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ALLEVIATION OF LEARNED HELPLESSNESS IN THE DOG[1]

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Dogs given inescapable shock in a Pavlovian harness later seem to "give up" and passively accept traumatic shock in shuttlebox escape/avoidance training. A theoretical analysis of this phenomenon was presented. As predicted by this analysis, the failure to escape was alleviated by repeatedly compelling the dog to make the response which terminated shock. This maladaptive passive behavior in the face of trauma may be related to maladaptive passive behavior in humans. The importance of instrumental control over aversive events in the cause, prevention, and treatment of such behaviors was discussed.

This paper discusses a procedure that produces a striking behavior abnormality in dogs, outlines an analysis which predicts a method for eliminating the abnormality, and presents data which support the prediction. When a normal, naïve dog receives escape/avoidance training in a shuttlebox, the following behavior typically occurs: At the onset of electric shock, the dog runs frantically about, defecating, urinating, and howling, until it scrambles over the barrier and so escapes from shock. On the next trial, the dog, running and howling, crosses the barrier more quickly, and so on until efficient avoidance emerges. See Solomon and Wynne (1953) for a detailed description.

Overmier and Seligman (1967) have reported the behavior of dogs which had received *inescapable* shock while strapped in a Pavlovian harness 24 hr. before shuttlebox training. Typically, such a dog reacts *initially* to shock in the shuttlebox in the same manner as the naïve dog. However, in dramatic contrast to the naïve dog, it soon stops running and remains silent until shock terminates. The dog does not cross the barrier and escape from shock. Rather, it seems to "give up" and passively "accept" the shock. On succeeding trials, the dog continues to fail to make escape movements and thus takes 50 sec. of severe, pulsating shock on each trial. If the dog makes an escape or avoidance response, this does not reliably predict occurrence of future responses, as it does for the normal dog. Pretreated dogs occasionally escape or avoid by jumping the barrier and then revert to taking the shock. The behavior abnormality produced by prior inescapable shock is highly maladaptive: a naïve dog receives little shock in shuttlebox training because it escapes quickly and eventually avoids shock altogether. A dog previously exposed to inescapable shock, in contrast, may take unlimited shock without escaping or avoiding at all.

Aside from establishing the existence of this interference effect, the experiments of Overmier and Seligman (1967) and Seligman and Maier (1967) have pointed to the variables controlling this phenomenon. Three hypotheses concerning the necessary conditions under which this phenomenon occurs have been disconfirmed, and one has been confirmed.

Overmier and Seligman (1967) tested two hypotheses which had been advanced to explain similar phenomena: a competing-motor-response hypothesis (Carlson & Black, 1960) and an adaptation hypothesis (MacDonald,

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1946). The competing-response hypothesis holds that, in the harness, the dog learned some motor response which alleviated shock. When placed in the shuttlebox, the dog performed this response, which was antagonistic to barrier jumping, and thus was retarded in its acquisition of barrier jumping. This hypothesis was tested in the following way: Dogs, whose skeleto-musculature was paralyzed by curare (eliminating the possibility of the execution of overt motor responses), received inescapable shock in the harness. These dogs subsequently failed to escape in the shuttlebox. Dogs, paralyzed by curare, but not given inescapable shock, escaped normally. These results disconfirmed the competing-response hypothesis. The adaptation hypothesis holds that the dogs adapted to shock in the harness and therefore were not motivated enough to escape shock in the shuttlebox. Overmier and Seligman (1967) found that dogs failed to escape in the shuttlebox, even when the shock intensity was increased to a point just below which some dogs are tetanized and thus physically prevented from jumping the barrier. These results are inconsistent with the adaptation hypothesis.

Seligman and Maier (1967) presented and tested an analysis of the phenomenon in terms of learned independence between shock termination and instrumental responding. Learning theory has traditionally stressed that two relationships between events produce learning: explicit contiguity (acquisition) and explicit dissociation (extinction). Seligman and Maier (1967) suggested that organisms are sensitive to a third relationship: independence between events. In particular, they proposed that, during inescapable shock in the harness, the dogs learned that shock termination occurred independently of their responses. Conventional learning theory allows that animals are sensitive to the conditional probability of shock termination given any specific response, and are also sensitive to the conditional probability of shock termination not given that response. In the special case in which these two probabilities are equal (independence), it is suggested that the animal *integrates* these two experiences. Thus, learning that shock termination is independent of a response reduces to learning that shock termination follows the response with a given probability, that shock termination occurs with a given probability if the response does not occur, and that these two probabilities do not differ. Such an integration could be called an expectation that shock termination is independent of responding. Seligman and Maier (1967) further proposed that one condition for the emission of active responses in the presence of electric shock is the expectation that responding leads to shock termination. In the absence of such an expectation, emitted responding should be less likely. When the dogs are subsequently placed in the shuttlebox, shock mediates the generalization of the initial learning to the new situation, and the probability of escape responding is thereby decreased.

This analysis was tested by varying the dogs' control over shock termination in their initial experience with shock. For one group (Escape), pressing panels located about 3 in. from either side of their heads terminated shock. Another group (Yoked) received the identical shock, but shock termination occurred independently of its responses (since shock duration was determined by the responses of the Escape group). The Escape group escaped normally in the shuttlebox, while the Yoked group failed to escape in the shuttlebox. This result confirmed the hypothesis that the learning of independence of shock termination and instrumental responding is a necessary condition for the interference effect. It disconfirmed a punishment interpretation of interference to the effect that the dogs failed to escape in the shuttlebox because they had been punished in the harness by the onset of shock for active responding. This experiment equated the groups for punishment by the onset of shock; the groups differed only with respect to the independence and nonindependence of shock termination and the head-turning response. This theoretical analysis, as noted below, predicts that failure to escape shock should be *eliminable* by compelling the dog to respond in a situation in which its responses terminate shock. Repeated exposure to the response-relief contingency should replace the expectation that shock termination is independent of responding with the expectation that responding produces shock termination.

Learned "helplessness" was defined as the learning (or perception) of independence between the emitted responses of the organism and the presentation and/or withdrawal of aversive events. This term is not defined as the occurrence of a subjective feeling of helplessness (although such a possibility is not excluded), nor is it to be taken as a description of the appearance of the organism. Such learning seems to be a necessary condition for the occurrence of the interference effect. That such learning occurs, moreover, seems to be a necessary premise for any systematic explication of the concept of "hopelessness" advanced by Mowrer (1960, p. 197) and by Richter (1957), the concept of "helplessness" advanced by Cofer and Appley (1964, p. 452), and the concept of "external control of reinforcement" of Lefcourt (1966).

Overmier and Seligman (1967) found that if 48 hr. elapsed between the inescapable shock in the harness and escape/avoidance training in the shuttlebox, dogs did not show the interference effect. Thus, although experience with inescapable trauma might be a necessary precondition for such maladaptive behavior, it was not a sufficient condition. However, Seligman and Maier (1967) found that the interference effect could be prolonged, perhaps indefinitely. If 24 hr. after inescapable shock in the harness the dog passively accepted shock in the shuttlebox, the dog again failed to escape after further rests of 168 hr. or longer. Thus, chronic failure to escape occurred when an additional experience with nonescaped shock followed the first experience.

Other work with infrahumans also suggests that lack of control (the independence of response and reinforcement) over the important events in an animal's environment produces abnormal behavior. Richter (1957) reported that wild rats rapidly gave up swimming and drowned when placed in tanks of water from which there was no escape. If, however, the experimenter (*E*) repeatedly placed the rats in the tank and then took them out, or if *E* allowed them repeatedly to escape from his grasp, they swam for approximately 60 hr. before drowning. Richter concluded that loss of hope was responsible for the sudden deaths. Maier (1949) reported that rats showed positional fixations when they were given insoluble discrimination problems (problems in which the responses of the rat and the outcome are independent). Making the problems soluble, alone, did not break up these fixations. But the "therapeutic" technique of forcing the rats to jump to the nonfixated side when the problem was soluble eliminated the fixations. Liddell (1956) reported that inescapable shocks produced experimental "neurosis" in lambs. Masserman (1943, pp. 79–85) reported that cats which instrumentally controlled the presentation of food were less prone to experimental neurosis than cats which did not have such control.

The maladaptive failure of dogs to escape shock resembles some human behavior disorders in which individuals passively accept aversive events without attempting to resist or escape. Bettelheim (1960) described the reaction of certain prisoners to the Nazi concentration camps:

> Prisoners who came to believe the repeated statements of the guards—that there was no hope for them, that they would never leave the camp except as a corpse—who came to feel that their environment was one over which they could exercise no influence whatsoever, these prisoners were in a literal sense, walking corpses. In the camps they were called "moslems" (*Müselmänner*) because of what was erroneously viewed as a fatalistic surrender to the environment, as Mohammedans are supposed to blandly accept their fate.
>
> . . . they were people who were so deprived of affect, self-esteem, and every form of stimulation, so totally exhausted, both physically and emotionally, that they had given the environment total power over them [pp. 151–152].

Bleueler (1950, p. 40) described the passive behavior of some of his patients:

> The sense of self-preservation is often reduced to zero. The patients do not bother anymore about whether they starve or not, whether they lie on a snowbank or on a red-hot oven. During a fire in the hospital, a number of patients had to be led out of the threatened area; they themselves would never have moved from their places; they would have allowed themselves to be burned or suffocated without showing an affective response.

It is suggested that an explanation which parallels the analysis of the interference effect in dogs may hold for such psychopathological behavior in humans. Consider an individual who has learned that his responses and the occurrence and withdrawal of traumatic events are independent. If a necessary condition for the initiation of responding is the expectation that his responses may control the trauma, such an individual should react passively in the face of trauma.

The time course of the interference effect found with dogs suggests that such human disorders may also be subject to temporal variables. Experience with traumatic inescapable shock produces interference with subsequent escape learning. This interference dissipates over time. Traumatic events must *intervene* if permanent failure to escape shock is to occur. This suggests that one traumatic experience may be sufficient to predispose an individual to future maladaptive behavior, producing, perhaps, a temporary disturbance which Wallace (1957) has called the "disaster syndrome." In order for this experience to be translated into a chronic disorder, however, subsequent traumatic events may have to occur.

Because the interference effect in dogs and these forms of human psychopathology may be acquired in similar ways, information about the modification of the interference effect may lead to insights concerning the treatment of such psychopathological behavior in humans. Two categories of treatment could be attempted: prevention or "immunization" against the effects of future inescapable shock (proactive), or modification of maladaptive behavior after inescapable shock has had its effect (retroactive). Seligman and Maier (1967) reported that prior experience with *escapable* shock immunizes dogs against the effects of later *inescapable* shock. Thus, preventive steps have been shown to be effective.

The above analysis of the interference effect predicts that by exposing a dog to the contingent relationship of shock termination and its responses the interference effect established by prior exposure to unavoidable shock should be eliminated. This experiment reports an elimination of learned "helplessness" in dogs that had chronically failed to escape from traumatic shock. Such retroactive treatment resembles the traditional treatment of human psychopathology more than does the preventive procedure.

METHOD

Subjects

The *Ss* were four mongrel dogs. They weighed 25–29 lb., were 15–19 in. high at the shoulder, and were housed in individual cages with food and water freely available. Each dog chronically failed to escape shock (see Procedure) as a result of receiving inescapable shock in Experiment I of Seligman and Maier (1967).

Apparatus

The apparatus is described fully by Overmier and Seligman (1967). In brief, it consisted of two separate units: a Pavlovian harness, in which initial exposure to inescapable shock occurred, and a dog shuttlebox, in which escape/avoidance training and modification of the failure to escape were carried out.

The unit in which each *S* was exposed to inescapable shock was a rubberized cloth hammock located inside a shielded white sound-reducing cubicle. The hammock was constructed so that *S*'s legs hung down below his body through four holes. The *S*'s legs were secured in this position, and *S* was strapped into the hammock. The *S*'s head was held in position by panels placed on either side and a yoke between them across *S*'s neck. Shock was applied from a 500-VAC transformer through a fixed resistor of 20,000 ohms. The shock was applied to *S* through brass-plate electrodes coated with electrode paste and taped to the footpads of *S*'s hind feet. The shock intensity was 6.0 ma.

The unit in which *S* received escape/avoidance trials was a two-way shuttlebox with two black compartments separated by an adjustable barrier. Running along the upper part of the front of the shuttlebox were two one-way mirror windows, through which *E* could observe and which *E* could open. The barrier was set at *S*'s shoulder height. Each compartment was illuminated by two 50-w. and one 7½-w. lamps. The CS consisted of turning off the four 50-w. lamps which resulted in a sharp decrease in illumination. The UCS was 4.5-ma. electric shock applied through the grid floors from a 500-VAC source. The polarity pattern of the grid bars was scrambled four times a second. Whenever *S* crossed from one side of the shuttlebox to the other, photocell beams were interrupted, and the trial was terminated. Latency of crossing was measured from CS onset to the nearest .01 sec. by an electric clock. Seventy decibels (SPL) white noise was present in both units.

Procedure

Inescapable shock exposure. Each *S* was strapped into the harness and given 64 trials of inescapable shock. The shocks were presented in a sequence of trials of diminishing duration. The mean intershock interval was 90 sec. with a 60–120-sec. range. Each *S* received a total of 226 sec. of shock.

Instrumental escape/avoidance training. Twenty-four hours after inescapable shock exposure, *S*s received 10 trials of instrumental escape/avoidance training in the shuttlebox. The onset of the CS (dimmed illumination) initiated each trial, and the CS remained on until trial termination. The CS–UCS onset interval was 10 sec. If *S* crossed to the other compartment during this interval, the CS terminated, and no shock was presented. If *S* did not cross during the CS–UCS interval, shock came on and remained on until *S* crossed. If no response occurred within 60 sec. of CS onset, the trial was automatically terminated, and a 60-sec. latency was recorded. The average intertrial interval was 90 sec. with a 60–120-sec. range.

All four *S*s failed to escape shock on each of the 10 trials. Thus each *S* took 500 sec. of shock during the first escape/avoidance session.

Testing for chronic failure to escape. Seven days later, *S*s were again placed in the shuttlebox and given 10 further escape/avoidance trials. Again, each *S* failed to escape shock on every trial (although one *S* avoided shock once, on the fifth trial). By this time, each *S* was failing to make any escape movements and was remaining silent during shock on every trial. Previous work has shown that when a dog remains silent and fails to make escape movements during shock, this reliably predicts that the dog will continue to fail to escape and avoid.

Treatment. The attempt at behavioral modification consisted of two distinct phases: all *S*s received Phase I; if Phase I succeeded, as it did with one of the four dogs, no further treatment was given, and "recovery" (see Recovery section below) was begun. The other three *S*s received Phase II following Phase I.

Phase I: no barrier, calling. At intervals ranging from 4 to 25 days following the demonstration that the interference was chronic, *S*s were again placed in the shuttlebox. The escape/avoidance contingencies used previously remained in effect during Phase I and II trials. The barrier dividing the two sides of the shuttlebox (formerly set at shoulder height) was removed. Thus in order to escape or avoid, *S* had only to step over the remaining 5-in. high divider. In addition, *E* opened the observation window on the side of the shuttlebox opposite the side *S* was on and called to *S* ("Here, boy") during shock and during the CS–UCS interval. The rationale for such treatment was to encourage *S* to make the appropriate response on its own, thus exposing itself to the response-reinforcement contingency. One *S* responded to this treatment and began to escape and avoid. The remaining *S*s then received Phase II.

Phase II: forced escape/avoidance exposure. Phase II began when it was clear that Phase I would not produce escape and avoidance in the remaining three *S*s since they remained silent and motionless during Phase I. The *S* was removed from the shuttlebox, and two long leashes were tied around its neck. The *S* was put back into the shuttlebox, and escape/avoidance trials continued. The end of each leash was brought out at opposite ends of the shuttlebox. Thus, two *E*s were able to drag *S* back and forth across the shuttlebox by pulling one of the leashes. Phase II consisted of pulling *S* across to the safe side on each trial during shock or during the CS–UCS interval. A maximum of 25 Phase II trials per day were given. The rationale for Phase II was to force *S* to expose himself to the response-reinforcement contingency. Such "directive therapy" continued until *S* began to respond without being pulled by *E*.

Recovery. Following Phase II (for three dogs) and Phase I (for the other dog), each *S* received further escape/avoidance trials. The barrier height was gradually increased over the course of 15 trials until shoulder height had been reached. Ten further escape/avoidance trials were then given. The last five of these recovery trials (with the barrier at shoulder height) were administered from 5 to 10 days following the first five trials with the barrier at this height. This tested the durability of the recovery.

RESULTS

Figure 1 presents the results of this study. It is clear that the procedures employed in Phases I and II of treatment were wholly successful in breaking up the maladaptive failure to escape and avoid shock. With the single exception of one *S* on one trial, the dogs had not escaped or avoided the intense shock prior to treatment. This is indicated

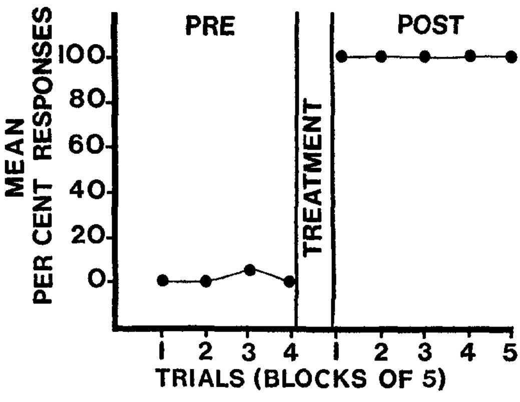

FIG. 1. Mean percentage of escape plus avoidance responses before treatment and during posttreatment recovery trials.

by the mean percentage of escape or avoidance responses present at or near zero during the pretreatment phase. Following Phase I (no barrier, calling) and Phase II (forced escape/avoidance exposure) of treatment, posttreatment recovery trials without forcing or calling were given to determine the effectiveness of the treatment. All *S*s escaped or avoided on every recovery trial.

The behavior of one *S* was successfully modified by Phase I of treatment. After sporadic failures to escape shock during this phase, it began to escape and avoid reliably after 20 Phase I trials. With the barrier increased to shoulder height, it continued to avoid reliably. The other three dogs all responded to treatment in a fashion similar to one another: after failing to respond to Phase I, each of these dogs began to respond on its own after differing numbers of Phase II trials on which it had to be pulled to safety. One of the Phase II *S*s required 20 forced exposures to escape and avoid in Phase II before it began to respond without being pulled; the other two required 35 and 50 such trials. During the course of Phase II trials, progressively less forceful pulls were required before *S* crossed to the safe side. With the barrier increased to shoulder height following Phase II, each *S* escaped and avoided efficiently. At this stage, the dogs responded like normal dogs at or near asymptotic avoidance performance.

DISCUSSION

The chronic failure of dogs to escape shock can be eliminated by physically compelling them to engage repeatedly in the response which terminates shock. Solomon, Kamin, and Wynne (1953) also attenuated maladaptive behavior in dogs by forcing them to expose themselves to the experimental contingencies. They reported that dogs continued to make avoidance responses long after shock was no longer present in the situation. A glass barrier, which prevented the dogs from making the response and forced them to "reality test," attenuated the persistent responding somewhat. Such "directive therapy" also is similar to Maier and Klee's (1945) report that abnormal positional fixations in rats were eliminated by forcing the rat to respond to the nonfixated side, and to Masserman's (1943, pp. 76–77) report that "neurotic" feeding inhibition could be overcome by forcing the cat into close proximity with food.

Seligman and Maier (1967) suggested that during its initial experience with inescapable shock, *S* learns that its responses are independent of shock termination. They further suggested that this learning not only reduces the probability of response initiation to escape shock, but also inhibits the formation of the response-relief association if *S* does make an escape or avoidance response in the shuttlebox. That the dogs escaped and avoided at all after being forcibly exposed to the response-relief contingency confirmed the suggestion that they had initially learned that their responses were independent of shock termination and that this learning was contravened by forcible exposure to the contingency. The finding that so many forced exposures to the contingency were required before they responded on their own (before they "caught on") confirmed the suggestion that the initial learning inhibited the formation of a response-relief association when the dog made a relief-producing response.

The perception of degree of control over the events in one's life seems to be an important determinant of the behavior of human beings. Lefcourt (1966) has summarized extensive evidence which supports this view. Cromwell, Rosenthal, Shakow, and Kahn (1961), for example, reported that schizophrenics perceive reinforcement to be externally controlled (reinforcement occurs independently of their responses) to a greater extent than normals. Such evidence, along with the animal data cited above, suggests that lack of control over reinforcement may be of widespread importance in the development of psychopathology in both humans and infrahumans.

In conclusion, one might speculate that experience with traumatic events in which the individual can do nothing to eliminate or mitigate the trauma results in passive responding to future aversive events in humans. The findings of Seligman and Maier (1967) suggest that an individual might be immunized against the debilitating effects of uncontrollable trauma by having had prior experience with instrumental control over the traumatic events. Finally, the findings suggest that the pathological behavior resulting from inescapable trauma might be alleviated by repeated exposure of the individual to the trauma under conditions in which his responses were instrumental in obtaining relief. It has been demonstrated that normal escape/avoidance behavior can be produced in "passive" dogs by forcibly exposing them to relief-producing responses.

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