

Head-banging, the slapping or hitting of the head or face by oneself, or the hitting (banging) of the head against objects in the environment, is a phenomenon as yet little understood among mentally retarded and occasionally also of the mentally ill patients. An excellent summary of traditional views has been given by Lovaas, Freitag, Gold, and Kassorla (1965).

It is quite conceivable that at least some forms of head-banging are simply linked to reinforcing features of the environment. In this view, the behavior is an operant maintained most typically by the attention it evokes from other persons. In support of this view, Wolf, Risley, and Mees (1964) reported that extinction and timeout procedures successfully reduced head-banging. Similarly Lovaas *et al.* (1965), in a series of studies with self-injurious behavior in a schizophrenic child, presented evidence that suggested that the self-injurious behavior was learned. Tate and Baroff (1966) provided further evidence to support this view. They used the presentation and withdrawal of physical human contact, as well as punishment procedures, to modify the severe self-injurious behavior of a 9-yr-old psychotic boy. Lest it be thought that only part of the armatory of the analysis of behavior be applicable to this problem it is interesting to note the ingenious use of a positive reinforcer in the control of self-destructive behavior reported by Peterson and Peterson (1968). They used brief walks across a room and access to a blanket as effective reinforcers for establishing behaviors that were incompatible with head-banging.

Thus, as Wolf *et al.* (1964) pointed out, procedures established originally with lower organisms can be successful with, and are increasingly applied to human problems. Yet, head-banging as such has never been explored *experimentally* with lower animals. At the same time, it is well to point out that the behavioral laws that were developed in animal laboratories are indeed so general that they can be applied to novel situations. But even so, to shed further light on this particular problem would require experiments with lower animals where a degree of control, which cannot be exercised with humans, is possible. In particular, it would be interesting to see under what conditions this behavior can be acquired. To explore this question was one objective of the present study.

Extensive self-injurious behavior has been observed in lower primates. Yerkes and Yerkes (1929) reported chest-beating, severe self-scratching, and hair-tearing of apes as expres-

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sions of anger. Finch (1942) described hair-tearing and severe scratching of primates as apparent frustration responses. Hebb (1947) related "anus picking to the point of gross self-injury" in a female monkey to the deprivation of the preferred cell mate. Tinklepaugh (1928) similarly observed paw biting and scrotum ripping with resulting severe lacerations to be a result of sexual starvation and laboratory imposed interferences with the happy sex life of a male monkey. He reported too, that this behavior later generalized to other situations. Cain (1961) quoted a statement by G. Cuvier dating back to 1811 to the effect that "impatience is the cause of the animal's throwing himself on the floor and striking his head on the floor."

Whether self-injury in primates is "merely" reflexive, physiologically occasioned, accidental, or whether it is an operant that can be controlled by discriminative stimuli is an empirical question. To explore whether head-banging could be brought under stimulus control was the second objective of the present study.

SUBJECTS AND GENERAL PROCEDURE

Two male rhesus monkeys, I and II, 7- and 2-yr-old respectively, had been raised from age one by the author and were tame to him, *e.g.*, he could enter the small cage of each animal and handle them ungloved. The animals were kept in separate rooms and could hear, but not see each other. For the procedures of shaping and maintaining the experimentally desired behavior, standard banana pellets (Ciba), half sections of monkey chow (Purina), slices of bananas and apples, grapes, and peanuts were used as the scheduled consequences for hitting the head with a forepaw (for Exp. I) and hitting the wall of the cage with the head (for Exp. II). The words: "Poor boy! Don't do that! You'll hurt yourself!" spoken by the experimenter in various combinations were used as a stimulus in the presence of which the behavior would be reinforced (S^D); the absence of these word's constituted S^Δ.

EXPERIMENT I

For the first shaping session, the experimenter seated himself in front of the 4 by 4 by 4 ft (1.2 by 1.2 by 1.2 m) cage which was enclosed on top, bottom, and on the right side with wire mesh, with galvanized steel on the rear and left side, and on the front with a door consisting of $\frac{3}{8}$ in. stainless steel bars spaced vertically 1.5 in. (3.8 cm) apart mounted in a square frame. The animals were deprived of food for 24 hr before the session.

At first, the raising of the animal's paw was followed by presentation of a single pellet of food. By successive approximations, the positioning of the paw above the head and finally the bringing down of the paw upon the head was followed by the food. The complete motion of touching the head was shaped in the adult monkey within 12 min; in the younger monkey, it took about 20 min. The first session was terminated after each animal had touched its head 30 times.

The second session constituted the first discrimination session. Now a stimulus ("Poor boy! . . . *etc.*") was presented continuously. After food pellets were presented for the 10 initial responses, the food pellets were scheduled to follow every other response for the next 10 responses, then every fifth response. Each response and food pellet was recorded via a noiseless handswitch connected to a standard cumulative recorder located in another room. The performance of both animals was very similar. The only difference was that the younger monkey emitted a total of 105 responses as compared to 140 responses for the older monkey during the 25-min session.

For this first discrimination session, the S^D and S^Δ periods were signalled to the experimenter by the appearance of a dim signal light out of sight of the animal, controlled by a tape program to be off or on in irregular multiples of 30 sec, such that the total S^D time was equal to the S^Δ time. Again, the record for both animals is similar, except that from this session on, the younger animal always responded at a greater rate than the older monkey.

At that time it became evident that considerably greater sophistication in instrumentation would be required to achieve a clear distinction between the stimulus complex, which the presence of the experimenter and his actions afforded on the one hand, and the spoken words "poor boy . . . *etc.*", which were intended as the control stimulus. In particular, the operation of the handswitch necessary during S^Δ intervals and the continued holding

of the right hand in the lab coat pocket bulging with food seemed to sustain responding. Rather than interrupt the study for the building of such apparatus, the following procedure was adopted: for both animals the sole supply of food for the next 10 days was made contingent upon head-hitting during repeated brief sessions in the course of a day, rather than during a single 25-min session.

No records were kept during this 10-day period. S^{Δ} sessions consisted of the experimenter sitting or standing in front of the animals' cages, hand in coat pocket containing food, or else walking by the cages in the course of regular lab routine work without speaking the control words; the S^{D} sessions were in every respect the same except that the control stimulus words were spoken during this condition and the food consequences were given for every tenth response (FR 10).

At the end of this 10-day training period, another 25-min session was held for each animal. The data for both animals are shown in Fig. 1. During this session an assistant, observing both experimenter and animal from another room through a window, operated the recording equipment. Scheduling of S^{D} and S^{Δ} was the same for both animals. Figure 1 shows that Monkey 1, the adult, discriminated more neatly (*i.e.,* hit itself promptly upon presentation of S^{D}) than did Monkey II. Monkey II responded at a higher rate, and as shown at points A in the record in Fig. 1, continued to hit itself even when the experimenter proferred the reinforcer after the tenth response had been emitted. At such instances the animal was not looking at the experimenter. Instead, it appeared to be looking at the ceiling or at the assistant, whose face could be seen through the window.

After this session, both animals were returned to a free-feeding schedule for a period of four days. On the third and fourth days of this period, *i.e.,* when the animals were satiated with food, the experimenter seated himself for a 10-min period in front of each cage exactly as during the training sessions and emitted the control stimulus as called for by the S^{D} and S^{Δ} program. To a naive onlooker it might well have appeared that the experimenter showed extreme "compassion" or "attention" during the S^{D} periods, while he was "indifferent" during the S^{Δ} period. The older animal did not hit itself once during these sessions. The younger animal did emit the behavior 60 times during the S^{D} sessions and 40 times during all S^{Δ} sessions. Typically, it hit itself in bursts of several responses at a time. No records of these session were taken; instead a count of the frequency of the behavior during each 10-min session was made. Figure 2 allows a comparison of the rate of responding for both animals averaged for the recorded sessions of Day 3 (the first day of discrimination training), Day 14 (the recorded session after 10 days of discrimination training), and Days 17 and 18 (before and during which the animals were on free feeding).

EXPERIMENT II

Immediately following this experiment, a session was begun with the older monkey to hit a wall of its cage with its paws to obtain a pellet of food. The intent was to replace the hitting paw(s) eventually by the head so as to make the food contingent not on touching the wall with the paws but with the forehead. The animal learned the new behavior of hitting the wall with paws within 20 reinforcements. During the same session, reinforcement for its head being close to the wall was also begun. Table 1 sumarizes the procedures employed in the course of the next 40 days. None of these procedures were successful. At the end of this time, the experiment was discontinued because of lack of funding.

DISCUSSION

An important aspect of this study is the reliability of the behavior: at one time the younger animal was presented to professional audiences in medical schools and universities in California and finally at a convention of the Western Psychological Association. The behavior proved extremely stable: not merely the experimenter, but any member of the audience could evoke the behavior, although the sight of a banana even without the control stimulus at these occasions was sometimes sufficient to produce the behavior.

There are additional observations in connection with Exp. I that are difficult to quantify *post facto,* but which easily could be subjected to the methods of the analysis of behavior. For example, as mentioned the younger monkey could not be brought under

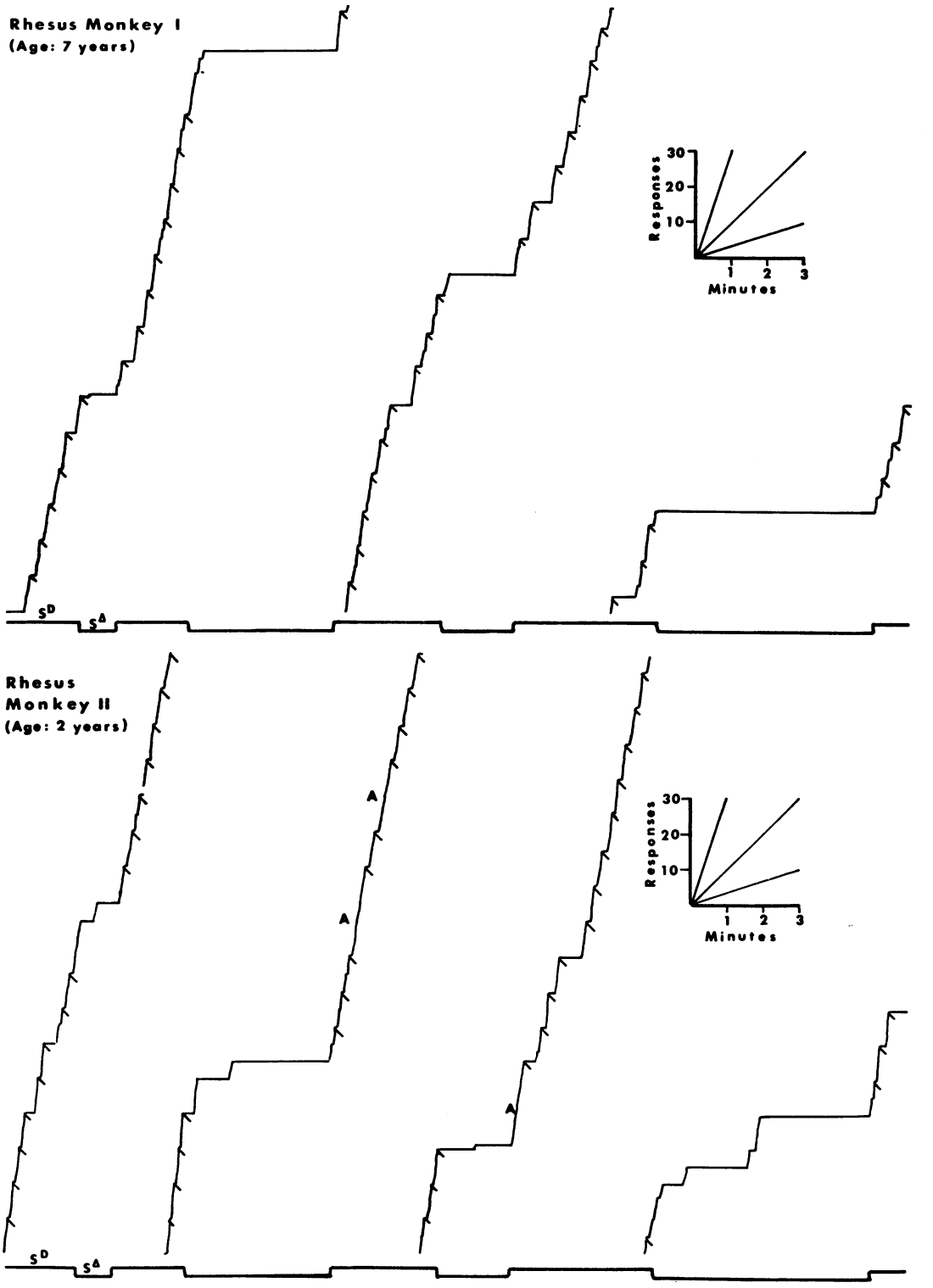

Fig. 1. Discrimination formation after 10 days (see text) for two rhesus monkeys 7 (I) and 2 (II) yr of age; self-head-hitting was reinforced (on FR 10) in the presence of the spoken words ("Don't do that! . . . *etc.*").

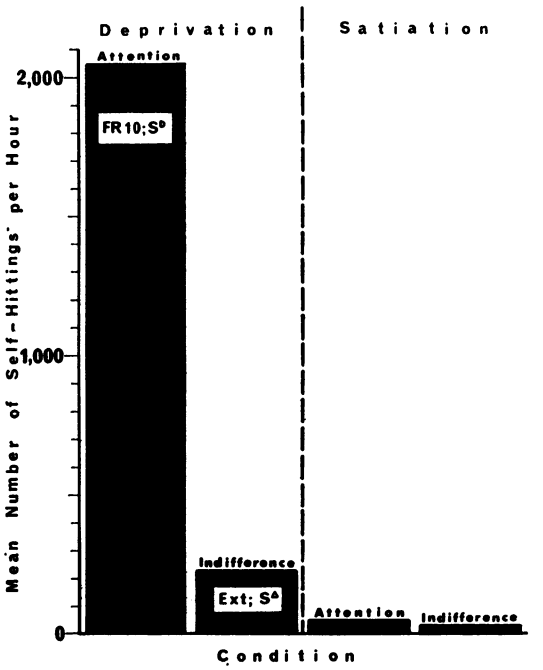

Fig. 2. Number of self-hittings averaged as arithmetic mean responses per hour for two rhesus monkeys over several experimental sessions and four different conditions. See text for details.

the same degree of stimulus control as the older animal; but also during the period of free feeding it began hitting itself when it heard the research assistant before cage-cleaning time during which it would be taken on a leash outside. Also, the monkey was seen hitting itself when the food truck (with bananas) arrived. At no time during these instances was the control stimulus spoken. The older monkey never emitted the behavior after it had been placed on free feeding. When the bananas arrived, it screamed and rattled the cage walls as it had usually done before the experiment began. That poor experimental control is likely to be involved here is substantiated by two observations: discrimination in the older animal had been formed better than in the younger; and for the younger animal the experimenter himself, even the noises he made in moving about the lab (as before cage-cleaning time) had come to function as control stimuli. Longer discrimination training and/or more sophisticated instrumentation aimed at isolating the experimental control stimulus from the experimenter himself might have solved this problem.

In the failure to establish wall-hitting with the head in the older animal, it is likely that a poor program of successive approximation was used in attempting to shape this behavior and that the experiment was abandoned before every possible alternative was exhausted.

The work with these animals confirms the findings of investigators who have worked on the same problem with humans in that it demonstrates that self-destructive behavior can be brought under the control of environmental

Table 1

Sequence of procedures used in successively approximating head-banging against cage wall in adult rhesus monkey.

Day	*Contingency*	*Success*	*Remarks*
1	One pellet for every touch of wall with hands	Excellent	
2-7	One pellet for every 10 hits with hands, close to wall	Excellent	Responses increase in intensity
8-10	One pellet for every movement of head away from and back to wall	Poor	Much screaming
11	Hold cage door bars with both hands and move head toward hitting wall	Excellent	
12-20	One pellet for every 10 moves like Day 11	Excellent	
21-30	One pellet for every contact sound made in touching head to wall while holding bars	Nil	Much screaming
31	One pellet for moving head close to wall opposite hitting wall *and* then toward hitting wall	Excellent	
32-35	Increase speed of head movement and reinforce for contact noise	Nil	Speed did increase but no contact
36-40	Like previous, but reinforce close proximity to hitting wall (within 0.25 in.) of head at end of movement	Poor	Screaming again

variables. Furthermore, in exploring the ways in which these variables initially acquire their influence over self-destructive behavior, it can now be said that the well-established procedures of the analysis of behavior are entirely justified for this problem: the behavior can be shaped by successive approximation, the reinforcer used must be effective to sustain the behavior, discriminations can be formed, *i.e.*, the behavior can be maintained while granting the reinforcer in the presence of one stimulus, and extinguished by withholding that same reinforcer in the presence of another stimulus.

On the strength of the present experimental evidence, it seems permissible and advisable to analyze each case of head-banging among humans for the presence of control-stimuli that set the stage for, and the presence of reinforcers that sustain this behavior. If these reinforcers are manipulable, then both extinction and satiation will lead to a cessation of the behavior. For example, if attention reinforces the behavior, then both continuous giving of these to an extreme degree, as well as their withholding when the behavior occurs, will diminish the behavior. It must be remembered, however, that there is no gradual weaning the organism of continuous attention. As soon as it is no longer given continuously, deprivation will increase and the behavior will reappear. Thus, from a clinical point of view it is much more advisable to use attention judiciously so as to avoid the inadvertant strengthening of undesirable or harmful behaviors.

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