Journal of Abnormal Psychology
1989, Vol. 98, No. 4, 448–459

0021-843X/89/$00.75

Observational Conditioning of Fear to Fear-Relevant Versus Fear-Irrelevant Stimuli in Rhesus Monkeys

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Two experiments examined whether superior observational conditioning of fear occurs in observer rhesus monkeys that watch model monkeys exhibit an intense fear of fear-relevant, as compared with fear-irrelevant, stimuli. In both experiments, videotapes of model monkeys behaving fearfully were spliced so that it appeared that the models were reacting fearfully either to fear-relevant stimuli (toy snakes or a toy crocodile), or to fear-irrelevant stimuli (flowers or a toy rabbit). Observer groups watched one of four kinds of videotapes for 12 sessions. Results indicated that observers acquired a fear of fear-relevant stimuli (toy snakes and toy crocodile), but not of fear-irrelevant stimuli (flowers and toy rabbit). Implications of the present results for the preparedness theory of phobias are discussed.

One issue of central importance to contemporary theories of the origins of fears and phobias is how to account for the nonrandom distribution of the objects of such fears (e.g., Marks, 1969, Chapter 3; Marks, 1987, Chapter 9; McNally, 1987; Mineka, 1985; Öhman, 1986; Öhman, Dimberg, & Öst, 1985; Seligman, 1971). For example, fears and phobias of snakes, spiders, and heights are relatively common, whereas fears of hammers, electrical outlets, guns, or knives are relatively uncommon, even though the latter objects may be at least as likely to be paired with direct or observational traumatic experiences. Contemporary research and theorizing about these observations has centered around the interrelated concepts of preparedness and selective associations. According to Seligman's (1971) original application of preparedness theory to fears and phobias, humans have a phylogenetically based predisposition (preparedness) to rapidly acquire fears of certain objects or situations that may once have posed a threat to our early ancestors. This predisposition was hypothesized to derive from the selective advantage that humans who had rapidly acquired fears of such objects or situations would have had over conspecifics who had not.

Since 1975, an impressive, well-known series of experiments by Öhman and his colleagues (e.g., Öhman, 1986; Öhman et al., 1985; Öhman, Eriksson, & Olofsson, 1975; Öhman, Fredrikson, Hugdahl, & Rimmö, 1976) has provided considerable support for some aspects of Seligman's original preparedness theory of fears and phobias. The most consistent finding in this literature is that human subjects demonstrate heightened resistance to extinction of the conditioned electrodermal response when fear-relevant (prepared) conditioned stimuli (CSs), such as slides of snakes and spiders, have been paired with shock unconditioned stimuli (USs). This heightened resistance to extinction is relative to what is seen when fear-irrelevant (unprepared) CSs, such as slides of flowers and mushrooms, have been paired with shock USs (however, see McNally, 1987, for a review of some failures to replicate this effect). There also seems to be some evidence that these represent selective associations. That is, subjects show superior conditioning when snakes and spiders are paired with shock USs, but not with other USs, thus demonstrating that the superior conditioning is not simply a function of greater salience of the snake and spider CSs (e.g., E. Cook, Hodes, & Lang, 1986; Öhman et al., 1976; although see LoLordo & Droungas, 1989, for a discussion of the limitations of these experiments in demonstrating selective associations).

There are several inherent limitations of the human conditioning literature on fear-relevant associations for the preparedness theory of phobias (Öhman et al., 1985; Seligman, 1971). First, it remains unclear whether conditioned electrodermal responses (especially the first anticipatory response [FAR], where fear-relevance effects have most often been noted) really signify conditioning of fear. The FAR is usually thought to reflect an orienting response, and it could be argued that, at best, it only indexes one component of the three response systems known to be involved in fear (Lang, 1968, 1971). A related limitation of the fear-relevance effects observed with electrodermal conditioning stems from the relatively short-lived nature of such responses. This shortcoming derives, at least in part, from ethical constraints that prohibit the induction of strong, intense, or persistent fears associated with actual clinical phobias. Therefore, it is unclear to what extent the fear-relevance effects described

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Experiment 1 of this article was submitted as part of a doctoral dissertation by Michael Cook to the University of Wisconsin–Madison. This research was supported in part by Grant BNS-8507340 from the National Science Foundation to Susan Mineka. We would like to thank Charles Snowdon for suggesting to us the use of videotaped stimuli, and for his comments on an earlier version of this article. We would also like to thank Jeffrey Schultz and Clark Thompson from the Instructional Media Development Center at the University of Wisconsin–Madison, for their technical aid in the preparation of videotaped material; Andrew Tomarken for his assistance with data analysis; Don Fowles and two anonymous reviewers for their helpful comments on an earlier version of this article; and Randy Busse, Sharon Knautz, Jill Wilker, Veronica Kibler, Kenton Price, and Jim Ekman for their assistance in running the subjects for these experiments. Correspondence concerning this article should be addressed to Susan Mineka, Department of Psychology, Swift Hall, Northwestern University, Evanston, Illinois 60208.

above for the psychophysiological component of fear would also occur under conditions more appropriate for the induction of phobic fears.

Finally, all human subjects have almost certainly been exposed to both fear-relevant and fear-irrelevant stimuli similar to those used as CSs in these studies. Because prior history with the CSs cannot be rigorously controlled, there exists the possibility of preexisting differences between these stimuli in degree of affective valence (viz., greater negative valence for fear-relevant stimuli due, perhaps, to such factors as cultural folklore and modeling experiences; see Delprato, 1980). It is therefore impossible to ascertain whether the observed differences in conditionability represent an experience-independent association bias between fear-relevant CSs and aversive USs (i.e., a selective association) or whether they stem from preexisting differences in valence between the two types of CSs (see LoLordo, 1979; LoLordo & Droungas, 1989, for detailed discussions concerning the definition of, and methodology appropriate for, the identification of selective associations).

One way to circumvent these limitations in the human literature on conditioned selective associations is through the use of a primate model of fear conditioning. Using a primate model, one can assess the extent to which strong and persistent, overtly expressed fears can be conditioned to fear-relevant CSs versus fear-irrelevant CSs. In addition, through the use of laboratory-reared primates, one can control for prior ontogenetic experiences with the fear-relevant and fear-irrelevant CSs to be used by choosing stimuli from both categories that are totally novel for the subjects.

A paradigm developed in recent years in our laboratory for studying observational conditioning of snake fear in rhesus monkeys seemed ideal for the examination of these issues. In our initial experiments, we had demonstrated that most laboratory-reared observer monkeys who were not initially afraid of snakes rapidly acquired an intense fear of snakes when they spent several sessions watching a wild-reared monkey exhibiting high levels of fear in the presence of snakes (M. Cook, Mineka, Wolkenstein, & Laitsch, 1985; Mineka, Davidson, M. Cook, & Keir, 1984). An obvious question stemming from these experiments is whether comparable observational conditioning would occur if models were seen reacting fearfully to fear-irrelevant stimuli. To address this latter question, one needs to compare the results of two groups of observer monkeys—one that watches a model monkey behaving fearfully with a fear-relevant stimulus (e.g., a toy snake) and one that watches the same model monkey displaying exactly the same fear behaviors directed toward a fear-irrelevant stimulus (such as flowers). Our recognition of the importance of the model's showing exactly the same fear behaviors in the two conditions derives from experimental findings in this laboratory indicating that the intensity of the model's fear response during observational conditioning is very highly correlated with the observer's level of acquired fear (see M. Cook et al., 1985; Mineka et al., 1984). Thus, if degree of model fear in the presence of snakes versus flowers is not controlled (i.e., equivalent), any differences in observers' level of acquired fear may not be attributable to the CSs per se, but may instead be due to quantitative differences, qualitative differences, or both, in the level of fear shown by the model to the CSs.

Recently, we circumvented this problem by demonstrating that observer monkeys can acquire a fear of snakes by watching a videotaped performance of model monkeys behaving fearfully toward snake stimuli (M. Cook & Mineka, 1989, Experiment 1). This demonstration of the ability of rhesus monkey observers to acquire snake fear vicariously through observation of videotaped models allowed us to make additional videotapes that were edited such that different videotapes showed the same model displaying the same fear behaviors, but to different stimuli. In an initial experiment (M. Cook & Mineka, 1989, Experiment 2; see Mineka, 1987, and Mineka & M. Cook, 1988, for preliminary results) using such edited videotapes, observer monkeys in the SN+/FL− group watched videotapes that had three kinds of trials: SN+ trials (60 s in duration) on which the model appeared to react fearfully to toy snakes, FL− trials (60 s in duration) on which the model appeared to react calmly to artificial flowers, and short (5-s) trials on which the model reacted calmly to neutral wood blocks.[1] Monkeys in the FL+/SN− group watched an identical videotaped model performance, but the snake and flower stimuli were "reversed"; that is, the model appeared to react fearfully to the flower stimuli (FL+ trials) and calmly to the toy snake stimuli (SN− trials), as well as calmly to the neutral objects (N− trials).

The results of this experiment demonstrated that a majority of monkeys in the SN+/FL− group acquired a fear of snakes, but not of flowers, whereas few monkeys in the FL+/SN− group showed any indication of acquiring a fear of flowers. Results of an additional experiment (M. Cook & Mineka, 1989, Experiment 3), using a complex appetitive operant paradigm, showed that rhesus monkeys were capable of learning about the same videotaped flower stimuli when those stimuli were cues for reward; indeed, learning rates were fairly comparable whether toy snakes or flowers served as cues for reward. Thus, although it appears that the flower stimuli are not very associable with fear, it cannot be maintained that they are simply inadequate stimuli for any kind of learning (see LoLordo, 1979; LoLordo & Droungas, 1989).

The present experiments had three goals. First, it seemed possible that the videotapes used in the experiment described above were so complex that they minimized or underestimated the possibility of significant acquisition of flower fear in the FL+/SN− group. That is, the presentation of three kinds of trials to the FL+/SN− observers (FL+ trials, in which models reacted fearfully to flowers; SN− trials, in which models reacted calmly to snakes; and briefer N− trials, in which models reacted calmly to wood blocks) may have confused observers to such an extent that they failed to show conditioning. Alternatively, the presentation of fear-relevant and fear-irrelevant stimulus trials in fairly close succession may have resulted in some weak long-delay conditioning of fear to the snake stimuli in the FL+/SN−

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[1] It should be noted that SN− (or FL−) trials and the neutral-object (N−) trials were highly similar in terms of model performance, but they differed greatly in duration (60 vs. 5 s). The brief N− trials were included largely to maximize the probability that the observers "recognized" the situation that they were observing on the videotape. That is, because observers had extensive adaptation experience with neutral objects, but not with snake and flower stimuli, the neutral object trials were included to enhance familiarity.

group; indeed, 2 out of the 13 observers in this condition showed indications of significant acquisition of snake fear. Such a process may have minimized the possibility of differential responding to the FL+ and SN− stimuli at posttest. According to these accounts, the failure of the observers to acquire a significant flower fear may have resulted, at least in part, from the use of this complex videotape, rather than from an inability of the observers to acquire a fear of the videotaped flowers per se. Because acceptance of the null hypothesis (i.e., that observers cannot acquire a fear of flowers) is always somewhat problematic, it seemed important to explore these alternative explanations for the failure of the FL+/SN− group to acquire a fear of flowers. Additionally, a second and related goal of Experiment 1 was to replicate, using a less complex procedure, the differential conditionability of snake and flower stimuli found in M. Cook and Mineka's second experiment (1989).

Thus, Experiment 1 was designed to determine whether differential conditionability of snake and flower stimuli would also occur with the use of less complex videotapes that had only two kinds of trials: Observers in one group (SN+ group) watched edited videotapes of models reacting fearfully with toy snakes and nonfearfully with neutral wood blocks; observers in a second group (FL+ group) watched models reacting fearfully to flowers and nonfearfully to wood blocks. Because the FL+ group never saw snake stimuli during conditioning, there was no possibility that poor conditionability of the flower stimuli was due to competition with snake stimuli for excitatory strength.

A third goal of these experiments was to extend the generality of the findings from the present Experiment 1, and from Experiment 2 of M. Cook and Mineka (1989). In particular, it was thought that the case for differences in conditionability to fear-relevant versus fear-irrelevant stimuli would be strengthened by using as a fear-irrelevant stimulus another animal that would not have posed a danger to primates' early ancestors. Therefore, in Experiment 2, a toy rabbit served as the fear-irrelevant stimulus. In addition, because pilot work had indicated that wild-reared rhesus monkeys (but not laboratory-reared monkeys) exhibited a fear of lizards and toy crocodiles (but not of toy rabbits) that was similar in intensity to their fear of snakes, a toy crocodile was used as the fear-relevant stimulus.

Experiment 1

Method

Observers and Models

Observers were 22 (3 male and 19 female) laboratory-reared rhesus monkeys (*Macaca mulatta*), ranging in age from 4 to 11 years. The videotaped models were a 32-year-old, female, wild-reared rhesus monkey and a 7-year-old, female, laboratory-reared rhesus monkey. The wild-born model had had approximately 5 years of experience in the wild in India prior to capture. The laboratory-reared model had acquired a fear of snakes through observation in a previous experiment (Mineka & M. Cook, 1986). All monkeys were living at the Harlow Primate Laboratory at the time of the experiment.

Apparatus

Testing took place in a Wisconsin General Test Apparatus (WGTA; Harlow, 1949).[2] In the WGTA, the experimenter sat behind a one-way mirror, unobserved by a monkey in a cage (98.5 cm long × 52.6 cm high × 51.4 cm wide). During WGTA adaptation and testing, stimuli were placed inside an uncovered Plexiglas box (53.4 cm long × 15.2 cm high × 21.3 cm wide), and food rewards were placed on a ledge at the top of the box's back wall (the wall furthest from the monkey). A blind, when lowered by the experimenter, prevented the monkey from viewing the box, stimulus, and reward. During observational conditioning, a color monitor (NEC, Model CM-1915A, 19-in. [48.3-cm] screen) connected to a video cassette recorder (VCR; Sony, Model SL-10) was situated within the WGTA (approximately 1 m from the cage holding the monkey) so that the monkey could view the videotaped stimuli on the monitor's screen when the blind was raised. Low-level white noise masked any extraneous noise occurring during sessions in the WGTA.

Stimuli

The following stimuli were presented to observers in the WGTA (in the Plexiglas box, on videotape, or both): (a) a 106-cm-long, sinuous, brown, rubber toy snake, 2.5 cm in diameter (the big toy); (b) two 61-cm-long, sinuous, rubber toy snakes (one brown and one green), 2.5 cm in diameter (the small brown and the small green toy); (c) three pairs of silk flowers with green plastic stems (one pair with a pink and a blue flower, one with a purple and a yellow flower, and one with a purple and a red flower; each pair was arranged so that each flower was adjacent to the end of the other flower's stem; each flower was between 38 and 43 cm in length, including its stem); and (d) several neutral objects: wood blocks of different shapes and colors, the largest measuring 2.5 cm high × 7.6 cm long × 7.6 cm wide.

Videotapes

Four videotapes were used during the course of the experiment. Two of the four tapes showed the wild-born model; two showed the laboratory-born model. Two tapes (one depicting the wild-born model and one depicting the laboratory-born model) showed a model reacting fearfully to the toy snake stimuli and nonfearfully to the neutral stimuli (wood blocks). These tapes were designated the SN+ tapes. The remaining two tapes (again, one depicting the wild-born model and one depicting the laboratory-born model) showed a model reacting fearfully to the flower stimuli and nonfearfully to the neutral stimuli. These tapes were designated the FL+ tapes. On these videotapes, fear (or lack of fear) was manifested by the model's reaction to stimuli and food treats in a WGTA setting. Stimuli were inside the uncovered Plexiglas box, and food rewards were on the ledge at the box's back wall. The models could obtain the food reward by reaching over the stimulus object in the box.

Each tape comprised 20 trials. Fourteen of the trials were neutral-object trials (each approximately 5 s in duration) that depicted the model reaching rapidly (within 2–3 s) over one of the neutral objects in the open Plexiglas box to obtain the food reward (indicating no fear of the neutral objects). The two FL+ tapes also contained 6 FL+ trials in which the model apparently evinced extreme fear of flowers for 60 s

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[2] Pretesting and three posttests (following Sessions 4, 8, and 12 of observational conditioning) were also conducted in a second context (Sackett Self-Selection Circus; Sackett, 1970), as in previous experiments in this series (e.g., M. Cook et al., 1985; Mineka & M. Cook, 1986; Mineka et al., 1984). Because of space constraints, and because some of the results fell just short of conventional levels of significance, details of the procedure and results of the Circus tests are not presented here (see M. Cook, 1988, for details). However, it should be noted that analysis of these results clearly indicated that the behavior in both groups did not significantly change over the three posttests; that is, learning appeared asymptotic after the first posttest, which followed the fourth observational conditioning session.

Table 1
Overview of Experiment 1 Procedure

Experimental phase	Procedure
Adaptation	Observers adapted in the WGTA using neutral stimuli to ensure stable, rapid responding for food treats.
Pretests	Observers administered a pretest in the WGTA consisting of 14 trials of 60 s, 6 with excitatory stimuli (toy snakes for Group SN+, flowers for Group FL+) and 8 with neutral stimuli.
Observational conditioning	Twelve observational conditioning sessions administered to each observer. In each session, observer watched two videotapes. FL+ observers watched tapes showing models reacting fearfully to flowers and nonfearfully to neutral stimuli. SN+ observers watched tapes showing models reacting fearfully to snakes and nonfearfully to neutral stimuli. Each tape consisted of 20 trials: 14 neutral object trials of 5 s and 6 excitatory trials of 60 s.
WGTA posttest	Following the last observational conditioning session, observers were administered a WGTA posttest. Procedure identical to that used during WGTA pretest.

Note. WGTA = Wisconsin General Test Apparatus.

(manifested by a failure to reach over flowers inside the open Plexiglas box for the food reward and by the display of various fear behaviors; see *Procedure* for an enumeration of fear behaviors). On half of these trials, the pink and blue flowers were inside the box; on the other half, the purple and yellow flowers were inside the box. The two SN+ tapes contained 6 SN+ trials, in which the model apparently evinced extreme fear of a toy snake for 60 s (manifested by a failure to reach over the toy snake inside the open Plexiglas box for the food reward and by the display of various fear behaviors). On half of these trials, the big toy snake was inside the box; on the other half, the small brown toy snake was inside the box.

As noted in the introduction, because of the editing techniques used, the different tapes were identical in the behavior exhibited by a given model; they differed only in the stimulus to which the model appeared to react with fearful behavior. Specifically, for each trial of the SN+ tapes that depicted the fearful behavior of a model in reaction to a toy snake, a counterpart trial existed in the FL+ tapes that depicted the identical fearful behavior of the model, but in reaction to the flowers. In actuality, all fearful model "performances" were obtained by videotaping models reacting to a live snake and a very large toy snake. The live snake and the very large toy snake were replaced during the editing process with the appropriate toy snake or flower stimulus. The 14 neutral-object trials, which were identical on the SN+ and FL+ tapes, did not require such editing. For each tape, trial order was as follows: Four neutral-object trials were followed by the six snake trials (for the SN+ tapes) or six flower trials (for the FL+ tapes). Snake (and flower) trials were separated from one another by further neutral-object trials. Following the last snake stimulus or flower stimulus presentation, five final neutral-object trials ensued. The intertrial interval (ITI) consisted of a 4-s period of "video black" (i.e., a blank, nonstatic screen image).

The images of the snake and flower stimuli, as they appeared on the videotapes, were similar to one another in size, ranging from approximately 17 to 20 cm long. The screen image of the neutral blocks was approximately 3.2 cm wide, that of the model monkeys was approximately 18 cm tall, and that of the food treat was approximately 1 cm in diameter. Although the dimensions cited for the food treat, in particular, may seem small, experimenters, making incidental observations of monkeys watching these videotapes, reported that monkeys would occasionally touch the treat appearing on the monitor's screen in an apparent effort to obtain it.

Procedure

Table 1 outlines the experimental procedure for Experiment 1.

WGTA adaptation and pretest. Observers were adapted to the WGTA apparatus and procedure prior to the WGTA pretest. An adaptation trial consisted of placing a neutral object inside the Plexiglas box, placing a food reward on the box's ledge, raising the blind (allowing the monkey to see the box, stimulus, and reward), and starting a timer. The trial ended when the monkey reached over the neutral object in the open box to obtain the reward. Monkeys were considered adapted when they obtained the reward within 10 s on 18 of 20 consecutive trials.

Following adaptation, observers were pretested for their fear of actual toy snakes or flowers in the WGTA. The pretest procedure differed from the adaptation procedure in the following particulars:

1. Trials did not end when the observer obtained the food reward, but instead were all 60 s long. If the observer failed to obtain the reward during a trial, a latency of 60 s was recorded.

2. The occurrence of any of 12 disturbance behaviors was recorded. Disturbance behaviors were scored using a 1–0 modified frequency system (Sackett, 1978). A 60-s trial was subdivided into three 20-s intervals. If a particular disturbance behavior occurred one or more times during a 20-s interval, the observer's disturbance score was incremented by 1. Because there were three intervals per trial, each of the 12 behaviors could increment the composite disturbance score by 0–3. The disturbance behaviors recorded were those used previously with this paradigm (M. Cook & Mineka, 1987; M. Cook et al., 1985; Mineka & M. Cook, 1986; Mineka et al., 1984; Mineka & Keir, 1983; Mineka, Keir, & Price, 1980): fear withdrawal (sudden retreat to, or flattening of the body against, the back of the cage), cage clutch (holding onto the side or the back of the cage), cage shake (vigorous moving or shaking of the cage), spasm or tic (vigorous shaking or jerking of the hands or upper body), eye aversion (rapidly looking away from the stimulus), stare (prolonged, fixed gaze at the stimulus from the back of the cage), fear grimace (stretching the lips over the gums, exposing the teeth), threat (lips thrust forward, ears retracted or flattened against the head), ear flap (ears flattened against the head but without the lips thrust forward as with a threat), lip smack (lips repeatedly moving up and down, chattering of teeth), vocalization, and piloerection (fur raised up on the shoulders and torso).

3. In addition to neutral objects, three other stimuli were presented, for a total of 14 trials. (As during adaptation, all stimuli were placed inside the open Plexiglas box during their presentation.) The SN+ observers were shown the big toy snake and the two small toy snakes, and the FL+ observers were presented with the pink and blue flowers, the purple and yellow flowers, and the purple and red flowers. Presentation order of stimuli was as follows: Two neutral-object trials preceded the presentation of the three nonneutral stimuli. The nonneutral stimulus trials were separated from one another by further neutral-object presentations. This sequence of seven trials was then repeated so that each

nonneutral stimulus was presented twice. Trials were separated by 45-s ITIs. (During adaptation, ITIs varied from between 5 and 15 s.)

WGTA adaptation sessions occurred over a 2–4 week period. The pretest was conducted after adaptation criteria had been met.

Observational conditioning using videotapes. Following the WGTA pretest, observers underwent 12 observational conditioning sessions over a 3–4 week period. During each session, observers were allowed to watch two videotapes in the WGTA setting. SN+ observers watched the two SN+ tapes; FL+ observers watched the two FL+ tapes. Each tape was approximately 8.4 min in duration. It was not necessary to train observers to watch the videotapes. Unfortunately, because the monitor was situated so that it impeded the experimenter's view of the subject, no systematic behavioral observations could be made.

WGTA posttest. Following the final observational conditioning session, observers received a WGTA posttest, identical in procedure to the WGTA pretest.

Data Analysis

Two investigators scored fear behaviors in the WGTA over the course of the experiment. Interrater agreement was assessed during four WGTA posttests. Interrater agreement was 86%; that is, 36 of the 42 behaviors recorded over the 56 trials were noted by both raters. If the instances for which the raters agreed no fear behaviors occurred were included in the assessment, agreement would exceed 99%.

For WGTA pretest and posttest sessions, the maximum attainable latency score per trial was 60 s; the maximum attainable disturbance behavior score per trial was 36 (three 20-s intervals × 12 behaviors).[3] For each WGTA session (pretest and posttest), a single food-reach latency (and disturbance behavior) score was computed for the toy snake stimuli by averaging scores over the toy snake trials. In the same manner, a single food-reach latency (and disturbance behavior) score was computed for the flower stimuli by averaging scores over the flower trials. Latencies and fear behavior scores for the neutral stimuli were derived by averaging scores over the first two neutral-object trials of a session.

For each of the two dependent measures, experimental hypotheses were tested with three sets of planned comparisons. The first two sets, one set for each of the two groups, comprised the same three within-group contrasts: (a) CS+ at pretest versus N at pretest,[4] (b) CS+ at posttest versus N at posttest, and (c) CS+ at pretest versus CS+ at posttest. The third set consisted of two between-group comparisons, contrasting the two groups in their reaction to CS+ at pretest and at posttest. An effort was made to control experimentwise Type I error by adopting a Dunn-Bonferroni strategy for setting the nominal alpha level at which the contrasts were evaluated (Dunn, 1961). Thus, each comparison in the first two sets was evaluated at $\alpha = .05/3 = .0167$. Similarly, each contrast in the third set was evaluated at $\alpha = .05/2 = .025$. As a result, experimentwise alpha associated with each dependent measure was equivalent to what would have been yielded had we conducted three planned comparisons, each evaluated at $\alpha = .05$. All planned comparisons were two-tailed.

We felt this approach was justified, given that the three sets into which the contrasts were partitioned appeared to test logically distinct experimental hypotheses. That is, the first two sets tested our hypotheses concerning changes in the responses of each group to the stimuli over the course of the experiment, whereas the third set tested hypotheses concerning differences between the two groups in the extent to which they responded to the excitatory stimuli. Omnibus analyses of variance (ANOVAS) for each dependent measure were also conducted, and these results are presented.

Results

In overview, observational conditioning resulted in the SN+ group's acquiring a fear of snake stimuli. By contrast, the FL+ group did not acquire a fear of flowers as a result of exposure to the videotapes.

Observational Conditioning

Unfortunately, as noted above, we were unable to make systematic observations of the observers' reactions to the videotapes. However, our incidental observations suggested that the observers reacted to the stimuli as though they were real. For example, observers occasionally reached for the food treat on the screen. Additionally, the observers seemed to find the models' fear performances disturbing, as evidenced by reactions such as retreating to the back of the cage and averting their gaze. Such disturbance reactions to the videotapes of models' fear performance parallel those shown to the fear performances of live models (M. Cook et al., 1985; Mineka et al., 1984). Finally, we noted a general tendency for observers to pay more attention to the videotapes in the earlier conditioning sessions than to those in the later conditioning sessions.

WGTA

Figure 1 depicts the mean latencies for the two groups at pretest and posttest. Observer latency scores were analyzed by a 2 × 2 × 2 (Groups [FL+ vs. SN+] × Tests [pretest vs. posttest] × Stimulus Objects [CS+ vs. neutral object]) mixed-design ANOVA. The analysis revealed significant main effects for tests and objects, $Fs(1, 20) = 10.25$ and 17.03, respectively; significant Groups × Tests and Tests × Objects two-way interactions, $Fs(1, 20) = 7.67$ and 7.82, respectively; and a significant Groups × Tests × Objects triple interaction, $F(1, 20) = 6.85$.

The planned comparisons (all evaluated at the alpha levels noted above) indicated that during the pretest, observers in both groups responded to both the excitatory and neutral stimuli with relatively short, equivalent latencies. However, at posttest, SN+ observers exhibited significantly longer latencies to the toy snakes than to the neutral stimuli. By contrast, the FL+ observers continued to respond at posttest with short, equivalent latencies in the presence of both flowers and neutral stimuli. Additionally, in pretest-to-posttest changes in response to the CS+, the SN+ observers showed a significant increase in latency to reach, whereas the FL+ observers did not. Finally, between-group comparisons revealed that the two groups did not differ from one another at pretest in their response to the CS+, but, following observational conditioning, the response

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[3] Although a disturbance score of 36 was theoretically obtainable, actual scores were far below this maximum for a variety of reasons. The expression of some behaviors was not compatible with the simultaneous expression of others (e.g., eye aversion vs. prolonged stare) so that the appearance of one behavior during a 20-s interval reduced the probability of the appearance of the conflicting behavior. Further, animals exhibiting fear tended to display only a subset of the 12 possible fear behaviors, with different monkeys displaying different subsets. One monkey might, for example, tend to vocalize, withdraw, and clutch the cage, but another might tend to avert eyes and grimace. Finally, some of the 12 fear behaviors appeared infrequently (e.g., threats).

[4] The flowers were the CS+ for the FL+ group; the toy snakes were the CS+ for the SN+ group. N refers to the neutral stimuli.

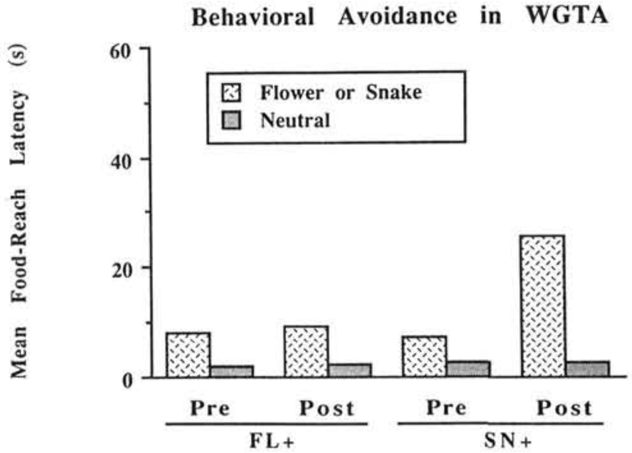

Figure 1. Mean food-reach latency (in s) in the Wisconsin General Test Apparatus in the presence of the excitatory stimulus (toy snakes or flowers) and the neutral object for the SN+ and FL+ observers of Experiment 1 at pretest and posttest.

latencies of the SN+ observers to the toy snakes were significantly longer than those of the FL+ observers to the flowers.

Figure 2 depicts the mean number of disturbance behaviors for the two groups at pretest and posttest. A $2 \times 2 \times 2$ (Groups × Tests × Stimulus Objects) mixed-design ANOVA for observer disturbance behavior (analogous to the $2 \times 2 \times 2$ ANOVA for latency) resulted in a significant main effect for objects, $F(1, 20) = 12.07$; significant Groups × Tests, Groups × Objects, and Tests × Objects two-way interactions, $Fs(1, 20) = 8.78$, 4.82, and 7.51, respectively; and a significant Groups × Tests × Objects triple interaction, $F(1, 20) = 6.52$.

The pattern of results yielded by the planned comparisons for disturbance behavior was identical to that outlined above for food-reach latency. That is, during the pretest, both the SN+ and FL+ observers showed little disturbance when in the presence of either the CS+ or the neutral stimuli. But, at posttest, the SN+ observers showed significantly more disturbance to the toy snakes than to the neutral stimuli, whereas the FL+ observers continued to exhibit little disturbance in the presence of either flowers or neutral stimuli. Again, in pretest-to-posttest changes in response to the CS+, the SN+ observers showed a significant increase in level of disturbance; the FL+ observers did not. The between-group comparisons revealed that the two groups did not differ from one another at pretest in their level of disturbance with the CS+, but did differ at posttest, with the SN+ observers exhibiting significantly more disturbance than the FL+ observers.

Discussion

The results of Experiment 1 confirm and extend those reported by M. Cook and Mineka (1989; see also Mineka, 1987; Mineka & M. Cook, 1988, for preliminary results). Specifically, the results of the SN+ group demonstrate that observer monkeys acquired a fear of snakes simply through watching videotapes of two model monkeys reacting fearfully to toy snakes. By contrast, observers watching videotapes of models showing exactly the same fear performance directed toward brightly-colored artificial flowers did not acquire a significant fear of flowers. This difference occurred in spite of the fact that the brightly-colored artificial flower stimuli are, at least to the human eye, much more salient stimuli than are the rather dull-colored toy snakes. Furthermore, because toy rather than live snakes were used as stimuli for the SN+ observers at all stages of the experiment, there is no possibility that stimulus differences in degree of movement confound interpretation of these results.

By demonstrating no significant acquisition of flower fear in the FL+ group, the results of this experiment do not support the hypothesis that the failure to observe significant acquisition of flower fear in the FL+/SN− group of the M. Cook and Mineka (1989) experiment resulted from the complexity of that experiment's videotape. Nor do the results support the hypothesis that any long-delay conditioning that may have occurred to the snake stimuli in the FL+/SN− group of that experiment reduced the possibility of finding excitatory conditioning to the flower stimuli. In the present experiment, only two kinds of trials were presented to the FL+ observers (FL+ trials and N− trials). Nevertheless, these observers still failed to show significant acquisition of flower fear. Indeed, if there exists a trend across experiments (i.e., the present experiment and Experiment 2 of M. Cook & Mineka, 1989), it is in the direction of superior learning with the more complex videotapes, even though the videotapes in the two studies were identical in the amount of exposure to excitatory trials (FL+ or SN+). In particular, mean snake fear in the SN+/FL− group of the other experiment was slightly higher than mean snake fear in the SN+ group of the present experiment.

Given this slight indication of superior learning using the more complex videotapes (SN+/FL− and FL+/SN−), it was decided to use a comparable videotape in Experiment 2, which tests the generality of the snake and flower results by using different fear-relevant and fear-irrelevant stimuli (a toy crocodile and a toy rabbit, respectively). An additional advantage to the use of the more complex videotape is that it controls for

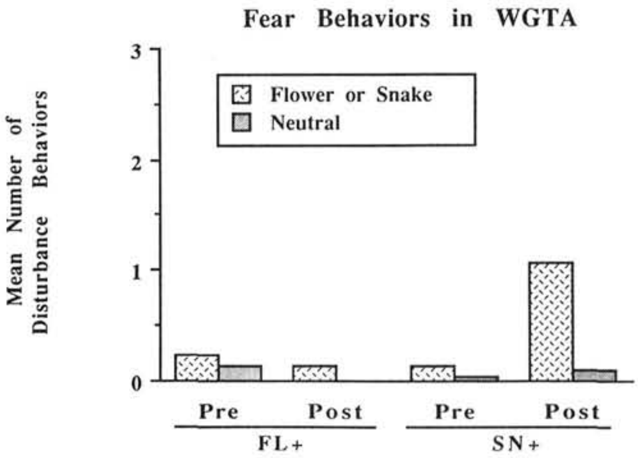

Figure 2. Mean number of disturbance behaviors exhibited in the Wisconsin General Test Apparatus in the presence of the excitatory stimulus (toy snakes or flowers) and the neutral object for the SN+ and FL+ observers of Experiment 1 at pretest and posttest.

possible nonassociative sensitization effects. That is, with this paradigm, both groups are exposed to both kinds of CSs and to the same fear performance of the models (which we have traditionally viewed as a US because of the disturbance it elicits in the observers; Mineka, 1987). The groups differ only in which CS is paired with the US (fear performance). Therefore, if selective sensitization is responsible for the elicitation of fear by the fear-relevant stimulus in subjects for which that CS was explicitly paired with the US, then one would also expect the fear-relevant stimulus to elicit the same degree of fear in the other group, even though that stimulus is explicitly unpaired with the US. Alternatively, if the superior conditioning that occurs to the fear-relevant stimulus is truly an associative effect, then one would expect to see such conditioning only in the group that sees the fear-relevant stimulus paired with fear (see LoLordo, 1979; LoLordo & Droungas, 1989).

As mentioned in the introduction, our selection of a toy crocodile as an alternate fear-relevant stimulus was determined in part by a pilot study that determined that live and toy lizards and a toy crocodile were strongly feared by wild-reared model monkeys, but not by their laboratory-reared counterparts (see Mineka et al., 1980, for comparable results on snake fear). By contrast, neither wild-reared nor laboratory-reared monkeys exhibited a fear of toy rabbits. In addition, it seemed to us that the logic and procedures used by other investigators in rating the preparedness of different objects of human fears and phobias (De Silva, Rachman, & Seligman, 1977; Zafiropoulou & McPherson, 1986) would lead one to categorize crocodiles as prepared or fear-relevant stimuli for human and nonhuman primates (and to categorize rabbits as unprepared or fear-irrelevant stimuli for human and nonhuman primates). Finally, Öhman (1986) has argued that reptiles are a prototypical fear-relevant stimulus for mammals because of the struggle of early mammalian species with the then-dominant reptile class.

Experiment 2

Method

Observers and Models

Observers were 20 laboratory-reared rhesus monkeys (9 male and 11 female), ranging in age from 4 to 17 years. The videotaped models were the same models used in Experiment 1. All monkeys were living at the Harlow Primate Laboratory at the time of the experiment.

Stimuli and Apparatus

Testing took place in the WGTA used in Experiment 1. The following stimuli were presented to observers in the WGTA (in the Plexiglas box and on videotape): (a) a green, white, and red, rubber toy crocodile (approximately 50 cm long × 6 cm high × 13 cm wide); (b) a light-brown and white toy rabbit with artificial fur (approximately 30 cm long × 14 cm high × 18 cm wide), and (c) the neutral objects used in Experiment 1.

Videotapes

As in Experiment 1, four videotapes were used during the course of the experiment, two showing the wild-born model and two showing the laboratory-born model. Two tapes (one depicting the wild-born model and one depicting the laboratory-born model) showed a model reacting fearfully to the toy crocodile stimulus on C+ trials and nonfearfully to the toy rabbit stimulus on R− trials. These tapes were designated the C+/R− tapes. The remaining two tapes (again, one depicting the wild-born model and one depicting the laboratory-born model) showed a model reacting fearfully to the rabbit stimulus on R+ trials and nonfearfully to the crocodile stimulus on C− trials. These tapes were designated the R+/C− tapes. All four tapes additionally depicted a model reacting nonfearfully to neutral stimuli (N− trials). As in Experiment 1, fear was manifested by the models' reacting to stimuli and food treats in a WGTA setting.

Each tape comprised 32 trials. In 20 of the trials, the model reacted nonfearfully to the neutral objects, as in the tapes for Experiment 1 (these trials were all approximately 5 s in duration). The two R+/C− tapes also contained 6 R+ trials, in which the model apparently evinced extreme fear of the toy rabbit for 60 s, and 6 C− trials, in which the model apparently reacted calmly in the presence of the toy crocodile for 60 s. In addition to the 20 neutral-object trials, the two C+/R− tapes contained 6 C+ trials, in which the model showed a high level of fear in the presence of the toy crocodile, and 6 R− trials, in which the model reacted calmly in the presence of the toy rabbit. For each tape, trial order was as follows: 4 neutral-object trials were followed by the 6 crocodile and 6 rabbit trials. Crocodile and rabbit trials alternated with one another and were separated from one another by further neutral-object trials. Following the last nonneutral stimulus presentation, 5 final neutral-object trials ensued, for a total of 32 trials. As in Experiment 1, an ITI consisted of a 4-s period of "video black."

As for Experiment 1, because of the editing techniques used, the different tapes were identical in the behavior exhibited by a given model; they differed only in the stimulus to which the model appeared to react with fearful or nonfearful behavior. The original fearful model performances were obtained by videotaping models reacting to the live snake and a very large toy snake. During the editing process, the images of the snakes were replaced with images of either the toy crocodile or toy rabbit. Snakes were used for the original videotapes because the large toy snake and a live snake were known to be highly reliable elicitors of extreme fear in the models; the toy crocodile stimulus, perhaps because it is smaller than either the live snake or the very large toy snake, was a less reliable elicitor of the very high levels of fear that were desirable for the videotape. However, it should be noted that qualitatively similar fear behaviors are elicited by both snake and crocodile stimuli. The original nonfearful model performances for the R− and C− trials were obtained by videotaping models reaching over an empty Plexiglas box for food treats. During the editing process, the empty box was replaced with a box containing the appropriate toy crocodile or toy rabbit. The 5-s trials with the neutral object did not need to be edited.

The images of the crocodile and rabbit stimuli, as they appeared on the videotapes, were not quite as similar to one another in size as were the snake and flower stimuli of Experiment 1, because of the very different shapes of these two toy animals. The image of the toy crocodile was approximately 22 cm long × 3 cm high, whereas the image of the toy rabbit was approximately 17 cm long × 7 cm high. Images of the model monkeys, neutral objects, and the food treats were the same as described for Experiment 1.

Procedure

WGTA adaptation and pretest. Adaptation procedures were identical to those for Experiment 1. The WGTA pretest procedures were also similar to those described for Experiment 1, except for the stimuli used. In addition to neutral objects, the toy crocodile and toy rabbit stimuli were presented. Presentation order of stimuli was as follows: Two neutral-object trials preceded the presentation of the two nonneutral stimuli. The nonneutral stimulus trials were separated from one another by a further neutral-object presentation. This sequence of 5 trials was then repeated so that each nonneutral stimulus was presented twice, for a total of 10 trials.

Observational conditioning. Following WGTA adaptation and pretesting, observers were assigned to one of two conditions, C+/R− and R+/C−. As in Experiment 1, observers underwent 12 observational conditioning sessions over a 3–4 week period. During each session, they watched either the two C+/R− or the two R+/C− videotapes, depending on group assignment. Each tape was approximately 18.5 min in duration.

WGTA posttests. Following the fourth observational conditioning session, observers were given a posttest in the WGTA. This posttest was procedurally identical to the WGTA pretest. This cycle of 4 observational conditioning sessions followed by a WGTA posttest was repeated two more times, so that observers received a total of 12 conditioning sessions and three WGTA posttests.

Data Analysis

Five investigators scored fear behaviors over the course of the experiment. Interrater agreement was assessed during 13 WGTA posttests. Interrater agreement was 86%; that is, 83 of the 96 behaviors recorded over the 130 trials were noted by both raters. If the instances for which the raters agreed that no fear behaviors occurred were included in the assessment, agreement would exceed 99%.

For each experimental session (pretest and posttest), a single score for each dependent measure for each stimulus category (neutral, crocodile, and rabbit) was derived in a manner analogous to that followed in Experiment 1. The maximum attainable latency score per trial was 60 s; the maximum attainable disturbance behavior score per trial was 36.

Following the general strategy outlined for Experiment 1, in Experiment 2, we used three sets of planned comparisons to test hypotheses concerning the effects of observational conditioning. However, because of the differences in design, the specific contrasts differed from those used in Experiment 1. The first two sets, one for each group, included four within-group contrasts: (a) CS+ at pretest versus CS− at pretest, (b) CS+ at average posttest versus CS− at average posttest, (c) CS+ at pretest versus CS+ at average posttest, and (d) CS− at pretest versus CS− at average posttest.[5] A third set consisted of two between-group contrasts: comparing the two groups for their responses to (a) CS+ at pretest and (b) CS+ at average posttest. Thus, comparisons in the first two sets were evaluated at $\alpha = .05/4 = .0125$. Comparisons in the third set were evaluated at $\alpha = .05/2 = .025$. As in Experiment 1, experimentwise alpha associated with each dependent measure was equivalent to what would have been yielded had we conducted three planned comparisons, each evaluated at $\alpha = .05$. All planned comparisons were two-tailed.

The foregoing comparisons did not involve the neutral stimulus, because it was thought that contrasts involving the neutral objects would be somewhat redundant, given that two CS−s were presented to each group: the toy rabbit or toy crocodile, and the neutral objects. The neutral object appeared to be the less appropriate of the two CS−s to use in the planned comparisons, for two reasons: First, stimulus presentation parameters during conditioning (trial duration, number of trials, etc.) for the neutral trials differed substantially from those for the other two stimuli. Second, subjects had extensive prior exposure during adaptation to the neutral objects (but not to the toy rabbit or crocodile).

Departures from sphericity can strongly bias the results of repeated measures ANOVAS as well as the results of planned and post hoc comparisons involving repeated measures (Rogan, Keselman, & Mendoza, 1979; Vasey & Thayer, 1987). Thus, for those instances where sphericity assumptions were violated, *F* values are reported with the conservative degrees of freedom recommended by Greenhouse and Geisser (1959). In addition, the planned comparisons involving repeated measures were calculated using separate comparison-specific error terms (Boik, 1981; Maxwell, 1980).

Results

In overview, observational conditioning resulted in the C+/R− group's acquiring a fear of the toy crocodile, but not of the toy rabbit. In contrast, the R+/C− group did not show fear of either the toy crocodile or the toy rabbit following exposure to the videotapes.

Observational Conditioning

Our incidental observations of the observers during observational conditioning confirmed those made in Experiment 1. That is, observers reacted to the stimuli appearing on the videotapes as if they were real and, in particular, seemed disturbed by the models' fear performance.

WGTA

Figure 3 depicts the mean latencies for the two groups at pretest and posttest. Observer latency scores were analyzed by a 2 × 2 × 3 (Groups [R+/C− vs. C+/R−] × Tests [pretest vs. average posttest] × Stimulus Objects [CS+, CS−, N−]) mixed-design ANOVA. The analysis revealed a significant main effect for objects, $F(2, 36) = 12.50$; significant Groups × Tests, Tests × Objects, and Objects × Groups two-way interactions, $Fs(1, 18) = 12.51$ and 5.18, and $F(2, 36) = 9.02$, respectively; and a significant Groups × Tests × Objects triple interaction, $F(1, 18) = 11.95$.

The planned comparisons indicated that during the pretest, observers in both groups responded to the two stimuli (crocodile and rabbit) with relatively short, approximately equal latencies. However, at posttest, C+/R− observers exhibited significantly longer latencies to the toy crocodile than to the toy rabbit. By contrast, the R+/C− observers continued to respond with short, equivalent latencies in the presence of the crocodile and rabbit. In the pretest-to-posttest changes in response to the stimuli, the C+/R− observers showed a significant increase in latency to the crocodile, but not to the rabbit, whereas latencies for the R+/C− observers did not increase at posttest for either stimulus. Between-group comparisons revealed that the two groups did not differ from one another at pretest in their response to the CS+. However, at posttest, response latencies of the C+/R− observers to the crocodile were significantly longer than were the posttest latencies of the R+/C− observers to the rabbit.

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[5] For the C+/R− group, the crocodile was the CS+ and the rabbit was the CS−; for the R+/C− group, the rabbit was the CS+ and the crocodile was the CS−.

Planned comparisons examined average rather than individual posttest scores because previous experiments had shown that fear was typically asymptotic at the first posttest and did not change over subsequent posttests (e.g., M. Cook et al., 1985; Mineka et al., 1984; Mineka & M. Cook, 1986). Mixed-design ANOVAS showed this to also be true in this experiment for both the latency and disturbance behavior measures. The details of these analyses are not presented here, but can be found in M. Cook, 1988.

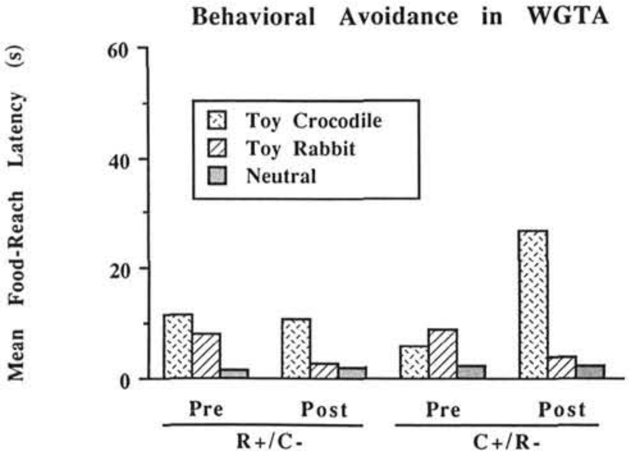

Figure 3. Mean food-reach latency (in s) in the Wisconsin General Test Apparatus in the presence of three stimulus objects (toy crocodile, toy rabbit, and neutral object) for the C+/R− and R+/C− observers of Experiment 2 at pretest and posttest.

Figure 4 depicts the mean number of disturbance behaviors for the two groups at pretest and posttest. A 2 × 2 × 3 (Groups × Tests × Stimulus Objects) mixed-design ANOVA for observer disturbance behavior (analogous to the 2 × 2 × 3 ANOVA for latency) resulted in a significant main effect for objects, $F(2, 36) = 7.19$; significant Groups × Tests, Groups × Objects, and Tests × Objects two-way interactions, $F(1, 18) = 7.95$, and $Fs(2, 36) = 8.35$ and 8.53, respectively; and a significant Groups × Tests × Objects triple interaction, $F(1, 18) = 7.62$.

The pattern of results yielded by the planned comparisons was very similar to that found for the latency dependent measure. During the pretest, observers in both groups responded to both of the stimuli (crocodile and rabbit) with little disturbance. At posttest, the C+/R− observers exhibited significantly more disturbance to the toy crocodile than to the toy rabbit. By contrast, the R+/C− observers continued to exhibit little distress at posttest in the presence of either the crocodile or rabbit. In the pretest-to-posttest changes in response to the stimuli, the C+/R− observers showed a nearly significant increase in distress to the crocodile ($p = .0126$), but not to the rabbit. Disturbance levels to the crocodile for the R+/C− observers did not change from pretest to posttest. Somewhat unexpectedly, the distress level of the R+/C− observers did significantly change from pretest to posttest for the rabbit, but this significant difference represented a decrease in disturbance at posttest rather than an increase. Finally, between-group comparisons revealed that the two groups did not differ from one another at pretest in their response to the CS+. However, at posttest, the C+/R− group showed significantly more disturbance to their CS+ (the crocodile) than did the R+/C− group to their CS+ (the rabbit).

General Discussion

The results of the present experiments, in conjunction with those of M. Cook and Mineka (1989), have several important theoretical and practical implications. First, they provide perhaps the first empirical documentation of fear-relevance/preparedness effects in the conditioning of strong or intense fears, as indexed by both behavioral avoidance and behavioral distress. All the other empirical literature bearing directly on the preparedness theory of phobias has involved the conditioning of autonomic responses. In addition, the elicitation and maintenance of those conditioned autonomic responses beyond a single laboratory session has never been measured (or at least has never been reported). In our previous work, we have repeatedly shown excellent retention of observationally acquired snake fear over a 3-month follow-up interval when live or videotaped models were used during acquisition (e.g., M. Cook & Mineka, 1989; M. Cook et al., 1985; Mineka & M. Cook, 1986; Mineka et al., 1984). In the present experiments using videotaped models, the final posttest followed the acquisition phase by only 2–5 days because, unfortunately, it was not practical to perform 3-month follow-up tests as in previous experiments. Nevertheless, at least the present demonstrations of differential conditioning of fear to fear-relevant objects were maintained beyond a single laboratory session.

A second important implication of the results of the present studies concerns their relevance to theories that argue that such behavioral elaborations with respect to fear-relevant stimuli are the result of natural selection (or, alternatively stated, that such behavioral elaborations derive from phylogenetic rather than ontogenetic/experiential factors; see Delprato, 1980; Johnston, 1981, for discussions of this issue). Such issues are, in principle, impossible to disentangle in a definitive fashion using adolescent or adult human subjects in Western society, who all have prior associations to at least some exemplars of the categories of stimuli used as CSs. By contrast, the laboratory-reared monkeys used as observers in Experiments 1 and 2 of this article, and Experiment 2 of M. Cook and Mineka, 1989, had no prior experience with snakes, flowers, crocodiles, or rabbits. Thus, it seems highly likely that the differences seen here in the associability of toy snakes and crocodiles, versus artificial flowers and toy rabbits, derive from phylogenetic rather than ontogenetic

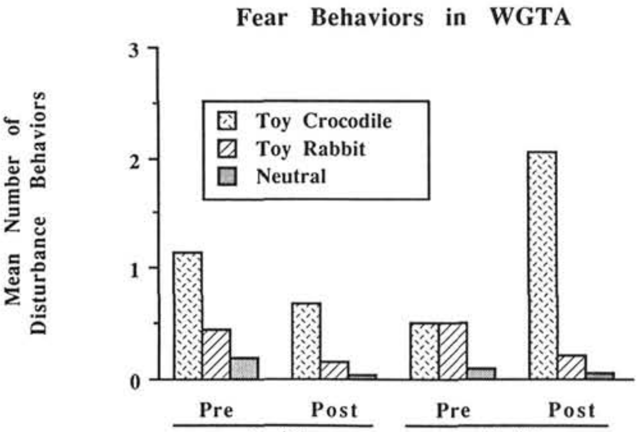

Figure 4. Mean number of disturbance behaviors exhibited in the Wisconsin General Test Apparatus in the presence of three stimulus objects (toy crocodile, toy rabbit, and neutral object) for the C+/R− and R+/C− observers of Experiment 2 at pretest and posttest.

factors (however, see M. Cook & Mineka, 1989, for discussion of the need for more stringent tests of this conclusion).

As discussed at length by M. Cook and Mineka (1989), the argument that phylogenetic factors are strongly implicated in mediating the selective associations involving snakes or crocodiles with fear rests on the assumption that predatory relationships exist (or did exist in the past) between these species and primates. For snakes and monkeys, few data exist to directly support this assumption; however, it is not an unreasonable one given that the habitat in which rhesus monkeys evolved (India) contains a large number of poisonous snakes, such as cobras. Stronger support for this argument could come from comparative research examining whether primate species that evolved in environments free of predatory snakes (where selective pressures would thus be absent) do not show selective associations of snakes with fear. There is even less evidence directly supporting the assumption of a predatory relationship between crocodiles and rhesus monkeys (see Anderson, 1986; Cheney & Wrangham, 1987, for recent reviews on the hypothesized effects of predation on the evolution of primate behavior).

Although direct support is weak for the assumption of a predatory relationship between crocodiles and monkeys, there is some indirect support. Indeed, the very fact that wild-born rhesus monkeys, observed either in the wild or in the laboratory, exhibit a fear of snakes is consistent with the fact that snakes are potential predators (Mineka et al., 1980; see Mineka & M. Cook, 1988, for a review). Similarly, as noted earlier, a pilot study conducted in our laboratory showed that wild-reared rhesus monkeys exhibited a fear of small lizards and of the toy crocodile used in Experiment 2. Unfortunately, it is unclear whether this fear reflects behavior evolved specifically in response to predation pressure by lizardlike species, or instead represents the generalization of fear from snakes to physically similar species. However, in either case, these results are consistent with Öhman's (1986) argument that animals of the reptilian order may be a prototype of a fear-relevant stimulus for mammals. Further tests of this general hypothesis might involve testing the fear-relevance status of species of reptiles, such as turtles, that would definitely not be expected to have had a predatory relationship with monkeys.

In spite of the implications concerning the operation of natural selection in accounting for the present results, important questions remain as to what differentiates fear-relevant from fear-irrelevant stimuli. For example, how does the human or nonhuman primate "know" or "recognize" whether the stimulus or situation encountered as a signal for danger or threat is fear-relevant or fear-irrelevant, in the absence of any prior experience with that stimulus? One possibility is that primates are endowed with complete hard-wired memory representations of prototypes for fear-relevant stimuli. An alternative is that phobic objects may share certain perceptual characteristics in common. In support of the latter alternative, Bennett-Levy and Marteau (1984) reported high correlations between levels of fear elicited by various animals and certain perceived characteristics of those animals (such as "ugliness, sliminess, speediness, and suddenness of movement"; p. 40). In a somewhat better controlled and more elaborate study, Merckelbach, van den Hout, and van der Molen (1987) also found significant correlations between self-reported fear and certain perceived characteristics of animals. These characteristics included ratings of how strange or odd the animals were on visual, auditory, and olfactory dimensions, and ratings of perceived controllability and predictability (the latter correlated negatively with fear). Given these results, the authors suggest that preparedness may be mediated by certain "perceived characteristics" or "salient qualities" of dangerous animals (Merckelbach et al., 1987, p. 1208) rather than by any complete representations of animals that were dangerous to our early evolutionary ancestors.

Unfortunately, the results of the present studies are not so clearly supportive of the perceived characteristics alternative. As detailed in the *Method* sections, the fear-relevant and fear-irrelevant CSs used in the present experiments were all videotaped, artificial, inanimate stimuli. Therefore, these stimuli did not have characteristics such as sliminess, peculiar odors, unusual sounds, speediness, suddenness of movement, and unpredictability. Furthermore, the laboratory-reared monkeys had no prior experiences with the live counterparts of those stimuli (snakes, crocodiles, flowers, and rabbits). Given the lack of a conditioning history (or some sort of experiential process) involving the perceived characteristics, it is difficult to conceive how such perceived characteristics in the artificial stimuli could affect subject behavior (see Bandura, in press, for further discussion of this issue).

Bennett-Levy and Marteau (1984) also raised the possibility that stimuli that are fear-relevant for people may differ from fear-irrelevant stimuli primarily in the degree to which they represent severe departures from the human form. Although snakes and crocodiles (as well as spiders) do indeed differ from humans more than do rabbits on this dimension, it is not at all clear how this explains the relatively common incidence of fear of rats (which do not differ that much from rabbits) or the relatively uncommon occurrence of fear of insects such as ladybugs (which do not differ that much from spiders or other insects, such as cockroaches, that are commonly feared). In sum, the results of the present experiments offer no obvious clues as to what the important perceived characteristics of fear-relevant objects might be. However, it should still be noted that the present results also do not offer clear support for the alternative hypothesis that primates have complete memory representations of the prototypes for fear-relevant stimuli. Rather than being taken as providing clear support for this alternative, the present results should probably simply be considered as problematic for the perceived characteristics alternative.

A third point of interest raised by the results of the present two experiments follows from the observation that in both experiments (as well as in Experiment 2 of M. Cook & Mineka, 1989) the differences in observational conditioning to fear-relevant and fear-irrelevant stimuli were found in acquisition rather than in extinction. (Indeed, possible extinction differences could not be studied because of the failure of acquisition of significant fear to the fear-irrelevant stimuli!) As mentioned in the introduction, some authors have argued that the failure to find significant differences in acquisition between conditioning to fear-relevant and fear-irrelevant stimuli is problematic for the preparedness theory of phobias (e.g., McNally, 1987). It has been our view that such criticisms, which are based solely on results from the human autonomic conditioning literature, are short-sighted in view of the extremely rapid acquisition of conditioned electrodermal responses to both fear-relevant and fear-irrelevant stimuli (cf. Mineka, 1985). Indeed, the present results provide empirical documentation of the occurrence of fear-relevance/preparedness effects during acquisition.

Finally, on a more practical note, the results of the present experiments document the observational conditioning of fear using videotaped rather than live models. The effects of the mass media on the acquisition of aggressive tendencies and specific aggressive behaviors in humans were first documented by Bandura and his colleagues in the 1960s (e.g., Bandura, 1965, 1969, in press). They found that children who watched a film of an adult model showing novel physical and verbal aggressive responses towards a Bobo doll later showed similar aggressive behaviors themselves toward the Bobo doll. It was shown that when an attractive incentive was introduced, the child learned the aggressive behaviors even when the model had been punished for displaying them; that is, when the child was given an incentive for behaving aggressively, the model's history of reward or punishment was irrelevant. Anecdotal observations have also been made in humans about the acquisition of new sources or objects of fear from movies or television. However, the present series of studies provides the first strong empirical documentation, using a primate model, that observational learning of phobic fears through the mass media (at least to fear-relevant stimuli) may indeed occur (see also Bandura, in press).

References

Anderson, C. (1986). Predation and primate evolution. *Primates, 27,* 15–39.

Bandura, A. (1965). Vicarious processes: A case of no-trial learning. In L. Berkowitz (Ed.), *Advances in Social Psychology* (Vol. 2, pp. 1–55). New York: Academic Press.

Bandura, A. (1969). *Principles of behavior modification.* New York: Holt, Rinehart, and Winston.

Bandura, A. (in press). Social cognitive theory and social referencing. In S. Feinman (Ed.), *Social referencing and social construction of reality.* New York: Plenum Press.

Bennett-Levy, J., & Marteau, T. (1984). Fear of animals: What is prepared? *British Journal of Psychology, 75,* 37–42.

Boik, R. (1981). A priori tests in repeated measures designs: Effects of nonsphericity. *Psychometrika, 46,* 241–255.

Cheney, D., & Wrangham, R. (1987). Predation. In B. Smuts, D. Cheney, R. Seyfarth, R. Wrangham, & T. Struhsaker (Eds.), *Primate societies* (pp. 227–239). Chicago: University of Chicago Press.

Cook, E., Hodes, R., & Lang, P. (1986). Preparedness and phobia: Effects of stimulus content on human visceral conditioning. *Journal of Abnormal Psychology, 95,* 195–207.

Cook, M. (1988). *Observational conditioning of fear to fear-relevant versus fear-irrelevant stimuli in rhesus monkeys.* Unpublished doctoral dissertation, University of Wisconsin–Madison.

Cook, M., & Mineka, S. (1987). Second-order conditioning and overshadowing in the observational conditioning of fear in monkeys. *Behaviour Research and Therapy, 25,* 349–364.

Cook, M., & Mineka, S. (1989). *Selective associations in the observational conditioning of fear in rhesus monkeys.* Manuscript submitted for publication.

Cook, M., Mineka, S., Wolkenstein, B., & Laitsch, K. (1985). Observational conditioning of snake fear in unrelated rhesus monkeys. *Journal of Abnormal Psychology, 94,* 591–610.

De Silva, P., Rachman, S., & Seligman, M. (1977). Prepared phobias and obsessions: Therapeutic outcome. *Behaviour Research and Therapy, 15,* 65–77.

Delprato, D. (1980). Hereditary determinants of fears and phobias. *Behavior Therapy, 11,* 79–103.

Dunn, O. (1961). Multiple comparisons among means. *Journal of the American Statistical Association, 56,* 52–64.

Greenhouse, S., & Geisser, S. (1959). On methods in the analysis of profile data. *Psychometrika, 24,* 95–112.

Harlow, H. (1949). The formation of learning sets. *Psychological Review, 56,* 51–65.

Johnston, T. (1981). Contrasting approaches to a theory of learning. *Behavioral and Brain Sciences, 4,* 125–173.

Lang, P. (1968). Fear reduction and fear behavior: Problems in treating a construct. In J. Shlein (Ed.), *Research in psychotherapy* (Vol. 3, pp. 90–102). Washington, DC: American Psychological Association.

Lang, P. (1971). The application of psychophysiological methods to the study of psychotherapy and behavior modification. In A. Bergin & S. Garfield (Eds.), *Handbook of psychotherapy and behavior change: An empirical analysis* (pp. 75–125). New York: Wiley.

LoLordo, V. (1979). Selective associations. In A. Dickinson & R. Boakes (Eds.), *Mechanisms of learning and motivation: A memorial to Jerzy Konorski* (pp. 367–398). Hillsdale, NJ: Erlbaum.

LoLordo, V., & Droungas, A. (1989). Selective associations and adaptive specializations: Food aversion and phobias. In S. Klein & R. Mowrer (Eds.), *Contemporary learning theories: Instrumental conditioning theory and the impact of biological constraints on learning* (pp. 145–179). Hillsdale, NJ: Erlbaum.

Marks, I. (1969). *Fears and phobias.* New York: Academic Press.

Marks, I. (1987). *Fears, phobias, and rituals: Panic, anxiety, and their disorders.* New York: Oxford University Press.

Maxwell, S. (1980). Pairwise multiple comparisons in repeated measures designs. *Journal of Educational Statistics, 5,* 269–287.

McNally, R. (1987). Preparedness and phobias: A review. *Psychological Bulletin, 101,* 283–303.

Merckelbach, H., van den Hout, M., & van der Molen, G. (1987). Fear of animals: Correlations between fear ratings and perceived characteristics. *Psychological Reports, 60,* 1203–1209.

Mineka, S. (1985). Animal models of anxiety-based disorders: Their usefulness and limitations. In A. Tuma & J. Maser (Eds.), *Anxiety and the anxiety disorders* (pp. 199–244). Hillsdale, NJ: Erlbaum.

Mineka, S. (1987). A primate model of phobic fears. In H. Eysenck & I. Martin (Eds.), *Theoretical foundations of behavior therapy* (pp. 81–111). New York: Plenum Press.

Mineka, S., & Cook, M. (1986). Immunization against the observational conditioning of snake fear in rhesus monkeys. *Journal of Abnormal Psychology, 95,* 307–318.

Mineka, S., & Cook, M. (1988). Social learning and the acquisition of snake fear in monkeys. In T. Zentall & B. Galef (Eds.), *Social learning: Psychological and biological perspectives* (pp. 51–73). Hillsdale, NJ: Erlbaum.

Mineka, S., Davidson, M., Cook, M., & Keir, R. (1984). Observational conditioning of snake fear in rhesus monkeys. *Journal of Abnormal Psychology, 93,* 355–372.

Mineka, S., & Keir, R. (1983). The effects of flooding on reducing snake fear in rhesus monkeys: 6-month follow-up and further flooding. *Behaviour Research and Therapy, 21,* 527–535.

Mineka, S., Keir, R., & Price, V. (1980). Fear of snakes in wild- and lab-reared rhesus monkeys. *Animal Learning and Behavior, 8,* 653–663.

Öhman, A. (1986). Face the beast and fear the face: Animal and social fears as prototypes for evolutionary analyses of emotion. *Psychophysiology, 23,* 123–145.

Öhman, A., Dimberg, U., & Öst, L.-G. (1985). Biological constraints on the learned fear response. In S. Reiss & R. Bootzin (Eds.), *Theoretical issues in behavior therapy* (pp. 123–175). New York: Academic Press.

Öhman, A., Eriksson, A., & Olofsson, C. (1975). One-trial learning and superior resistance to extinction of autonomic responses conditioned to potentially phobic stimuli. *Journal of Comparative and Physiological Psychology, 88,* 619–627.

Öhman, A., Fredrikson, M., Hugdahl, K., & Rimmö, P.-A. (1976). The premise of equipotentiality in human classical conditioning: Conditioned electrodermal responses to potentially phobic stimuli. *Journal of Experimental Psychology: General, 105,* 313–337.

Rogan, J., Keselman, H., & Mendoza, J. (1979). Analysis of repeated measurements. *British Journal of Mathematical and Statistical Psychology, 32,* 269–286.

Sackett, G. (1970). Unlearned responses, differential rearing experiences, and the development of social attachments by rhesus monkeys. In L. Rosenblum (Ed.), *Primate behavior: Development in field and laboratory research* (Vol. 1, pp. 112–140). New York: Academic Press.

Seligman, M. (1971). Phobias and preparedness. *Behavior Therapy, 2,* 307–320.

Vasey, M., & Thayer, J. (1987). The continuing problem of false positives in repeated measures ANOVA in psychophysiology: A multivariate solution. *Psychophysiology, 24,* 479–486.

Zafiropoulou, M., & McPherson, F. (1986). "Preparedness" and the severity and outcome of clinical phobias. *Behaviour Research and Therapy, 24,* 221–222.

Received November 28, 1988
Revision received June 13, 1989
Accepted June 19, 1989 ■