

Observational Conditioning of Snake Fear in Rhesus Monkeys

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For years theorists have hypothesized on the basis of meagre evidence that observational conditioning is involved in the origins of many human and nonhuman primates' fears and phobias. The present experiments provide strong support for this hypothesis by demonstrating observational conditioning of snake fear in rhesus monkeys. Experiment 1 demonstrated the usefulness of a new index of snake fear in rhesus monkeys and, using this new measure, also demonstrated that young monkeys raised by parents who have a fear of snakes do not acquire this fear in the absence of any specific experience with snakes. In Experiment 2, however, five out of six adolescent/young-adult rhesus monkeys did acquire an intense and persistent fear of snakes as a result of observing their wild-reared parents behave fearfully in the presence of real, toy, and model snakes for a short period of time. The fear was not context specific and showed no significant signs of diminution at 3-month follow-up. Implications of the present results for current theories of the origins of human fears and phobias are discussed.

In recent years many theorists have proposed that vicarious classical conditioning probably accounts for the origins of a greater proportion of human fears and phobias than does direct classical conditioning (e.g., Bandura, 1969; Marks, 1969, 1977; Rachman, 1978). Thus they have argued that simply observing someone behave fearfully in the presence of a neutral stimulus may often be sufficient for the observer to acquire an intense fear of that stimulus. Given the importance that has been placed on the role of observational conditioning in the origins of fears and phobias, it is unfortunate that "the evidence in support of vicarious acquisition of fear in humans is indirect and largely anecdotal" (Rachman, 1978, p. 190). This is perhaps in part because of ethical constraints that limit study of the conditions that result in the induction of long-lasting and intense fears in human subjects.

Of the studies that have been conducted on vicarious fear conditioning in human sub-

jects, all appear to have been single-session laboratory experiments involving the conditioning of autonomic responses such as galvanic skin response and heart rate to neutral stimuli as a result of observational experiences (e.g., Bandura & Rosenthal, 1966; Berger, 1962; Brown, 1974; Craig and Lowery, 1969; Hygge, 1976; Kravetz, 1974). These studies clearly have extended our knowledge of factors that influence vicarious classical conditioning of autonomic responses. However, there are at least four major reasons why these studies are of limited usefulness in furthering understanding of the role that vicarious conditioning actually plays in the origins of real human fears and phobias. The first and most obvious limitation stems from the observation made above: They have all involved conditioning of autonomic components of fear, which are known to not always correlate highly with other components of fear (e.g., Hodgson & Rachman, 1974; Lang, 1968, 1971; Mineka, 1979). Therefore we do not know how well the other components of fear, which are prominent aspects of real human fears and phobias, can be conditioned observationally.

The second and third limitations stem from design problems of the experiments themselves. In none of these studies were the subjects ever tested for their fears in situations other than the one in which their fear had

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been acquired. Thus the context specificity of these fears acquired vicariously in the laboratory is unknown, although the naturally occurring fears that such studies are attempting to model and understand are clearly not context specific. (See Bouton & Bolles, 1979; Konorski, 1967; Rescorla & Wagner, 1972, for discussions of context effects.) The third limitation is that most of these studies have taken place in a single laboratory session and have not involved any follow-up to determine the persistence of the fears. In the few studies that have examined extinction of vicariously conditioned fears, extinction has been quite rapid even though many naturally occurring human fears, and certainly phobias, are notoriously resistant to extinction.

The fourth limitation of the studies conducted to date stems from the fact that all except one (Hygge & Öhman, 1978) of the studies employed highly arbitrary neutral stimuli as the conditioned stimulus (CS). Yet Marks (1969) and Selgman (1971), among others, have pointed out that the objects of people's fears and phobias usually do not come from a random arbitrary group of objects, such as electric outlets, stoves, hammers, bicycles, and so forth, even though such stimuli may frequently be associated with trauma and/or with parents' verbal instructions to avoid these objects. These observations, in combination with the work of Öhman and his colleagues in recent years (Öhman, Ericksson, & Olofsson, 1975; Öhman, Fredrikson, Hugdahl, & Rimino, 1976; Öhman, Fredrikson, & Hugdahl, 1978a, 1978b), suggest that there are qualitative and/or quantitative differences in the characteristics of conditioning to potentially phobic as opposed to nonphobic objects. Therefore more studies of vicarious conditioning should be conducted that use potentially phobic stimuli as CSs. (The study that has been done shares the first three limitations discussed above; Hygge & Öhman, 1978.)

Over the years a fruitful interchange has developed between animal researchers and human researchers interested in the origins of, and the cures for, fears and phobias. In particular, animal research has had a large impact on both theory and research on the topic of human fears and phobias (e.g., Ban-

dura, 1969; Baum, 1970; Eysenck & Rachman, 1965; Marks, 1969; Mineka, 1979, in press; Rachman, 1978; Riccio & Silvestri, 1973; Wolpe, 1958). It is therefore unfortunate that the paucity of evidence on vicarious conditioning of fear in humans is paralleled in the animal literature, where there are also only a handful of studies. Probably the two best studies are those of Stephenson (1967) and Crooks (1967, cited in Bandura, 1969), who both demonstrated vicarious conditioning of fear in rhesus monkeys. However, these studies share the four limitations discussed above for the human literature in that (a) they used only one measure of fear (behavioral avoidance), (b) they had no test for context specificity or for retention of the fear, and (c) they used arbitrary stimuli as CSs. The focus of the present research was to find more clear-cut and convincing evidence for the vicarious acquisition of an intense and long-lasting fear in rhesus monkey subjects and thereby to provide a more convincing animal model for the vicarious acquisition of phobic fears in humans.

Snakes were chosen as the potentially phobic stimuli for the present research because it has long been known that many adult primate species exhibit an intense fear of snakes. There has been a long-standing controversy over whether this fear is innate or spontaneous (e.g., Hebb, 1946; Masserman & Pechtel, 1953; Morris & Morris, 1965), as opposed to being based on some form of learning (e.g., Haselrud, 1938; Schiller, 1952; Yerkes & Yerkes, 1936). Probably the most convincing evidence to date that the fear must indeed be learned stems from the observations of Joslin, Fletcher, and Emlen (1964), who made the first systematic comparisons of the response of wild-reared and laboratory-reared rhesus monkeys to a live snake and other snakelike objects. They found that only the wild-reared monkeys consistently exhibited a strong fear of snakes, and they suggested that these monkeys had probably learned the fear when they were in the wild a number of years prior to the study. They also argued that it was unlikely that all of these monkeys had had a direct traumatic conditioning experience with snakes and therefore that observational conditioning

rather than direct conditioning was the more likely source of the fear. Some years later these results were replicated by Murray and King (1973) with squirrel monkeys, and by Mineka, Keir, and Price (1980) again with rhesus monkeys.

Mineka et al. (1980) also demonstrated that certain components of the fear are extraordinarily persistent even in the face of seven repeated flooding sessions designed to reduce the fear. In particular, although there were significant changes in behavioral avoidance of the snake (as measured by the latency to reach for food on the far side of the snake), there were no significant changes in the behavioral disturbance component of the fear, which is probably more akin to the autonomic and/or subjective components seen in humans. The same pattern of results occurred 6 months later when the monkeys were given a follow-up test and further flooding sessions (Mineka & Keir, 1983). This pattern of results is analogous to findings in the literature on flooding of human phobias (e.g., Hodgson & Rachman, 1974; Rachman, 1978) and therefore further substantiates the contention that these monkeys' fear of snakes has a phobic-like quality.

There is then good reason to suspect that wild-reared monkeys acquired their fear of snakes vicariously and that the fear shares a number of the characteristics of human phobias. However, as seen above, the evidence supporting the proposition that a fear this intense and persistent—in a monkey or in a human—could in fact be learned observationally is meagre at best. The present experiments were designed to test this proposition as directly as possible in a laboratory setting. In the first experiment, the usefulness of a new index for measuring fear of snakes that has not previously been used in this line of research was explored. It was important to have this new index both because the procedures most commonly used in the past are not always well suited for young monkeys like those being used here, and because it provided a different context in which to assess the context specificity of the fear. In the second experiment, the facility with which young monkeys acquire a fear of snakes by observing their wild-reared parents' fearful

behavior in the presence of both real and model snakes was examined. Several indices of fear were used, and the context specificity and retention of the fear were also examined.

Experiment 1

The primary purpose of this experiment was to devise a new test of snake fear and to examine its relation to other indices of snake fear used previously. This was necessary because of difficulties in adapting some of the young monkeys to be used in Experiment 2 to the Wisconsin General Test Apparatus (WGTA) that has been used in most studies in this area (e.g., Joslin et al., 1964; Mineka et al., 1980; Murray & King, 1973). A special problem in adapting young monkeys that were still living with parents and peers to this apparatus is that each test session constitutes a brief separation, which results in agitated behavior (cf. Mineka & Suomi, 1978, for a review) not conducive to rapid responding (reaching for food) in the WGTA. Because rapid responding is one primary index of lack of fear, it was necessary to devise an alternative way to test for avoidance of snakes in these monkeys. The Sackett Self-Selection Circus (Sackett, 1970), which is normally used to test social preferences, was adapted for this purpose by using fear stimuli rather than social stimuli. As will be seen, in using this new procedure the results with wild-reared monkeys essentially duplicate the results of fear testing in the WGTA, thus validating this as an index of fear.

A secondary purpose of the present experiment was to explore one alternative explanation suggested by Joslin et al. (1964) as to why laboratory-reared monkeys do not show a fear of snakes. They suggested that there was a slight possibility that the social environment of laboratory-reared monkeys has been sufficiently aberrant that such a fear does not develop, although it might develop spontaneously in a normal social environment. For example, perhaps some subtle developmental experience that can only be fostered by wild-born parents is necessary to produce a fear of snakes. To test this possibility a group of laboratory-reared monkeys living with their wild-born parents need to

be tested for their fear of snakes. Although the ideal test would be one in which all of the monkeys were living in a naturalistic outdoor environment that did not contain snakes, the closest approximation that can be made in a laboratory setting is to test monkeys that have been reared and are living in a Nuclear Family Unit (M. Harlow, 1971). In these living units, 4 wild-born adult male-female pairs live in adjacent cages with their laboratory-born offspring. Small openings from the cages allow the infant and adolescent/young-adult offspring (but not the full-grown adults) to enter a central cage where they have access to a variety of toys and can interact directly with the offspring of the other parents. This environment has consistently been shown to produce the most "normal" and socially sophisticated monkeys that exist at the Wisconsin Primate Laboratory (Suomi, 1974). Thus it seems to provide a good first test of the hypothesis that the laboratory-reared monkeys of the Joslin et al. (1964) and Mineka et al. (1980) studies do not show snake fear because of aberrations in their social development.

Method

Subjects

Subjects were 7 wild-reared and 9 laboratory-reared rhesus monkeys (*Macaca mulatta*) living in one Nuclear Family Unit at the University of Wisconsin Primate Laboratory. The wild-reared adults were living in pairs, each confined to a 1.3 m × 1.3 m × 2 m living cage. (One of the wild-reared females had a young infant at testing time, so she could not be used as a subject. Thus there were 7 wild-reared subjects instead of 8.) However, their laboratory-reared offspring had access not only to the cage of their parents, but also to a central 2.6 m × 1.3 m × 2 m play area and to the living cages of the other 3 adult male-female pairs in the unit. Thus the offspring had access to their biological parents and siblings, to peers, and to other adults of both sexes (See M. Harlow, 1971, for a more complete description.)

The 4 male and 3 female wild-reared monkeys ranged in estimated age from 19 to 28 years, with a mean of 22.7 years. They had all been imported from India at least 13 years prior to the study and had had at least 2 years experience in the wild prior to capture. Of the 9 laboratory-reared monkeys, there were 4 sexually mature young adults (two males and two females, all approximately 5-6 years old), 2 adolescent females (approximately 3-3½ years of age), and 3 infants (two males and one female, 8-10 months of age). At the time of the experiment each family consisted of one adult male-female pair living with 1-3 offspring, and one sexually mature 5-year-old young adult.

Apparatus

The following objects were used to determine each subject's reactions. (a) A young 2½-ft-long (75 cm) live boa constrictor (*Constrictor constrictor*), approximately 1.25 in (3.25 cm) in diameter; (b) a nonmoving, 20-in long (56 cm), sinuous lifelike model of a snake, approximately ½-in. (1.3 cm) in diameter and colored to imitate the appearance of a grass snake; (c) a 24-in-long (61 cm), sinuous, rubber, toy snake, approximately 1 in (2.6 cm) in diameter, which jiggled slightly when moved by the experimenter; (d) a 3-ft-long (91.5 cm), sinuous, black, rubber, electrical cord, approximately ⅜ in. (1 cm) in diameter; (e) a 3¾-ft-long (114 cm), sinuous, yellow plastic-covered electrical cord; and (f) four neutral objects—an unpainted square wood block, a red painted triangular block, a blue painted cross-shaped object, and a red painted round block. The first two neutral objects were used alternately in the WGTA, and all four were used in the Circus pretest.

Some of the testing was done in a Wisconsin General Test Apparatus. The WGTA consists of a cage for the subject, a movable cage blind, a movable gray tray used to present stimulus objects, and a one-way mirror behind which the experimenter sits (see H. Harlow, 1949, for a detailed description). The objects were all presented in one of two uncovered 53.4 cm × 21.3 cm × 15.2 cm Plexiglas boxes, each with a small Plexiglas ledge at the top of the back side (side away from the monkey) where a food reward could be placed. The Plexiglas box was placed on the movable gray tray.

The second testing apparatus was the Sackett Self-Selection Circus (Sackett, 1970), which consists of a hexagonal center cage, surrounded by six rhomboidal outer cages. The walls separating the center compartment from the six outer cages were formed by guillotine-type doors that could be hydraulically raised and lowered by cable. Only four of the six outer cages were used in the present experiment as stimulus chambers, and for each of these, both the outer walls and the guillotine-type doors adjacent to the center cage were Plexiglas. The side walls separating the six different outer cages from each other were made of ½ in plywood. A fifth outer cage was used as a start compartment, and its guillotine-type door was made of plywood, preventing visual access to the central compartment. (The sixth outer cage was not used, its central wall was wooden as well.) Light was provided by a horizontal fluorescent fixture attached just outside the outer Plexiglas wall of each outer cage. A video camera was mounted directly above the apparatus and was positioned in such a way that the entire apparatus was seen from above on a monitor in an adjacent room. An observer recorded the number of entries into and amount of time spent in each compartment.

Each of the four stimulus objects used in Circus testing (real, toy, and model snakes, and neutral unpainted wood object) were placed inside a transport cage made of wire and Plexiglas. The Plexiglas side of each transport cage faced the outer Plexiglas wall of one of the four outer cages, and so the stimuli were seen through two layers of Plexiglas. (The real snake was also placed inside a Plexiglas box before being placed in the transport and so was seen through three layers of Plexiglas.)

Procedure

Wisconsin General Test Apparatus Prior to the test day, each subject was adapted to the apparatus and procedure. Although some of the subjects (especially among the wild-reared adults) had had previous WGTA experience, they were all readapted to ensure that their performances would be comparable. The adaptation technique was similar to that used in the general adaptation procedure for the WGTA. A food reward (either a fruit loop, raisin, chocolate chip, or marshmallow, depending on individual preference) was placed on the ledge of the Plexiglas box. An adaptation object (one of three different, colored, wood blocks) was placed in the box. The moving tray with the Plexiglas box on it was advanced toward the subject, and then the blind was raised by a hydraulic mechanism, at which point an electric timer was started. The timer stopped when the subject touched the food reward. The subject was considered to be adapted when it reached for and touched the food reward within 10 s on 18 out of 20 trials. Most subjects required at least several days of adaptation before reaching criterion and some required many days, especially the subjects with no prior WGTA experience.

In the fear-testing session, the same procedure was followed except that different test stimuli (including the snake and snakelike objects) were used on each trial. In addition, although the timer was stopped when the subject touched the food reward, the trial continued until 60 s had elapsed. It should be noted that with this procedure the monkey was required to reach across the open box containing the test object in order to obtain the reward. The trial was terminated after 60 s even if the subject had not yet reached for the food.

There were 22 trials, which included 2 presentations of each of the five snakelike objects and 12 presentations of the neutral objects. The first two trials were always with two of the neutral wood objects (unpainted and red triangular blocks). The remaining five snakelike objects were presented in one of two randomly predetermined orders that differed in whether the real or the toy snake was presented first, (a) toy snake, yellow cord, model snake, black cord, and real snake, or (b) real snake, yellow cord, model snake, black cord, and toy snake. One of the two wood objects was always presented between each of the other objects, the two wood objects being used alternately. The stimuli were then repeated in the same order as first presented, starting with the two wood objects and then proceeding with a wood object between each of the other test stimuli.

The latency of the food-reaching response and the disturbance behaviors that occurred during the 60-s trial were observed and recorded. The disturbance behaviors were scored every 20 s using a 1-0 modified frequency system (Sackett, 1978). The occurrence of a particular disturbance behavior was given a score of 1 with no further recording of that behavior during that 20-s interval. There were 12 disturbance behaviors that had previously been shown to occur in this situation (cf. Mineka et al., 1980): cage clutch (holding onto the side or the back of the cage), cage shake (obvious moving or shaking of the cage), eye aversion (rapidly looking away from the stimulus), fear grimace (stretching the lips over the gums, thus exposing the teeth), spasm/tic (a vigorous shaking or jerking of the hands or upper body), threat (lips thrust

forward, ears retracted and flattened against the head), vocalization, fear withdraw (sudden retreat to the back of the cage), ear flap (ears flattened along the head but without the lips thrust forward as with the threat), lip smack (lips repeatedly moving up and down, chattering of teeth), piloerection (fur raised up on shoulders and torso), and stare (prolonged fixed gaze into the box from the back half of the cage). Because each behavior could be scored from 0 to 3 times in a given 60-s trial, the maximum composite emotionality score for any subject on any trial was 36.

An evaluation of the real snake's movement was made upon each presentation because it was not feasible to control for this variable. The rating system was based on a scale of increasing degree of movement from 0 to 3, with 0 indicating no movement at all and 3 indicating that the snake was on the verge of coming out of the Plexiglas box. The highest score received on any trial was 1 (slight movement), although the snake was completely free to move about.

The WGTA test was administered to all 7 wild-reared adults and to the four 5-year-olds as well. Adaptation proved to be extremely difficult for the 2 adolescents (they did not adapt in 20-30 sessions) and so was not even attempted for the 3 infants.

Sackett Self-Selection Circus On each Circus test all of the subjects first entered the center compartment of the apparatus from a transport cage. After the opaque outer wall of the side cage used as a start compartment had been put in place, they were allowed to enter the start compartment, with its four opaque walls, from the center compartment and were detained there for 5 min. During this time the four stimulus objects were all put in their appropriate positions outside the stimulus chambers. Five minutes after entry into the start compartment, the door to the center compartment was opened and simultaneously the four doors to the four outer cage stimulus compartments surrounding the center compartment were raised as well. When the monkey exited from the start compartment (almost always instantaneously), the wooden wall to it was lowered to prevent reentry. The monkey was then free to enter and reenter any of the four side compartments or to stay in the center compartment for the next 5 min, at which point the trial terminated.

Each subject was first adapted to the apparatus and procedure by conducting neutral object tests during which all four stimuli were the wooden blocks described in the Apparatus section. The purpose of the adaptation trials was to familiarize the animal with the apparatus and to check for compartment preference. Each subject received from 3 to 6 adaptation tests until they met a criterion on three consecutive sessions of *no preference*, which was defined as spending from 10% to 35% of the total entry time in each compartment. All of the subjects met this criterion, and in fact only 2 of the wild-reared subjects took more than three sessions to do so.

Each subject was given four 5-min fear tests with the three snake stimuli and the unpainted neutral object following the adaptation sessions. The four stimuli were each placed behind each compartment once. Number of entries and total entry time for each compartment were recorded. An animal was defined as having entered a compartment when its shoulders and head had passed the line dividing the central compartment and one of the

side compartments. All of the subjects were tested in the Circus within 4 weeks after their WGTA test. The three Circus adaptation tests occurred approximately 1 week prior to the four fear tests, which were conducted over a 10-day period with each test being separated by 2-3 days.

In all statistical analyses, the rejection level was set at $p < .05$; all significant effects are reported.

Results

Wisconsin General Test Apparatus

The WGTA tests of the 7 Nuclear Family wild-reared adults produced the typical pattern of results that was previously reported by Joslin et al. (1964) and Mineka et al. (1980). All 7 adults exhibited avoidance of the real and toy snakes by not responding at all within 60 s on either of the presentations of either stimulus. In addition, 4 failed to respond to the model snake, and the mean latency of the other 3 subjects was 43 s. By contrast, the 4 laboratory-reared subjects that were WGTA-trained, showed rapid responding in the presence of all of the stimuli. These results are illustrated in Figure 1.

To affirm that the differences in responding of the two groups to the different objects were statistically significant, a 2×6 (Groups \times Stimulus Objects) analysis of variance (ANOVA) was performed. The analysis revealed a highly significant main effect both for groups, $F(1, 9) = 12.48, p < .01$, and for stimulus objects, $F(5, 45) = 50.75, p < .001$. There was also a highly significant Groups \times Stimulus Objects interaction, $F(5, 45) = 19.91, p < .001$. Further analysis revealed that there was a significant simple main effect of stimulus object for the wild-reared group, $F(5, 30) = 247.83, p < .001$, but not for the laboratory-reared group, $F(5, 15) = 1.29$. Duncan's post hoc comparisons ($\alpha = .01$) revealed that the wild-reared group had longer latencies to the real, toy, and model snakes than to the yellow and black cords or the neutral object. In addition, the wild-reared subjects showed longer latencies than the laboratory-reared subjects with the real, toy, and model snakes, but not with the yellow and black cords or the neutral object (Duncan's, $\alpha = .01$). (For the remainder of the article the yellow and black cords are considered to be two of the three neutral objects

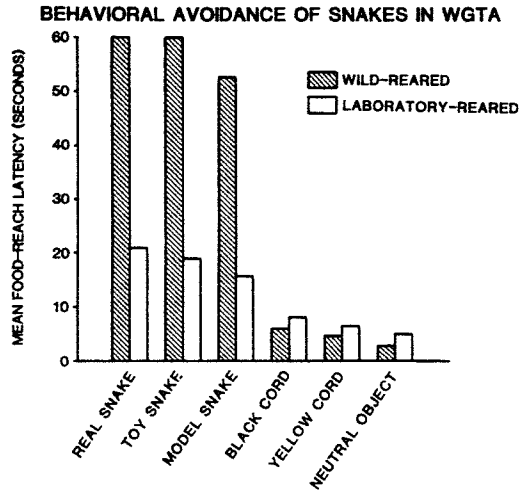


Figure 1 Mean latency to reach for the food in the Wisconsin General Test Apparatus in the presence of the six different objects for the 7 wild-reared and 4 laboratory-reared monkeys of Experiment 1

because their results are always identical to those with the other neutral object.)

To determine whether there were significant differences in emotionality or disturbance behaviors exhibited by the two groups to the different stimulus objects, another 2×6 (Groups \times Stimulus Objects) ANOVA was performed on disturbance behavior scores. The analysis revealed highly significant main effects both for groups, $F(1, 9) = 39.31, p < .001$, and for stimulus objects, $F(5, 45) = 38.30, p < .001$. In addition, there was a highly significant Groups \times Stimulus Objects interaction, $F(5, 45) = 26.64, p < .001$. Further analysis revealed that there was a significant simple main effect for stimulus object for the wild-reared group, $F(5, 30) = 70.62, p < .001$, but not for the laboratory-reared group, $F(5, 15) = 1.0$. Duncan's post hoc comparisons ($\alpha = .01$) revealed that the wild-reared group showed more disturbance behaviors in the presence of the real, toy, and model snakes than in the presence of the other three neutral objects, which did not differ from each other. In addition, the wild-reared subjects showed more disturbance behaviors than the laboratory-reared subjects in the presence of the real ($\alpha = .01$), toy ($\alpha = .01$), and model ($\alpha = .05$) snakes, but not in the presence of the other three neutral objects.

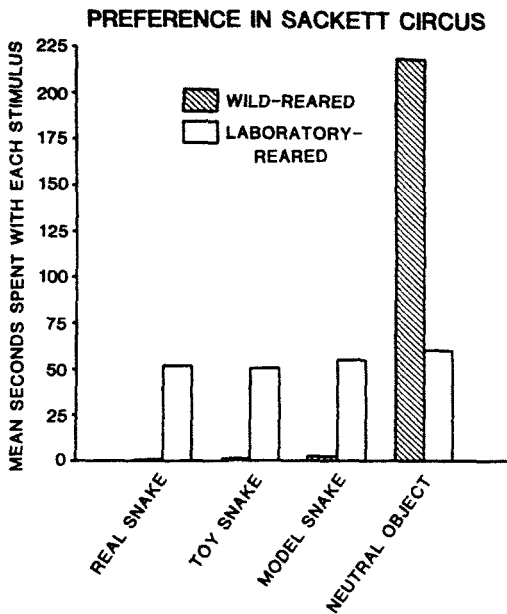


Figure 2 Mean amount of time spent with the four different objects in the Sackett Circus, averaged across four tests, for the 7 wild-reared and 9 laboratory-reared monkeys of Experiment 1

Sackett Circus Test

In the Sackett Circus all 7 wild-reared subjects showed almost complete avoidance of the three snake stimulus compartments and a preference for the neutral stimulus compartment. Entry times summed and averaged across the four Circus tests are illustrated in Figure 2. The mean entry times across all 7 wild-reared subjects and all four sessions were real snake, 0.2 s; toy snake, 0.8 s; model snake, 2.2 s; and neutral stimulus compartment, 219.6 s. By contrast, the 9 laboratory-reared subjects showed no significant avoidance or preference for the different compartments.

These results were analyzed in a 2×4 (Groups \times Stimulus Objects) ANOVA. The analysis revealed a highly significant main effect for stimulus objects, $F(3, 42) = 112.80$, $p < .001$, and a highly significant Groups \times Stimulus Objects interaction, $F(3, 42) = 97.62$, $p < .001$. Analysis of simple main effects revealed that there was a significant simple main effect of objects for the wild-reared group, $F(3, 18) = 101.86$, $p < .001$, but not for the laboratory-reared group, $F(3,$

24) = 1.03. Duncan's post hoc comparisons ($\alpha = .01$) revealed that the wild-reared group spent significantly less time in the real, toy, and model snake compartments than in the neutral compartments. In addition, the wild-reared group spent significantly less time than the laboratory-reared group in the real, toy, and model snake compartments, and significantly more time in the neutral compartment (Duncan's, $\alpha = .01$). Finally, although the numbers of subjects in the various subgroups of the laboratory-reared group were too small to be compared statistically ($n = 4$ young adults, $n = 2$ adolescents, $n = 3$ infants), examination of their results revealed no suggestion of possible subgroup differences.

Correlation of Sackett Circus and WGTA results

The use of the Sackett Circus as an additional measure of fear can be justified by examining whether there is a close relationship between the latency scores in the WGTA to a given object and the amount of time spent with that object in the Circus tests. Correlations were therefore computed for the 11 subjects who had been tested in the WGTA (7 wild reared plus 4 laboratory reared), between WGTA latency scores and Circus entry times for the real, toy, and model snakes. The correlations were all negative and significant (Pearson $r_s = -.95, -.75, -.76$, respectively, for the real, toy, and model snakes). Although such correlations should be viewed with some caution because they pool both within and between group variations, they do suggest that the stronger the avoidance of the snake stimuli in the Circus, the longer the food-reach latency in the WGTA test.

In addition, a 2×2 contingency table was constructed, divided on the basis of whether the subject had been fearful in the WGTA and in the Circus. Fear in the WGTA was defined as no food-reaching response to the real snake (maximal latency score of 60 s on both trials); fear in the Circus was defined as spending 10 s or less with the real snake. (The 10-s criterion was used because, occasionally, subjects would briefly enter a snake compartment before they noticed the snake stimulus.) A four-fold point-contingency coef-

ficient (Hays, 1973, p. 744) computed on this table yielded a $C = -0.75$. In other words, animals tend to be fearful or nonfearful in both situations.¹

Discussion

The results of Experiment 1 provide no support for the hypothesis that laboratory-reared monkeys fail to show a fear of snakes because of having been reared in impoverished or aberrant social environments. Nuclear-family-reared offspring of wild-reared parents do not show a fear of snakes in spite of having lived with parents who do show a fear of snakes. Thus, simply living with parents who have a fear of snakes is not sufficient to acquire the fear. Furthermore, these nuclear-family-reared offspring were reared in an environment that produces highly socially sophisticated monkeys, and so their lack of snake fear cannot be attributed to having highly aberrant social histories. Of course, it is always possible that any laboratory environment per se is sufficiently aberrant that it fails to provide necessary general experiences for the development of snake fear (e.g., experience with any small live animals might suffice to sensitize a fear of snakes in the absence of any specific experience with snakes). Such a hypothesis obviously awaits further testing of monkeys that have been reared in naturalistic outdoor environments that do not contain any snakes.

However, even in the absence of such a study, it seems likely that some experience with snakes per se is necessary for a strong fear to develop. As suggested above, this experience is more likely to be vicarious than direct if one is to account for the high incidence of the fear in our wild-reared monkeys (at least 80%). In Experiment 2 we test the plausibility of this hypothesis by examining the effects for adolescent/young-adult monkeys of observing their wild-reared parents behave fearfully in the presence of our real, toy, and model snakes. Because of the close relationship that was demonstrated in Experiment 1 between the behavioral avoidance component of fear as measured in the Sackett Circus and in the WGTA, the observers could be tested for the fear both before and after observational conditioning in a

place other than the one in which they acquired the fear. As suggested earlier, this test for context specificity is an important feature of the present experiment that is lacking in all other demonstrations of observational conditioning.

Experiment 2

Method

Subjects

Five of the wild-reared adults from Experiment 1 served as fearful models for this experiment. Six of their adolescent or young-adult (3–6 years old) laboratory-reared offspring (also from Experiment 1) served as nonfearful observers. All of the subjects were living together in the same nuclear family unit of the Wisconsin Primate Laboratory as in Experiment 1, they were the only such wild-reared-parent/laboratory-reared-adolescent pairs that were still living together in the Wisconsin Primate Laboratory at the time of this experiment (The infants from Experiment 1 were still living in the group as well, but were judged to be too young for this experiment for a variety of reasons.) For purposes of observational conditioning all of the adolescent/young adults were paired with one of their respective parents with whom they had lived their entire lives. The relationships among the 6 model-observer pairs were as follows: One mother served as model for her two daughters (in separate conditioning sessions), one mother served as model for her son and her daughter (again in separate conditioning sessions), one father served as model for his son, and one mother and father both served as models for their daughter (see Procedure section for details).

Apparatus

The WGTA described for Experiment 1 was used for the pretest of the wild-reared models and 4 of the 6 adolescent/young-adult observers. It was also used for the observational conditioning sessions and for the final behavioral test for the observers. During the observational conditioning sessions the observer was placed in a transport cage that had one Plexiglas side and one wire mesh side (the other two door ends were solid sheet metal). The

¹ Only one laboratory-reared animal crossed these boundaries by being classified as fearful in the WGTA and nonfearful in the Circus, there is some reason to believe that this was in part because it had not adapted to the WGTA as fully as had the others (although it had met the adaptation criterion, it had taken many more sessions to do so). In addition, its scores for the Circus reveal that it had spent more than 50% of its time with the three snake stimuli, suggesting that in some ways the Circus may be an even more sensitive measure of behavioral avoidance than is the WGTA. If a monkey balks (refuses to respond) in the WGTA, as sometimes happens even in well-adapted animals, this may be confused with the behavioral avoidance index of fear.

transport cage was set on a cart that was placed adjacent to the model parent's WGTA cage, with the Plexiglas side of the transport facing the WGTA. This allowed the observer to watch both the various test stimuli and the model parent's response to them.

The Sackett Self-Selection Circus described for Experiment 1 was used both for pretesting all of the observers and models and for testing the acquisition of behavioral avoidance of the snake stimuli by the observers.

Procedure

Pretest The four Circus tests with the snake stimuli of Experiment 1 served as the baseline pretests for Experiment 2, inasmuch as the two experiments were conducted with only about a 1-month interval between them. The 6 observers all qualified as nonfearful by spending more than two thirds of their total entry time, averaged across the four sessions, in the three snake stimulus compartments (out of four possible entry compartments). The 5 models qualified as fearful by spending no more than an average of 20 s (out of a possible 300 s) of their total entry time in the three snake stimulus compartments combined. The 5 models had also received pretests in the WGTA as a part of Experiment 1. The models again all qualified as fearful by not reaching for the food within 60 s on at least three of the four trials with the real and toy snakes. Furthermore, they all showed at least two different disturbance behaviors in the presence of the real and toy snakes.

Only 4 of the 6 observers had been given a pretest in the WGTA as a part of Experiment 1 because the other 2 younger subjects had not met the baseline criterion even after extensive adaptation testing and so could not be given a WGTA pretest (they failed to meet our adaptation criterion in spite of over 20 sessions there). Three of the 4 observers that were pretested in the WGTA qualified as nonfearful in this situation and in reaching for the food on all four real and toy snake trials with latencies of 10 s or less. As discussed in Footnote 1, the fourth observer that was pretested in the WGTA did evidence considerable reluctance to reach for the food on the snake trials. However, because it showed only minimal signs of avoiding the snake compartments in the Circus, it was used as a subject nevertheless, to determine whether its level of fear would increase following observational conditioning.

Observational conditioning sessions During observational conditioning, the observer was confined in the transport with one Plexiglas side adjacent to the WGTA cage so that it could observe the model and the various stimuli, but could not touch them. All trials were conducted as for Experiment 1 except that they were of 40- rather than 60-s duration. There were 15 trials in each session, with the neutral object and the real, toy, and model snakes as the four stimuli (the black and yellow cord were not used). The order of the 15 trials was as follows: 6 neutral trials; 6 trials with the real, toy, and model snakes, and 3 neutral trials. In Sessions 1, 3, and 5, the snake stimuli were presented twice each in the following order: real, model, toy. In Sessions 2, 4, and 6, the snake stimuli were presented twice in the following order: toy, model, real. This difference in ordering of trials from the pretest (i.e., not having strictly alternating

snake and nonsnake trials) was necessary because in Experiment 1, and in the pretest, the fearful models occasionally refused to reach for the food on one or more neutral trials that followed a snake trial. Such balking obviously interferes with the opportunity for the observer to discriminate between the objects that evoke fear in the model and those that do not. Using this ordering of trials, no model ever balked on more than the first of the last three neutral trials. As during pretesting, the experimenter recorded the model's latency to reach for the food as well as the disturbance behaviors that were exhibited. Only incidental observations of the observers' behavior were made (e.g., whether the observer was attending to the stimuli and to the model's behavior).

There were six observation sessions for each observer; Sackett Circus tests occurred after Sessions 2, 4, and 6 to test for acquisition of a fear of snakes in a situation other than where the conditioning took place.² The Circus tests were exactly as described for Experiment 1, with subjects having 5 min to freely enter and leave any of the four compartments containing the neutral object and the three snake stimuli. Following the third Sackett Circus test, there was also a final WGTA test, exactly like the pretest, that was conducted to test for behavioral avoidance and behavioral disturbance in the same situation where the fear was acquired. The six conditioning sessions, three Circus tests, and final WGTA test were all conducted over a 3-week period. Typically, one cycle of two conditioning sessions and a Circus test were conducted over a 7-day period. This cycle was repeated three times over 3 consecutive weeks, and the final WGTA test was conducted during the week following the last Circus test.

Follow-up tests were conducted in the Circus and in the WGTA 12 weeks after the final observation sessions in order to assess retention of the acquired fear. The Circus test was given approximately 3 days prior to the WGTA test, as in the posttest.

Results

Models and Observers at Pretest

The data from the pretest performance of the 5 models and 6 observers, which is a subset of that presented for Experiment 1, were reanalyzed and gave identical results for performance in the Sackett Circus, latency in

² One observer received 10 sessions with additional Circus tests following the 8th and 10th sessions. This was because this observer was the first subject in the experiment, and so procedural details had not been precisely worked out. Results were subsequently analyzed using both performances on the third and on the fifth (last) Circus test, and the pattern of significant effects was not affected. In general, the results that are reported used data from the fifth Circus test. Another subject that showed no signs of learning after watching its father for six sessions was given six more sessions with its mother and also showed no sign of learning after those six sessions. Only the results from the first six sessions (and three Circus tests) are included in the analysis.

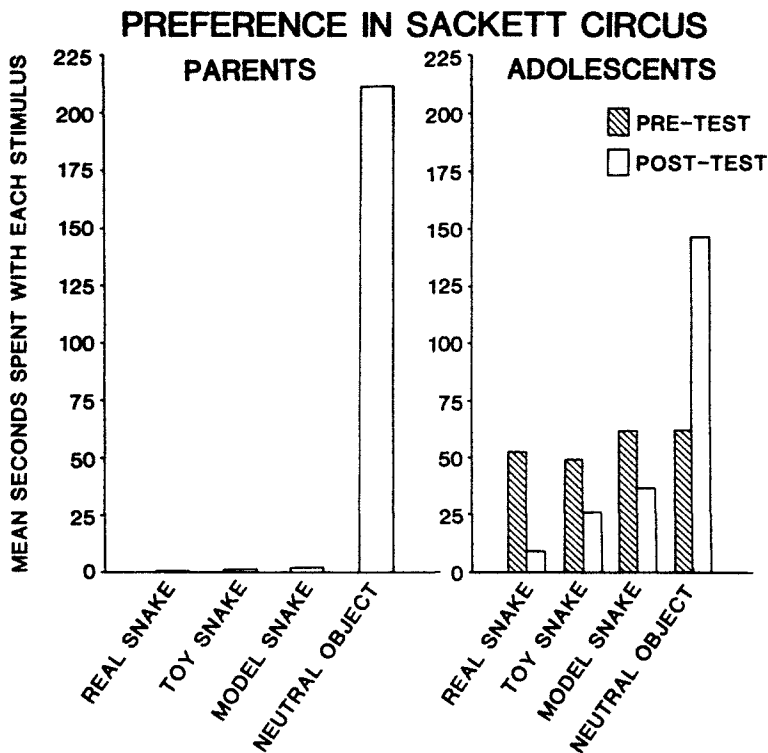


Figure 3 Mean amount of time spent with the four different objects in the Sackett Circus for the 5 parental models in the pretest and for the 5 adolescent/young-adult observers that learned in the pretest and posttest of Experiment 2

the WGTA, and disturbance behaviors in the WGTA. The results of the pretest for both models and observers in the Sackett Circus are shown in Figure 3. For the parental models' pretest, the latency results in the WGTA are presented in Figure 4 and the disturbance behavior results are presented in Figure 5.

Models During Observational Conditioning

The models' performance in the WGTA did not change significantly over the course of the six observational conditioning sessions. A 4×6 (Stimulus Objects \times Sessions) ANOVA on WGTA latency scores for the first six sessions of each model revealed only a significant main effect for stimulus object, $F(3, 12) = 785.43, p < .001$. Latencies were longer to the three snake stimuli than to the neutral objects (Duncan's, $p < .05$). In fact the models all showed maximal (40-s) latencies on all of the real and toy snake trials of every session.

Another 4×6 (Stimulus Objects \times Sessions) ANOVA on disturbance behaviors also revealed only a significant main effect for objects, $F(3, 12) = 28.06, p < .001$. There were significantly more disturbance behaviors in the presence of the real snake than in the presence of all the other objects, and more in the presence of the toy snake than in the presence of the model snake and neutral objects, which did not differ significantly from each other (Duncan's, $p < .05$).³

³ These ANOVAs should be interpreted with some caution because they did not include all of the results from the two models who served as models twice, that is, for those two models only their first six sessions were included. Two more ANOVAs were performed using the second set of six sessions for these two models, and the first and only set of six sessions for the other three models. The results of these ANOVAs were similar with the exception that there was a possibly significant interaction of stimulus objects with sessions for disturbance behaviors. However, the interaction seemed to reflect some fluctuations over sessions rather than systematic increases or decreases.

BEHAVIORAL AVOIDANCE OF SNAKES IN WGTA

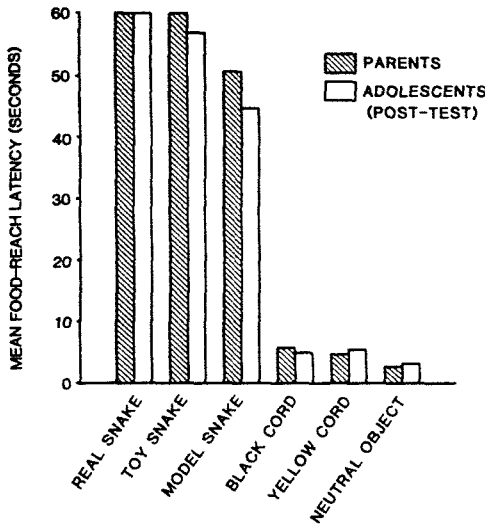


Figure 4 Mean food-reach latency in the Wisconsin General Test Apparatus in the presence of the six different objects for the five parental models in the pretest and for the five adolescent/young-adult observers who learned in the posttest

Observers Acquisition and Retention of Fear

Five out of the 6 adolescent/young-adult observers showed rapid acquisition of snake fear as evidenced by their performance both in the three Sackett Circus tests (following conditioning Sessions 2, 4, and 6) and in the WGTA posttest. They also showed no signs of loss of fear at 3-month follow-up in either test situation. For practical reasons the subject that did not learn (as evidenced by no signs of avoidance of the snake stimuli in the Circus, and by short food-reach latencies with the snake stimuli in the WGTA) was not included in the 3-month follow-up. Therefore, as we noted, some of the analyses to be presented include its data in order to be conservative and some do not where it was not possible or applicable. The average individual data for each phase (pretest, post-test, and follow-up) for all 6 subjects are presented in Tables 1 and 2. However, all of the figures include data only for the 5 subjects who learned.

Sackett Circus The mean performance of the 6 observers in the four Sackett Circus pretest sessions and the mean performance

in the acquisition test sessions (three for 4 subjects, five for 1 subject, and six for 1 subject) were analyzed in a 2×4 (Sessions \times Stimulus Objects) ANOVA. The analysis revealed a significant main effect for stimulus object, $F(3, 15) = 16.95, p < .001$, and a significant Sessions \times Stimulus Objects interaction, $F(3, 15) = 11.97, p < .001$. Duncan's post hoc comparisons ($\alpha = .01$) revealed that there was differential responding to the different stimulus objects in the acquisition tests but not during the pretest. The observers spent less time with the real ($\alpha = .01$), toy ($\alpha = .05$) and model ($\alpha = .05$) snakes during acquisition than during the pretest, and more time with the neutral object during acquisition than during the pretest ($\alpha = .05$). The right-hand portion of Figure 3 illustrates these results for the 5 observers who learned.

For 4 of the 5 observers who did show conditioning, tests were conducted to assess whether there was a significant increment in learning from the first to the last acquisition

FEAR BEHAVIORS IN WGTA

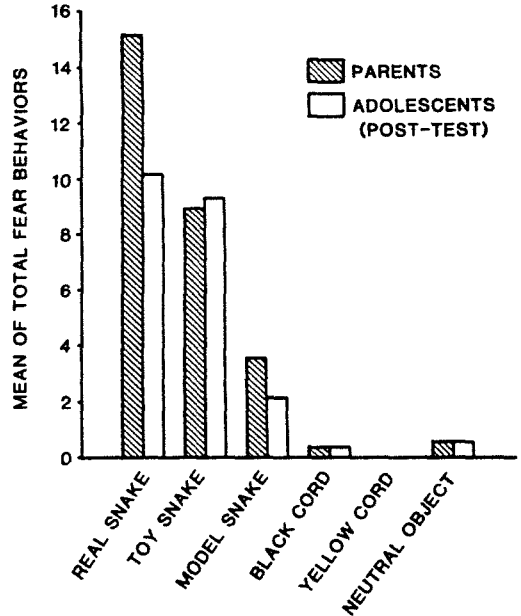


Figure 5 Mean number of disturbance behaviors exhibited in the Wisconsin General Test Apparatus in the presence of the six different stimuli for the 5 parental models in the pretest and the 5 observers who learned in the posttest

Table 1
Individual Sackett Circus Data

Observer	Pretest				Posttest				Three-month follow-up			
	R	T	M	N	R	T	M	N	R	T	M	N
AA32	61.3	28.5	68.3	55.8	0.0	2.0	9.3	193.3	0	0	12	208
AA38	55.8	42.5	65.3	67.2	45.0	48.0	40.8	55.8	No follow-up			
AA82	28.0	45.3	60.0	93.8	13.3	20.7	29.7	136.7	0	0	15	197
AC30	57.0	55.3	57.5	61.3	11.0	16.6	36.0	149.3	31	20	30	141
AG39	60.8	56.0	64.5	46.8	0.8	51.3	54.4	137.4	11	33	53	152
AG47	58.0	64.0	59.3	52.3	23.3	44.0	53.7	115.0	0	25	0	20

Note Table entries are time spent (in seconds) in each stimulus compartment. Pretest and posttest values are averages because each subject received more than one of each. R = real snake, T = toy snake, M = model snake, N = neutral object.

test.⁴ A 3×4 (Tests \times Stimulus Objects) ANOVA revealed a significant main effect for stimulus object, $F(3, 9) = 22.90$, $p < .001$, and a significant Tests \times Stimulus Objects interaction, $F(6, 18) = 5.90$, $p < .01$. Duncan's post hoc comparisons revealed that responding to the real and toy snakes did not change over sessions, but that responding to the other two stimuli did change from the first test session to the last test session. The observers spent more time with model snakes and less time with the neutral stimulus during the first test session than during the last test session. The amount of time spent with these stimuli during the second test session was intermediate and did not differ significantly from the amount of time spent during either the first or the last sessions.

For the 5 observers who learned, a test was also performed to determine whether there were significant changes from baseline to 3-month follow-up, or from acquisition to 3-month follow-up. The average pretest performance (average of four sessions), the average acquisition performance (average of three sessions), and the single follow-up session were included in a 3×4 (Repeated Measures \times Stimulus Objects) ANOVA. The analysis revealed a significant main effect for stimulus object, $F(3, 12) = 19.32$, $p < .001$, and a significant Stimulus Objects \times Repeated Measures interaction, $F(6, 24) = 13.28$, $p < .001$. Duncan's post hoc comparisons ($\alpha = .01$) revealed that the observers did not respond differentially during the pretest, but did respond differentially during both acquisition and follow-up, spending less time with

the real, toy, and model snakes than with the neutral object at each of these time points. Duncan's tests ($\alpha = .05$) also revealed that for the real and toy snakes, as well as for the neutral object, responding did not change significantly from acquisition to follow-up, which both differed from baseline. However, the observers spent significantly less time with the toy snake during the 3-month follow-up than during acquisition ($\alpha = .05$). The average results from the 3-month follow-up are illustrated in Table 3.

Wisconsin General Test Apparatus All 6 observers were tested in the WGTA for disturbance behaviors and food-reach latencies following conditioning. This was possible because in this final WGTA test, the 2 subjects who had not reached the adaptation criterion prior to conditioning displayed very short food-reach latencies (less than 10 s) on the neutral block and on the yellow and black cord trials. Apparently they had profited from observing their parents' performance in the WGTA during the observational conditioning sessions.

The results of the WGTA posttest paralleled those in the Sackett Circus in demonstrating that very dramatic observational conditioning of snake fear had occurred. For several reasons formal analyses of these results are not pre-

⁴The 5th subject who learned was omitted from this analysis because of lost data from the individual sessions. Only the average data are available. For the subject that had 10 conditioning sessions, the results of the first two sessions, and of the last two sessions, were averaged and used as the first and third tests, respectively.

sented here: First, there were a small number of subjects that varied at the three stages of testing ($n = 4$ on the pretest, $n = 6$ on the posttest, and $n = 5$ on the follow-up test). Second, the form of the data did not meet all the assumptions for ANOVA, thereby making formal tests of questionable validity. Third, the results were so striking as to render significance tests unnecessary. Therefore the data are simply described (although the results of formal analyses may be obtained on request from the first author).

Regarding the latency data, it can be seen in Table 2 that 3 of the 4 observers reached for the food in an average of 8.5 s or less on both of the real snake trials of the pretest. By contrast, on the posttest, 5 of the 6 observers did not reach for the food at all on either of the real snake trials. Similarly, on the toy snake trials of the pretest, 3 of the 4 observers reached rapidly for the food, but

on the posttest, 3 of the 6 did not reach for the food at all on either of the toy snake trials, and 2 others showed very long latencies to reach. There were also striking changes in the latency to reach on the model snake trials, but no changes in latency on the neutral stimulus trials. The same pattern of results existed at 3-month follow-up as had existed at the posttest.

As Table 2 shows, the results for the disturbance behaviors closely paralleled those for the latency data. In the pretest, only one observer showed any disturbance behaviors in the presence of the real and toy snakes. By contrast, on the posttest, 5 of the 6 observers showed three or more disturbance behaviors in the presence of the real snake, and 4 of the 6 showed nine or more disturbance behaviors in the presence of the toy snake. For the model snake, 3 of the 6 observers showed disturbance behaviors on

Table 2
Individual Wisconsin General Test Apparatus Data

Observer	Latency (s) ^a						Disturbance behavior (frequency) ^b					
	R	T	M	N	Y	B	R	T	M	N	Y	B
Pretest												
AA32	17	10	9	7	15	9	0	0	0	0	0	0
AA38	16	12	9	8	9	9	0	0	0	0	0	0
AA82	120	120	97	15	19	38	6	5	0	1	0	1
AC30	15	10	11	11	9	9	0	0	0	0	0	0
AG39	Did not reach criterion											
AG47	Did not reach criterion											
Posttest												
AA32	120	120	64	5	11	11	14	15	3	1	0	0
AA38	54	10	8	4	37	5	1	0	0	0	0	0
AA82	120	120	120	6	10	8	12	9	5	1	0	1
AC30	120	102	74	5	10	10	9	12	3	1	0	1
AG39	120	108	86	9	13	10	3	0	0	0	0	0
AG47	120	120	105	8	12	11	13	11	6	0	0	0
Three-month follow-up												
AA32	120	120	56	7	19	12	11	10	4	0	0	0
AA38	No follow-up											
AA82	120	120	120	12	9	11	8	8	4	0	0	0
AC30	120	82	67	6	11	10	6	6	2	0	0	0
AG39	120	82	95	10	16	15	6	1	0	0	0	0
AG47	120	120	120	11	19	9	12	8	2	0	0	0

Note These scores reflect the sums of two trials with each stimulus R = real snake, T = toy snake, M = model snake; N = neutral object, Y = yellow cord, B = black cord

^a Maximum score = 120 (60 s for each of two trials)

^b Maximum score = 72 (36 s for each of two trials)

Table 3
Three Measures of Fear Retention at Three-month Follow-up for Experiment 2

Measure	Posttest	Three-month follow-up
Circus test (in s)		
Real snake	9.7	8.4
Toy snake	26.9	15.6
Model snake	36.6	22.0
Neutral objects	146.3	143.6
WGTA latency (in s)		
Real snake	60.0	60.0
Toy snake	57.0	52.4
Model snake	44.9	45.8
Neutral objects	4.6	5.9
WGTA disturbance behaviors (mean no)		
Real snake	10.2	8.6
Toy snake	9.4	6.6
Model snake	2.2	2.4
Neutral objects	0.3	0.0

Note These data are only for the 5 subjects that learned WGTA = Wisconsin General Test Apparatus

the posttest, although none had done so in the pretest. The same general pattern of results existed at 3-month follow-up, with all 5 observers showing disturbance behaviors to the real and toy snakes, and 4 of the 5 to the model snake as well. By contrast, disturbance behaviors to the neutral stimuli occurred very infrequently during the posttest, and not at all during the 3-month follow-up.

Comparison of the Models' Pretest Performance With the Observers' Posttest Performance

One further question of interest is whether the fear acquired by the 5 adolescent/young-adult observers was as intense as that of their parental models. Strictly speaking, these tests cannot be performed because in two cases the same animal served as model for two different observers, and so the data are not strictly independent. Nevertheless, as can be seen from Figures 3, 4, and 5, the results from the posttest of the observers were highly similar to those of the pretest of the models. As can be seen in Figure 5, the parental models tended to show more total disturbance behaviors with the real snake than did the observers. However, as can be seen in Figure 6, there were no apparent differences in the number of *different* fear behaviors shown by

the parental models and the observers who learned in the presence of the real, toy, or model snakes.

Correlation of Model's Disturbance Behavior During Conditioning With Observer's Fear

To assess whether there was any relation between the level of disturbance behaviors shown by the parental models and the observer's level of acquired fear, Spearman correlations were computed. The total number of disturbance behaviors shown by the models across all the observational conditioning sessions was first correlated with the 6 observer's disturbance behavior on the WGTA posttest. When the correlations were computed separately for the real, toy, and model snakes, they were all highly positive, but only the correlation for the real snake was statistically significant (real snake, $r_s = .90$; toy snake, $r_s = .757$; model snake, $r_s = .643$). A further correlation between the total number of disturbance behaviors exhibited by the models

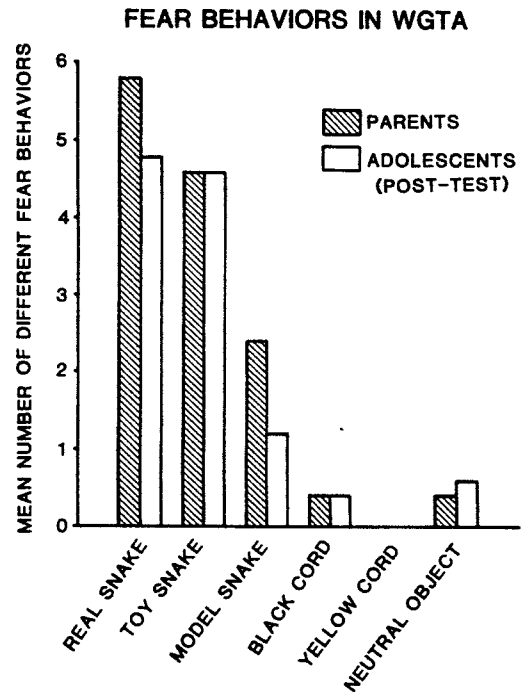


Figure 6 Mean number of *different* disturbance behaviors exhibited in the Wisconsin General Test Apparatus in the presence of the six different stimuli for the 5 parental models in the pretest and the 5 observers that learned in the posttest

to all three snake stimuli combined across all the observational conditioning sessions and the total number of disturbance behaviors exhibited by the observers to the three snake stimuli combined on the WGTA posttest was highly significant ($r_s = .986$). Finally, the total number of disturbance behaviors across all three stimuli and all sessions for the models was correlated both with the total amount of time spent by the observers in the three snake compartments combined in the last acquisition Circus test ($r_s = -.829$, $p < .10$) and with the summed food-reach latency scores in the WGTA posttest to the three snake stimuli ($r_s = .543$). The only moderately positive value of this latter correlation was at least partially due to the fact that most of the observers were showing maximal food-reach latencies in the WGTA posttest.

General Discussion

The results of Experiment 2 provide the most clear-cut demonstration to date of observational conditioning of a strong and persistent fear in a primate species. As such, this demonstration clearly provides strong support for the hypothesis advocated by many theorists in recent years that the fears of many human and nonhuman primates may be based on observational conditioning. In the following discussion a number of different aspects of these results that make them a compelling model for the acquisition of some human fears and phobias are considered.

The first striking and noteworthy aspect of the results of Experiment 2 is the rapidity with which the fear was acquired. It does, of course, make sense in an adaptive/evolutionary framework that such a fear of a predator should be acquired rapidly (if it is not innate) because in the wild there are not an unlimited number of opportunities to acquire such a fear. Furthermore, when the opportunities do arise, the learning should be rapid because mistakes may be fatal. (In India, for example, there are many varieties of poisonous snakes, such as cobras and adders.) Nevertheless, it still seems somewhat surprising that there were significant signs of avoidance of the real and toy snakes appearing on the first Circus test trial after only 8 min (twelve 40-s trials) of watching the parents behave fearfully in

the presence of the real, toy, and model snakes. There was a tendency for the fear to increase over the next two Circus test trials for the model snakes, but avoidance of the real and toy snakes was essentially asymptotic in the first session. Furthermore, all the posttests and the follow-up in the Circus and the WGTA occurred after a total of only 24 min of exposure,⁵ and only 8 of those minutes were with the real snake. The high incidence of snake fear even in people who have had minimal contact with snakes becomes easier to explain to the extent that the speed of acquisition of this fear in monkeys is paralleled in humans. In particular, our results suggest that it does not take much exposure to a fearful model for a very strong fear to be acquired.

In conjunction with the rapidity of learning seen in 5 out of our 6 subjects, three other aspects of the results of Experiment 2 lend strong support to the hypothesis that many human and nonhuman primates' fears and phobias may be based on observational conditioning. First, unlike in any other study of observational conditioning, there is evidence that more than one of the three primary components of fear can be conditioned simultaneously. The Circus results, as well as the food-reach latency results in the WGTA, support the contention that the observer monkeys were showing behavioral avoidance of the real, toy, and model snakes, one of the three systems of fear in Lang's (1968, 1971) theory. In addition, the disturbance behavior results in the WGTA posttest support the contention that the more subjective and/or autonomic components of the fear were also conditioned. This demonstration of the conditioning of several components of fear is important because, generally, the naturally occurring fears that an attempt is being made to model (such as those exhibited by most human phobics and by the wild-reared monkeys in our experiments) clearly involve more than one component.

The second and third important aspects of these results are that the fear was persistent and not context specific. The observer mon-

⁵ The one exception was the one subject that had 10 conditioning sessions for a total of 40 min of exposure

keys showed virtually complete retention of the fear at 3-month follow-up, and although they acquired their fear in the WGTA, they exhibited it from the outset in the Circus as well. Although it is possible that the fear responses conditioned observationally in the other laboratories were also persistent and not context specific, there has been no demonstration of this to date. Yet, these are clearly important characteristics of the monkey and human fears being modeled here. For example, our wild-reared monkeys presumably acquired their fear in India at least 12 years prior to our study. In spite of having had no experience with snakes in the interim and in spite of being tested in a vastly different setting than where the fear was acquired, they still exhibited full-blown fear reactions when tested in a laboratory setting many years later.

A fourth noteworthy point concerns the use of snakes per se as stimuli for observational fear conditioning. As discussed above, the fear of snakes acquired by the monkeys in Experiment 2 is intense and longlasting. In fact, it was virtually indistinguishable from that of the wild-reared parents. This might be expected, given the good evidence that a fear of snakes is widespread among primates. It might also be expected, given the evidence of Öhman and his colleagues, that electrodermal conditioning with snakes as CSs in humans is qualitatively and/or quantitatively superior to conditioning with more arbitrary neutral objects (Öhman et al., 1975, 1976, 1978a, 1978b). In fact, it is tempting to speculate that the observer monkeys of Experiment 2 acquired snake fear observationally more rapidly than they would have acquired a fear of more arbitrary objects. This would also be in keeping with the hypothesis of Murray and Foote (1979) that many human fears and phobias are examples of "prepared" observational conditioning. Unfortunately, at present, any evidence to support such speculation is lacking until there actually is a demonstration of superior observational conditioning with fear-relevant stimuli (such as snakes) as compared to fear-irrelevant stimuli (arbitrary objects).

A final striking finding of Experiment 2 is the high correlation between the number of disturbance behaviors shown by the parental

models to the snake stimuli during observational conditioning and by their offspring to the snake stimuli in the WGTA posttest ($r = .986$). By itself, such a correlation could stem from three sources: (a) very close modeling by an observer of the degree of fear or disturbance that particular stimuli elicit in the model, (b) genetic/constitutional similarities between the parental models and their observer offspring, and (c) earlier modeling experiences in the fearful situations that might have led to the observers generally showing similar levels of fear behavior to those shown by their parents. Unpublished data from our laboratory strongly support the first of these alternatives (Cook, Mineka, Wolkenstein, & Latsch, 1984). In this experiment there were 10 observers who were unrelated to the two fearful models. The observers and models "knew" each other only by virtue of having lived in the same room together (in separate cages) at some time in the recent past. When the same correlation, between the degree of disturbance shown by the models during conditioning and by the observers in the posttest, was computed for that experiment, it revealed $r = .94$. Because these monkeys were unrelated and had never lived closely together for any length of time, the possibility does not exist of genetic/constitutional factors or earlier modeling experiences having contributed to this extremely high correlation. Instead, it seems likely that there is very close modeling by an observer of the degree of disturbance shown by a model to particular stimuli. This suggestion would be consistent with the findings of Murray and Foote (1979) that levels of snake fear and phobia in college student subjects are significantly correlated with the levels of such fears in their parents.

If this interpretation of the high correlation between the models' and the observers' level of fear is correct, it would have interesting implications regarding the possibility of prevention of fears. In particular, it would suggest that parents who have strong fears or phobias should avoid confronting their phobic object as much as possible in the presence of their children. Although one might expect that such avoidance, especially if it were obvious, might suffice to instill a fear in the children, the results of Experiment 2 and of our as yet unpublished data suggest that the level of

disturbance exhibited by the parental model is more important than behavioral avoidance per se. This suggestion stems from the observation that, although all of the models showed virtually complete and equivalent behavioral avoidance, it was their level of disturbance that correlated so highly with the level of fear conditioned in their offspring. Thus, to the extent that parents can prevent themselves from exhibiting their fear in a dramatic way, they may be able to help prevent the observational conditioning of fear in their children or, at a minimum, to reduce the extent of such conditioning.

In this regard it is also interesting to comment on the one subject that did not acquire a fear of snakes even after 12 observational conditioning sessions (6 with its father followed by 6 with its mother). There are two noteworthy points to make about this subject: First, it did not seem to pay much attention to either of its models during the conditioning sessions and was described by the experimenter (M.D.) as an agitated and excitable monkey. This high level of agitation was also evidenced in the Circus tests where the subject made over twice as many entries and exits from the different compartments as did any other subject. Second, during the first six observational conditioning sessions its father exhibited the fewest signs of disturbance of any of the models, although his behavioral avoidance was complete (i.e., he had maximal 40-s latencies on all trials). Thus, it is not surprising that the results from this monkey suggest that the level of fear that is conditioned in an observer may be affected by the attention paid to the model and/or by the level of disturbance exhibited by the model. Indeed, when attention is minimal or when the level of disturbance exhibited by the model is quite low, or both, observational conditioning may not occur.

In sum, it is now clear that intense and long-lasting fears can be conditioned in adolescent/young-adult monkeys after only a very short period of exposure to a parental model behaving fearfully in the presence of a snake. Failure of the model to demonstrate high levels of disturbance behaviors and/or failure of the observer to pay attention to the model may, however, prevent such conditioning from occurring. Furthermore, this fear that is so

rapidly acquired is not context specific and is manifest in at least two of the three fear response systems proposed by Lang (e.g., 1968, 1971) and Rachman (e.g., 1978). Future research should be designed to determine the effect on conditioning of a variety of variables such as the nature of the CS used and the relationship between the model and the observer. The results of such experiments are important in furthering our understanding of the role of observational conditioning in the origins of many fears and phobias.

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