

EMOTIONS AND ANXIETY

New Concepts, Methods, and Applications

Edited by
Marvin Zuckerman and
Charles D. Spielberger

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Volume 12

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CHARLES D. SPIELBERGER**

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Emotions and Anxiety

**NEW CONCEPTS, METHODS,
AND APPLICATIONS**

EDITED BY

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Preface

More than a quarter century has passed since the explosion of research on anxiety and emotion in the early 1950s, and considerable progress has been made in the measurement of anxiety and its treatment. During the past decade, there have also been significant advances in theory and research on anxiety and emotion, but many investigators are not yet familiar with these “new concepts.” This book will be of interest to behavioral and medical scientists concerned with the topics of anxiety and emotion, and should be useful as a supplementary text in advanced undergraduate and graduate courses in personality and motivation.

The book is divided into four major parts. The chapters in Part I examine the origins of fear, anxiety, and other emotions. Self-report and psychophysiological approaches to the measurement of anxiety are considered in Part II. Recent research evidence regarding the effects of anxiety on the behavior of normal and abnormal subjects is reported in Part III. The final section is concerned with behavioral approaches to the assessment and treatment of anxiety in clinical settings.

The three chapters in Part I reflect the current *Zeitgeist* in psychology, which gives increasing emphasis to biological and genetic determinants of emotion, in contrast to the extreme environmentalism of psychoanalysis and radical behaviorism. A second major trend in Part I that continues throughout this volume is a persistent concern with the role of cognition in the mediation of emotional behavior. In Chapter 1, Suomi and Harlow examine the evolution of fear as an adaptive motive. Their observations of primate behavior reveal that grossly novel stimuli consistently evoke a variety of unlearned responses, including characteristic facial expressions. Such observations lead Suomi and Harlow to challenge traditional explanations of conditioned fear as resulting from the association of previously neutral stimuli with pain. They also discuss Sackett's astounding

finding that a threatening expression on a monkey's face strikes terror in the monkey heart, even for animals raised in social isolation where a painful bite never followed such expressions.

In Chapter 2, Paul McReynolds views "primary anxiety" as the buildup of unassimilable or incongruent perceptions. This definition, which encompasses a child's fear reactions to his parent's frown or suddenly harsh voice, is quite consistent with Suomi and Harlow's developmental studies which show that avoidance of novel stimuli tends to diminish with age. As humans develop more complex cognitive schemata, it becomes easier for them to assimilate novel environmental stimuli and the primary source of fear shifts to perceptual inputs that are incongruent with cognitive self structures.

A cognitive view of anxiety is also expressed by Averill, who regards emotions as the products of complex cognitive systems. For Averill, primary anxiety is a state of cognitive disintegration produced by an abrupt change in, or a threat to, an individual's cognitive systems. Thus, anxiety results from an individual's inability to impose meaning on the world and is, therefore, existential in its nature. All of these explanations of the origins of fear and anxiety are a far cry from the birth trauma, castration threat, or high drive state explanations of anxiety that have been posited by psychoanalysts and learning theorists.

The chapters in Part II examine the complex methodological and theoretical problems that are encountered in efforts to measure human anxiety. Zuckerman examines the logical and empirical properties of the concepts of state and trait anxiety. He also reports new evidence with regard to the relationship between environmental stress, state and trait anxiety, and specific and generalized patterns of autonomic arousal. Zuckerman contends that the measurement of anxiety states should be emphasized in future research and that trait anxiety should be redefined in terms of the average level of state anxiety in specific types of stressor situations over time. Hodges critically examines the relationship between measures of trait anxiety and patterns of autonomic reaction to stress situations. His results provide additional evidence for the validity of Spielberger's distinction between two types of stressor situations—threats to self-esteem (e.g., failure, embarrassment) and threats of physical pain or bodily harm. Both Zuckerman and Hodges conclude that situation-specific trait measures are required for more accurate predictions of state anxiety reactions to such fear-producing stimuli as snakes and the threat of electric shock.

Drive theorists such as Kenneth Spence have noted that anxiety may facilitate or interfere with performance on learning tasks, depending on the complexity of the task and the level of anxiety. The first two chapters in Part III explore the effects of anxiety on the performance of normal and abnormal subjects on learning and memory tasks. In Chapter 6, Mueller reports findings which demonstrate that high anxiety interferes with the encoding of complex information by normal subjects. In contrast, Patterson reports findings in Chapter 7 which demonstrate that anxiety facilitates the performance of schizophrenic subjects

on simple coding tasks. In the context of the experimental literature, these studies provide striking evidence that similar laws of motivation and learning hold for normal and abnormal populations. In addition, Patterson's research is particularly interesting because it challenges a well-known theory of schizophrenia, the Censure Deficit Hypothesis, which attributes observed decrements in the performance of schizophrenics to the disruptive effects of censure.

In Chapter 8, Kilpatrick, Sutker, and Smith compare normal and abnormal subjects on trait anxiety and sensation seeking. While alcoholics and drug addicts both scored much higher than normal subjects on Spielberger's trait anxiety scale, this measure failed to distinguish between the drug addicts and the heavy drinkers. In contrast, on Zuckerman's trait sensation-seeking scale the drug users scored much higher in sensation seeking than the alcoholics, who did not differ from the normals. Subsequent work in this field will be considerably facilitated by the recent development of a state sensation-seeking scale.

The final section of this volume is concerned with the diagnosis and treatment of clinical problems in which anxiety symptoms predominate. In Chapter 9, William McReynolds defines fear as a complex response with cognitive, motoric, and somatic components, which combine in *idiosyncratic ways* in each person. McReynolds evaluates the objective assessment techniques currently used by behavior therapists, and concludes that they are no less subject to distortion than verbal report measures. For example, if enough pressure is placed on a subject, he might pick up a snake while continuing to report veridically that he is "scared stiff." McReynolds also reviews a wide variety of techniques, including cognitive procedures, that have proven effective in the reduction of fear and in the elimination of avoidance responses.

In Chapter 10, Spielberger, Anton, and Bedell examine the nature of test anxiety, which they define in terms of its two major components: worry and emotionality or state anxiety. They note that in the treatment of test anxiety a disproportionate effort has been devoted in attempting to reduce emotionality in test situations, and that little attention has been given to eliminating the debilitating cognitive responses (worry, self-depreciating thoughts) of test anxious persons. On the basis of a careful review of the test anxiety treatment literature, Spielberger *et al.* conclude that reducing test anxiety is not sufficient to bring about improvement in academic achievement. There is also a need to improve the deficient study habits of test anxious persons that contribute to their inadequate preparation for tests.

Although some personality theorists insist that the construct of anxiety has outlived its usefulness and that the age of anxiety is over, the research and theory reported in this volume suggests a radically different conclusion. Earlier conceptions of anxiety and emotion have suffered because they were, at the same time, too narrow and too much influenced by vague clinical generalities. The contributions to this volume support a more complex state-trait conception of anxiety phenomena in which cognitive factors are central.

The development of new methods for the assessment of state and trait anxiety, and the construction of situation-specific trait anxiety measures, have helped to revitalize anxiety as a psychological construct. In the treatment of anxiety, cognitive factors are also receiving considerable attention. Apparently it is not enough to reduce the affective or felt aspects of anxiety. In order to improve performance, one must also eliminate the cognitive habits (worry responses) that are invariably associated with anxiety.

MARVIN ZUCKERMAN
CHARLES D. SPIELBERGER

Part I

ORIGINS OF FEAR, ANXIETY, AND OTHER EMOTIONS

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1

The Facts and Functions of Fear

Stephen J. Suomi

Harry F. Harlow

University of Wisconsin

Fear is not foreign to any social organism. Although long recognized by behavioral scientists, psychoanalysts, novelists, theologians, politicians, and philosophers as a major factor in the activity of most higher species, it has always remained a rather nebulously defined concept. Some investigators view fear as an emotional state, others focus upon it as a motivational force, while still others use its perception as a stimulus. The term is widely and diversely employed in our everyday language, both as a noun and a verb form—witness Roosevelt’s “we have nothing to fear but fear itself”—and as a modifier, it can serve both adjectival and adverbial functions. In short, across a variety of feelings, phenomena, and functions, “fear” seems to be intuitively understood by almost everyone. Yet it seems likely that it is misunderstood by virtually all as well.

There are at least two potential hazards in interpreting the facts and functions associated with fear. First, because it is used in so many different contexts, the term itself has possibly become too broad to have any predictive value. Second, because the emotional condition identified as fear is decidedly unpleasant for most individuals, it is compelling to dismiss it as undesirable, thus ignoring any adaptive function it might serve.

In this chapter we propose to address these points, using data accumulated from years of laboratory study utilizing rhesus monkeys as subjects. It is our contention that fear in monkeys, and most likely in all other primates, is an unlearned response system which soon after emergence into an animal’s behavioral repertoire becomes subject to the contingencies of the environment. Further, it is our position that the fear response system has evolved over millions of years and represents a mechanism adaptive in at least two respects: it enhances the probability of survival of individual species members, and it promotes and maintains social structures within the species. In the following pages we will

propose a workable definition of fear as exhibited by rhesus monkeys, trace its chronological development, and describe experimental factors which affect its frequency and intensity of occurrence. Finally, we will consider its evolutionary importance in the development and maintenance of social behavior.

FEAR AS STUDIED IN NONHUMAN SUBJECTS: PROBLEMS OF GENERALIZATION

There can be little question that all adult humans are in some way familiar with fear. There can also be little argument over the fact that fear is not an exclusively human property. Considerable anecdotal and experimental evidence has documented fearful-type behavioral reactions by members of numerous species, even though nonhuman subjects obviously could not have verbally reported their inner feelings or states. It seems more than probable that exhibition of fear is a near-universal capability of mammals and possibly other classes of animals.

Numerous studies investigating various aspects of fear have been performed on a variety of species. Although operational definitions of fear have differed considerably from species to species, they usually have involved description of a set of discrete behaviors, typically precipitated by a well-controlled form of stimulation. For example, a common index of fear among most species studied is urination and/or defecation, reflecting a loss of autonomic control following presentation of certain stimuli. The dependent measure is sometimes termed the "bolus count." Other behavior patterns often associated with fear in nonhuman subjects have included withdrawal from stimuli, aversion of the eyes, or emission of particular vocalizations.

These fear behaviors have been carefully monitored following specific "standard" experimental manipulations such as placement in a totally novel environment, subjection to inescapable shock, or exposure to a natural predator. Some researches have achieved "conditioning" of fear, whereby previously neutral stimuli have acquired the same capability to produce fearful behavior patterns as "standard" stimuli following periods of pairing. The classic example of this approach in the human literature has been the study by Watson and Rayner (1920) involving "Little Albert." Here, a previously neutral stimulus, a white rat, was paired with a loud, noxious sound, an unlearned fear stimulus, and soon Albert was petrified at the sight of anything white and furry. Similar studies have been performed using animal subjects, for example, Masserman (1943). The assumption made in these studies is that the "conditioned" fear response is identical to the original form of fear response, even though all one observes is the behavioral concomitant or, more often, only a predefined portion of it.

Other investigators, in efforts to utilize more "objective" measures of what they believe to represent fear, have concentrated on physiological concomitants.

Commonly used physiological indices of fear in nonhuman subjects have included changes in autonomic activating systems, such as heart rate, blood pressure, and respiratory rate increases, various patterns of EEGs, vasoconstriction, and secretion of certain hormones. One problem encountered with use of these measures is the fact that they are nonspecific. They all can be elicited, in whole or in part, by a number of stimuli which could be construed to be other than specifically fear inducing. For example, many of the above measures are highly activated during sexual arousal, but one would be hard put to classify such activity as intrinsically fearful for most human or nonhuman subjects. Thus, researchers employing such measures lack the absolute assurance that what they are measuring in their subjects is truly fear. Indeed, they usually prefer to describe their data as indices of "emotionality," or "arousal."

Nevertheless, such problems in definition and measurement have not prevented animal researchers from generalizing their findings to human behavior. For example, results obtained from studies of rats in approach-avoidance paradigms have been employed for explanation of neurotic and psychotic behavior patterns associated with human phobias. Displacement behaviors obtained in fish and birds by ethologists regularly appear as explanations of human activity in stressful situations (Lorenz, 1965). Behavior patterns described as representing "experimental neurosis" in nonhuman mammals have been used to explain human patterns of psychopathology (Liddell, 1947). Tonic immobility observed in numerous nonmammalian species has been related to human catatonia, catalepsy, and cataplexy by several investigators (Gallup & Maser, 1974). In each case, the reactions of nonhuman subjects to manipulations conceived by the experimenters to be fear inducing in one way or another have been recorded, and the long-term consequences of such manipulations have been posited as models for various human psychopathologies.

Such generalization of research findings obtained from nonhuman subjects to human characteristics and predicaments rests upon at least two basic assumptions. The first involves the belief that these behaviors observed in nonhuman subjects are indeed akin to human-like fear, if not identical to human fear itself. The second assumption lies in the feeling that the procedures involved in production of these behavioral forms mimic the etiology of the human disorders. Of course, both of these assumptions are not beyond question, but testing their validity is far from a simple matter, because verbal reports in animals are nonexistent and because there is a paucity of rigorous etiological data for most human psychopathologies.

We, too, have been engaged in nonhuman research at Wisconsin, much of it directed toward uncovering relationships which hold for humans as well as for the rhesus monkeys we study. Out of necessity, we have been acutely aware of the problems inherent in the generalization of findings from one species to another (Harlow, Gluck, & Suomi, 1972), and have thus found it profitable to establish criteria which our data must meet in order to generalize with accuracy

rhesus monkey facts and functions to humans or to other species. These criteria have been described and discussed elsewhere in detail (McKinney & Bunney, 1969), but three of those most important can be mentioned. First, the behavior patterns thought to manifest functions that transcend species ought to be similar in each species studied. In other words, if the behaviors associated with intense fear in humans can be found in the monkey's behavioral repertoire, one is on stronger grounds in proclaiming generalization of fear reactions from man to monkey than if similar behaviors do not exist.

Second, the case for generalization of findings from one species to another is necessarily strengthened if the manipulations which produce the activity in question are similar or identical across species. A stimulus such as a live snake usually produces withdrawal and vocalizations in some humans and is often accompanied by verbal reports of fear. The same stimulus produces similar behaviors in monkeys, which obviously cannot verbalize any fear. But the inference that fear exists in these monkeys is compelling.

A final criterion employed to justify particular generalizations involves the nature of manipulations or procedures which alleviate or attenuate a system of response. If these are similar across species, one is more certain of the generalization. For example, a human infant who stops crying when picked up by its mother is likely exhibiting the same phenomenon as a monkey infant who stops screeching when it is picked up by its own mother.

In sum, one can establish criteria for the validity of cross-species generalization. When these criteria are met, generalization becomes appropriate. When they are not met in full, generalization becomes suspect. At this point, one might reasonably ask, "why generalize?" What is the purpose of cross-species generalization?

We can readily point out what we consider to be two extremely important functions of generalization, particularly from monkey to man and vice versa. The first is simple and direct: certain researches are impossible to perform on human subjects for either ethical or practical reasons—sometimes both. Some of these researches can be successfully carried out with nonhuman primate subjects, assuming that generalization is appropriate. In these cases it is possible to learn facts about human behavior which could not be properly pursued via human research.

The second reason for generalizing is not as readily apparent. If findings obtained on one species, for example, the rhesus monkey, can be generalized to another species, for example, *Homo sapiens*, then by definition the findings do not reflect a system of behavior or function which is exclusive of a single species. If, for example, it can be shown that rhesus monkeys react with fear-associated behaviors to a certain class of social stimuli which elicit fear responses in humans, then it cannot be maintained that reactivity to that class of stimuli is an exclusively human disposition. Thus, recent work suggesting that chimpanzees possess the capacity to interpret and communicate syntactical concepts seriously

undermines previously held notions concerning the uniqueness of certain aspects of human language (Gardner & Gardner, 1974; Premack, 1971; Rumbaugh, Gill, & von Glaserfeld, 1973).

Continuing this theme, if a set of behaviors or functions can be discovered to exist in more than one reasonably related species, then it is likely that the phenomena possess some evolutionary significance. If one takes evolutionary theory seriously, then he or she is unlikely to attribute the same constellation of behaviors in reaction to the same stimuli across more than one species to mere chance. Rather, one is more apt to conclude that the capability to react in the given manner now has, or had at one time, adaptive consequences which increase the probability of individual survival and/or species propagation. Discovery of similarities of phenomena across species will invariably enhance the acknowledged evolutionary importance of those phenomena (Hinde, 1974).

We have included this brief discussion of generalization of data from one species to others because we believe it is basic to the material which follows. Specifically, data will be presented concerning the appearance and development of fear responses in monkeys. Similarities between these data and human data will be pointed out, and some conclusions will be offered regarding the evolutionary significance of fear reactions for social and nonsocial development and survival.

STIMULI AND RESPONSES ASSOCIATED WITH FEAR IN RHESUS MONKEYS

As previously pointed out, one cannot approach the study of fear in nonhuman primates by asking monkeys what makes them frightened, but this does not preclude investigation of such phenomena. Rather, study of fear in rhesus monkeys has been accomplished by "asking" the subjects nonverbally which stimuli elicit fear, and the monkeys' answers usually are behavioral responses. What are these fear stimuli, and what are the resulting responses?

Stimuli which elicit fear responses in rhesus monkeys can be generally divided into two classes: those which are innately fearful, and those which yield fear behaviors only after associative learning. The former covers a wide range of stimuli, but surprisingly for rhesus monkeys, natural predators apparently do not fall into this group. Wild-born monkeys rapidly develop a healthy respect for animals such as tigers and leopards which might endanger their existence, but the evidence suggests that this tendency may be learned. For example, Joslin, Fletcher, and Emlen (1964) studied the reactions of feral-born rhesus monkeys to live bull snakes and inanimate models varying in the degree they resembled the real snakes. All but a few of the subjects showed clear fear behaviors in the presence of the snakes and those stimuli which most closely approximated them. Such behaviors were not exhibited when neutral stimuli such as wooden cubes

were presented. In sharp contrast, monkeys who had been born and raised in the laboratory showed no fear of either animate snakes or their closest inanimate models. The authors concluded that fear of snakes was not an inherited tendency of rhesus monkeys and that most likely it was acquired via observational learning, a capability well within the cognitive limits of the genus (Miyadi, 1959; Riopelle, 1960).

These and similar findings have contributed support to the theoretical position of Klopfer (1962) and more recently Stephenson (1975) regarding the evolution of fear behavior. They believe that prewired sensitivity to specific stimulus patterns could be adaptively harmful if the species evolved in an environment where natural predators were widespread in range and turnover. In other words, if predators changed more rapidly than genes, the species would be in trouble. Inasmuch as rhesus monkeys and most higher primates had ancestors during an epoch when this was the case over the ancestors' ranges, it is intuitively compelling to accept the position that most predatory-based fears are learned. This principle does not necessarily hold for all animals. Most avian species, for example, have specific stimuli such as predatory birds which are innate elicitors of fear behavior. With most primates this is apparently not the case.

This does not mean that there exist no stimuli which can produce fear behavior independent of experience. The group of animals most able to produce fear responses which have no basis in learning turns out to be the subjects' *own* and closely related species. Certain social stimuli very clearly have a prepotent capacity to produce fear, a fact which will be discussed at length subsequently. These include various facial gestures and body postures. For example, the social threat posture of a large male readily elicits fear responses from most monkeys, relatively independent of social rearing history. Also, it has been found that dead or mutilated bodies, for example, severed heads, of fellow monkeys are powerful elicitors of fear behaviors (Van Lawick-Goodall, 1973). It might be noted that the very same forms of stimuli are apparently quite effective fear producers within the human species.

Another general category of innate fear-releasing stimuli for monkeys covers a variety of phenomena which are most easily described as grossly novel compared to previous configurations. Monkeys are fearful of the very strange, and such fear is displayed almost as soon as infants are capable of distinguishing the strange from the familiar. The form of the novelty may vary across several sensory modalities; it is the degree of novelty that is important for elicitation of fear behaviors. Very strange and/or powerful visual stimuli, such as extremely bright television spotlights, consistently elicit fear behavior in monkeys of all ages (Dodsworth, 1975). Likewise, loud, sharp, and unfamiliar noises are particularly effective fear stimuli (Novak, 1973). Extremes in temperature (Baysinger, Plubell, & Harlow, 1973) and unusual kinesthetic stimulation (Milbrath, 1971) appear to be equally reliable producers of fear. The effectiveness of such stimuli

are not necessarily limited to laboratory situations. Naturally occurring extremes in light, sound, temperature, and kinesthetic phenomena elicit fear in feral animals. Lightening, thunder, fire, high wind, and sudden changes in barometric pressure yield behaviors which can be appropriately described as fearful in monkeys young and old.

The other class of stimuli can be characterized as being learned, i.e., neutral *a priori* but meaningful only after specific experiences. For example, a harmless-looking object wired with electric shock will soon be totally avoided by even the most socially deficient monkey (Sackett, 1968). Virtually any object or individual associated with painful or otherwise aversive stimulation can acquire fear-provoking capabilities. Like many other animals, rhesus monkeys can develop fear behavior specific to given individuals. For example, a young monkey may develop an attachment to the person who frequently dispenses sugared candies and other treats, but the same monkey will scream with terror the moment the animal caretaker who draws blood samples enters its housing room. These animals learn many things very fast—fear included. Hence virtually any stimulus can be potentially fear invoking, given the appropriate pairing.

A special class of learned fear stimuli involves specific members of the subject's own species. Very early in life, usually by three months of age, monkey infants can differentiate between friends and strangers, and strangers as often as not elicit fear response (Suomi & Harlow, *in press*). Even within the same social group, individuals who are "neutral" to some animals may be terrifying to others. For example, among several macaque species, offspring of dominant females are seldom attacked, harassed, or otherwise bothered by other members of the social group. These infants grow up fearing no other group members. In contrast, offspring of females low in the group's dominance hierarchy may be attacked by other infants, juveniles, and adults of both sexes. Such infants are likely to develop a healthy respect for the rest of the group and consequently will almost never initiate any major sequence of behavior without first visually "checking out" the other animals in the group (Koyama, 1967). Certain social stimuli can be enormously effective inducers of fear behavior in certain monkeys.

Thus, we can delineate several classes of stimuli which evoke fear responses in monkey subjects: certain species-specific social gestures, the very novel, and situations, objects and/or individuals which have been associated with previous noxious experiences. But what do we mean by fear? What are the specific elements, if any, within a monkey's behavioral repertoire which can be reliably identified with the type of response which would be labelled "fear" in humans?

As in most animals, human and nonhuman, behavioral manifestations of fear in rhesus monkeys have a rather wide range across individuals of both intensity and mode of expression. However, one particular behavior pattern—the fear grimace—has always been associated with fear across all individual monkeys and situations. The fear grimace is a facial expression which can be loosely described

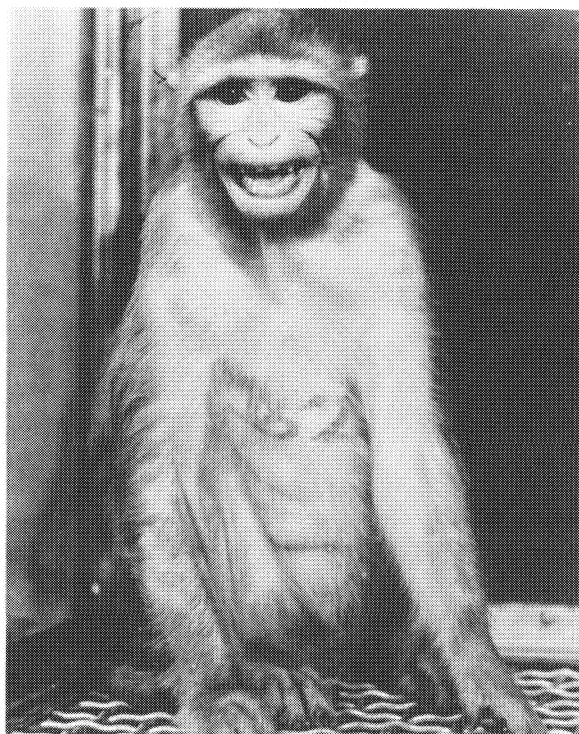


FIG. 1 The fear grimace, as exhibited by a young rhesus monkey.

as a monkey "smile" with teeth exposed. More specifically, it entails retraction of the corners of the mouth, a pulling back of the lips, and full exposure of upper and lower teeth. A typical fear grimace is illustrated in Fig. 1.

Fear grimaces are almost always associated with fearful *social* stimuli. For example, an attacking, dominant, strange adult male is almost certain to elicit a fear grimace from a smaller monkey, whereas a flash of lightning may well elicit fear but usually no fear grimace. As we shall shortly see, the fear grimace is clearly an unlearned response pattern which matures at a given chronological point independent of environmental contingencies. This fact is consistent with the previously mentioned notion that social fears need not be learned but rather may be prepotent, elicited by species-specific gestures and body postures. It makes sense that a response system which has an unlearned basis and is triggered by specific stimuli would itself be maturationally determined. Fear grimaces come as close to qualifying as fixed action patterns (FAPs) as any response system which can be found in a rhesus monkey's behavioral repertoire. Unlike other behavior patterns, the fear grimace is never used as a bluff. To a certain degree, the intensity of social fear stimuli is reflected by the frequency and duration of fear grimace behavior shown by a given subject.

This is not to maintain that the fear grimace is the *only* behavioral concomitant of fear in monkey subjects. There are other indices of fear in the monkey's total behavioral repertoire. Unfortunately, they do not share all the properties of the fear grimace: they are not necessarily specific responses to threatening situations, nor do they necessarily vary quantitatively with the intensity of the fear stimuli. Rather, qualitatively different constellations of specific behaviors could be expected in situations which vary to the degree with which fear behaviors are provoked, instead of merely different frequencies of the same set of behaviors. Nevertheless, years of study of the behavior of rhesus monkeys of all ages, reared in different environments and observed in diverse settings, have consistently verified that these activities represent fearful responses to various stimuli, both social and nonsocial.

For example, monkeys beyond a month of age will exhibit approach-avoidance behavior when presented with novel objects that are not overtly noxious. Initially, there is avoidance, but subsequently behaviors which are ambivalent in nature may be exhibited. To give two examples, an infant monkey presented with a novel object or monkey may run back to its mother, or an older monkey might run back toward the center of its social group. If these responses do not lead to some sort of social support, the animal's reaction to the stimulus will likely remain fearful. However, if the original aversive response is followed by limited or lasting social support, the subject's behavior changes to



FIG. 2 Infant returning to surrogate mother for security.

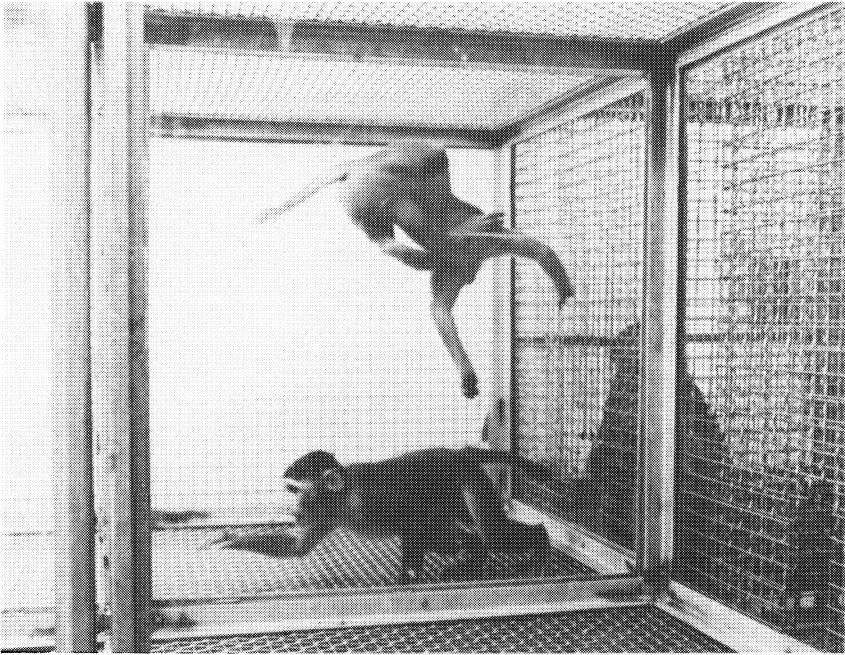


FIG. 3 Fear through flight.

ambivalent approach-avoidance, and over time, fear, and flight change to search and exploration of the same stimulus. Thus, if an infant's mother supports and comforts her infant when it runs from the "fearful" stimulus, it is likely to go back out and further investigate the object. Indeed, considerable research has shown that artificial surrogate mothers apparently can provide "support" so that infants will readily use them as bases for exploration of the environment, as is illustrated in Fig. 2 (Harlow & Suomi, 1970). Similarly, the adult who has the backing of its social group is likely to return to the stimulus for further investigation. If social support is not provided, the avoidance is apt to persist. This form of avoidance behavior is among the most mild which can still be called fear.

A clearer exhibition of fear behavior can be seen in pure flight behavior, usually to a place of security. There is no ambivalence in this activity, but simply rapid withdrawal. If no appropriate social object of support is available, a rhesus monkey will head for the portion of the environment farthest from the threatening stimulus. In a laboratory situation this usually means the upper corner of a cage, as can be seen in Fig. 3.

As fear increases, so does the degree of behavioral disturbance. Loss of autonomic control, including spontaneous urination and/or defecation, becomes a typical concomitant. Crouching, self-clasping, and aversion of the eyes, as

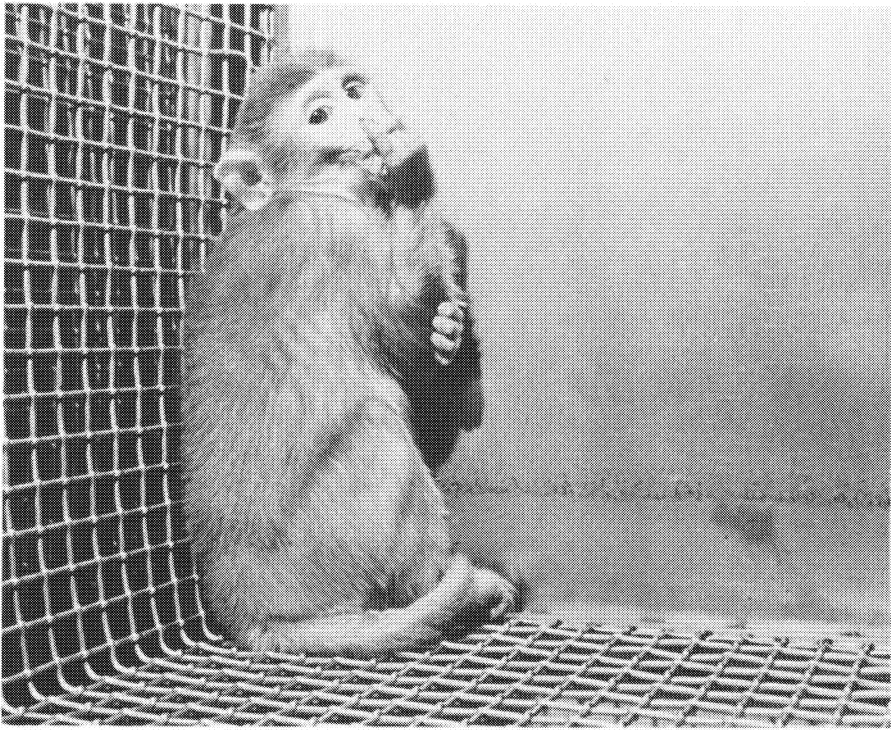


FIG. 4 Visual withdrawal from fear stimulus.

shown in Fig. 4, are also typical concomitants of intense fear. Animals who possess stereotypic patterns of activity in their repertoire, are likely to exhibit these patterns at an increased rate when exposed to fear stimuli. For example, an isolate-reared monkey who periodically exhibits stereotypic rocking is very likely to rock vigorously and compulsively when frightened (Mitchell, 1970).

Perhaps the most severe behavioral exhibition of fear in rhesus monkeys is freezing behavior, in which the subject becomes immobilized. Illustrated in Fig. 5, this behavior can be found in situations involving natural predators or terrifying fellow-species members. Such intense fear seems to be similar to the tonic immobility characteristic of many avian and mammalian species (Gallup & Maser, 1974).

THE DEVELOPMENT OF FEAR IN YOUNG MONKEYS

Behavioral representations of fear in rhesus monkeys show major changes associated with increasing chronological age. In this respect they do not differ from most complex patterns of activity in monkeys—very few systems of behavior are present in their final adult form when they first emerge as part of a young

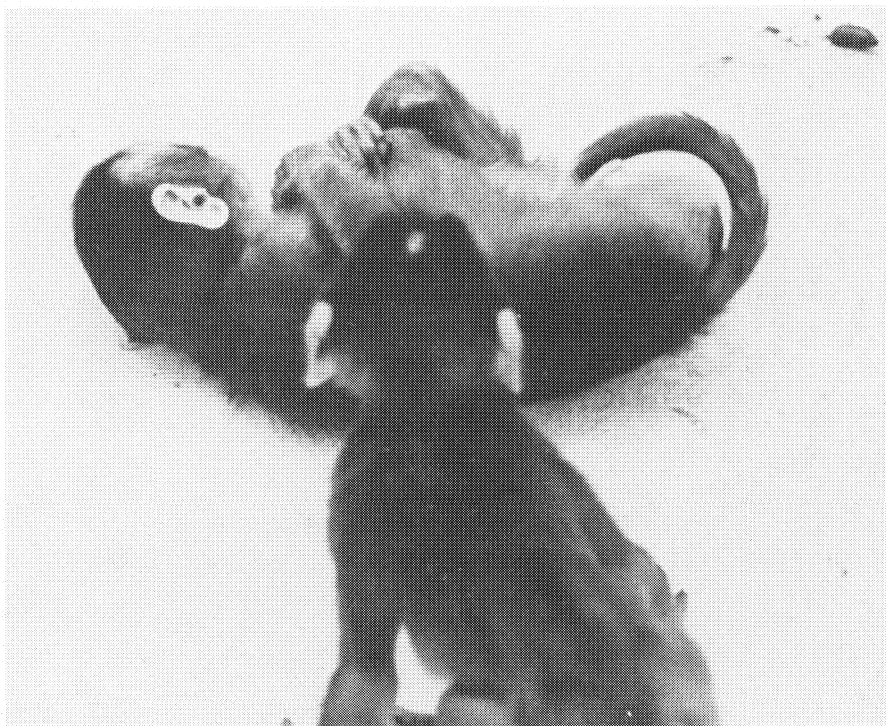


FIG. 5 Monkey immobilized by fear.

monkey's repertoire. Rather, like most response systems, activities associated with fear undergo considerable change in form, style, and sophistication. Fear in adult monkeys often differs in form from fear in infants, just as some of the stimuli which elicit fear in infants do not elicit fear in adults, and vice versa. The above observations hold for man as well as for most primates and other mammals. In short, in these species fear responses are more flexible than fixed, a fact not without certain evolutionary significance. Complex organisms whose repertoires transcend fixed action patterns seem intuitively better equipped to adapt successfully to nonstatic environments.

However, of equal importance in terms of evolutionary significance is the fact that fear, at least as a social response, is not present at birth in monkeys. Rather, it emerges later in life, well after other behavioral systems have matured and become integrated into the young animal's developing behavioral repertoire. Analysis of the ontogeny of fear behaviors, the chronological points at which they first begin to appear, and the existing behavioral repertoire available to the infant when the behaviors emerge indicates some relationships whose implications are most significant in determining the function of fear.

While infant monkeys do not exhibit specific fear reactions at or shortly after birth, they do possess other behavioral capabilities which are primarily reflexive

in form. Neonatal monkeys root, cling, suck, and cry from birth, and all of these behaviors are precursors to major response systems which will dominate their activity later in life. For example, sucking later becomes the basis for eating behavior, while clinging provides the mechanisms by which social attachments will be developed and cultivated (Harlow, 1958). Within the first two weeks, these initially reflexive behavior patterns come under voluntary control (Harlow & Harlow, 1965).

Within the first month of life the clinging reflex has been transformed and developed into a set of behaviors directed toward maintaining strong and specific social attachments. We consider the fact that monkeys form attachment relationships before they exhibit fear most important in understanding the function of fear. The attachments by the end of the first month of life in feral environments are almost always directed toward mothers, but in laboratory situations it has been shown that attachments similar in form can be developed to adult males (Redican & Mitchell, 1973), peers (Chamove, Rosenblum, & Harlow, 1973), surrogate mothers (Harlow & Suomi, 1970), and even furry dogs (Mason, 1974). The capability to form attachments is present before the capability to exhibit fear responses.

This is not without evolutionary significance, since the evidence indicates that the same tendencies exist among the young of most mammalian social species (Klopfer, 1962). Having the capacity to form early and strong social attachment almost assures that infants will be securely attached before they first exhibit fear responses. Their objects of attachment can then serve the purpose of tempering and moderating the initial fear reactions as such response patterns emerge into the young animals' behavior repertoires.

In what behavioral form does fear initially appear in the infant macaque? Numerous investigators have observed and described a behavior, commonly called "geckering" by primatologists (e.g., Altmann, 1962; Lindburg, 1973), which some investigators believe reflects a fear reaction. Geckering consists primarily of spasms or body jerks, usually accompanied by sharp vocalizations. However, as Sidowski (1974) points out, it appears unlikely that this is a true fear response. Geckering seems to reflect reflexive activity with no discernible environmental cause. It appears spontaneously in infant monkeys reared in a variety of social situations and declines sharply as the infants grow older. When discernible fear behaviors finally emerge in young monkeys, their occurrences are uncorrelated with the incidence of geckering (Sidowski, 1974).

Bonafide fear behaviors are first exhibited by young monkeys at about four weeks of age. They typically take the form of approach-avoidance activity if the infant is living in a stable environment and has had the opportunity to form a social attachment. For example, in an unpublished study conducted several years ago at Wisconsin, several infants were separated from their mothers at birth and reared on surrogate mothers. Beginning at seven days of age a stimulus object was periodically placed in the cage containing each subject and its surrogate. It was presumed that some of these external stimuli would produce fear at an early

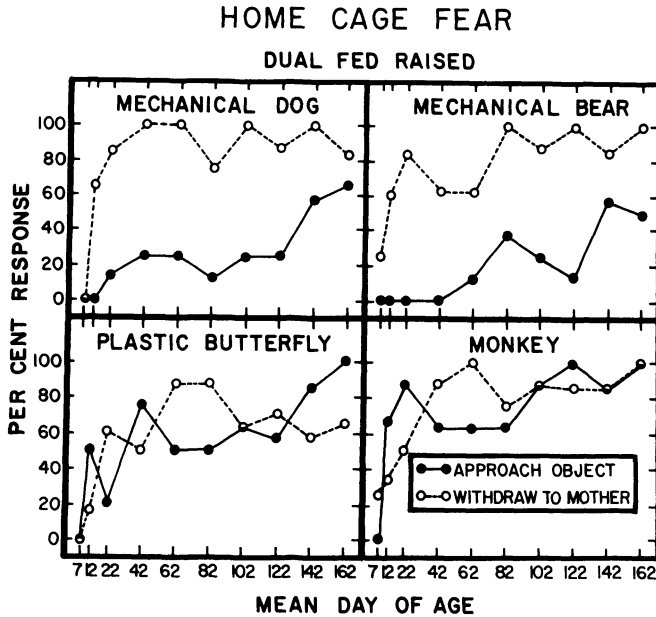


FIG. 6 Approach and withdrawal to various stimuli.

age and some would not. Among the stimuli were a small plastic butterfly supported from a narrow wire hook, an immobile stuffed monkey doll somewhat larger than the infant monkeys themselves, a mobile, noisy, mechanical dog, and a moving mechanical bear. Two different behavioral measures were taken: one, the positive exploratory responses made by monkeys to the inanimate object, and the other, the frequency of withdrawal to the surrogate mother. We judged these to be representative of approach and withdrawal responses.

Results of the study are summarized in Fig. 6. The infants' responses to the plastic butterfly were predictable. As soon as the neonates could locomote, they frequently left the surrogate and approached the butterfly. Although the infants moved back and forth from the butterfly to their surrogates, they did so without signs of trepidation or terror. The responses to the monkey doll were somewhat surprising since the infant monkeys positively explored this object with no trace of terror or turmoil. Indeed, the frequency of positive responses by the infants to the doll were almost identical to the frequency of responses to the surrogate. Actually, early in life monkeys do not readily differentiate between social and similar sized and textured inanimate objects (Baldwin & Suomi, 1974). Therefore, social-like approaches are likely to be initiated toward adult females, peers, and surrogate "mothers" by monkeys of this age, whereas withdrawal from such stimuli is considerably less common.

Almost all of the infant monkeys' responses to the mechanical dog and the bear were initially avoidant. The only surprising fact was that the infant

monkeys showed an increasing frequency of approach to these two objects from about a hundred days onward. The fear of the mechanical dog and the mechanical bear was probably alleviated by the presence of the surrogate mother, always available for the infants.

These findings are hardly unique. Monkey infants have been venturing from, then scurrying back to their real mothers for countless millenia, and their evolutionary predecessors undoubtedly did so too. In this manner the young monkey soon learns which novel aspects of a rapidly changing environment can be explored or ignored without danger. During the learning it can always run back to mother. As we shall soon see, infant monkeys denied mothers often fail to approach novel objects because they have no suitable security object to which to return. For these unfortunate animals the early mild fears are never satisfactorily reduced, and unless radical therapeutic interventions are initiated, the subjects remain excessively fearful of most novel stimuli throughout the rest of their lives.

The incidence of approach-withdrawal activity associated with novel objects and mother figures is influenced by a number of parameters. These include nature and stability of the immediate environment, disposition and experience of the mother figure, and constitutional aspects, such as activity level, of the infant. Consequently, there is considerable variation across individual infants with respect to the chronological point at which the activity first emerges.

The data regarding the development of the fear grimace are considerably more precise. Numerous studies of behavioral development of infant rhesus monkeys in social groups (Hansen, 1966; Harlow & Harlow, 1969; Rosenblum, 1961; Ruppenthal, Harlow, Eisele, Harlow, & Suomi, 1974) have reported that the behavior is not exhibited prior to 60 days of age. Other data confirm this finding among monkeys reared in more socially restricted environments. For example, Harlow and Zimmermann (1959) reported that infant monkeys reared on surrogate mothers first began showing grimace behavior at an average of 75 days of age. Baldwin and Suomi (1974) found a similar date of initial occurrence among partial isolate-reared monkeys periodically exposed to various social and nonsocial stimuli.

The classic study concerning the origin of fear responses in young rhesus monkeys was performed by Sackett (1966). He raised eight infants from birth in total social isolation chambers, that is, wire-mesh cages covered by Masonite to prevent visual and tactual contact with conspecifics. The monkeys' only source of visual stimulation was a series of slides, projected on the back wall of each subject's cage for 15-30 min daily, beginning when each monkey was 14 days of age and continuing for the next 8½ months. Some of the slides were controlled by the experimenter, while others could be "chosen" by the subjects via the pressing of a small lever inside their isolation units. Ten types of slides were used: a monkey threatening, an infant peering at the subject, a monkey withdrawing, a monkey exhibiting a fear grimace, a monkey playing with another monkey, a monkey exploring a toy ball, two monkeys copulating, a mother-

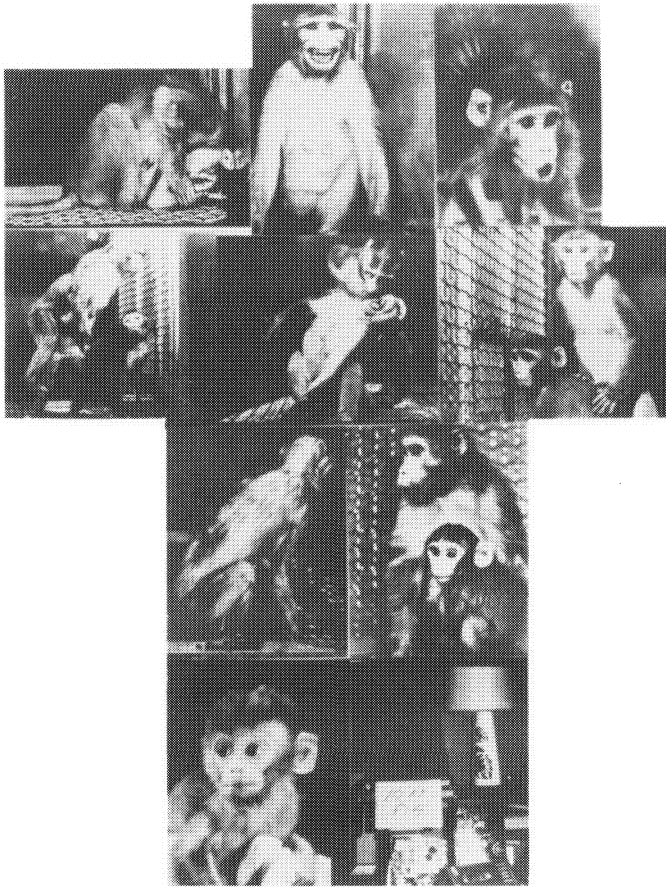


FIG. 7 Stimuli employed in Sackett's (1966) study.

infant monkey pair in ventral contact, a blank slide, and a control slide of the experimenter's living room. Some of these slides are illustrated in Fig. 7. Behavioral reactions of the infants to each slide presentation were recorded throughout the study.

The data in Sackett's study most relevant to the present discussion involved the monkeys' reactions which could be classified as fearful, including withdrawal, stereotypic rocking, huddling, and most importantly, fear grimacing, to the slides. Sackett found fear behavior to occur at uniformly low or nonexistent levels throughout the 9-month period for all pictures *except threat*. Beginning at 2 to 2½ months and peaking at 2½ to 3 months, each subject exhibited high levels of fear behavior, including the initial fear grimaces, whenever the slide of a monkey threatening appeared. Furthermore, during this chronological period the

subjects also stopped showing the threat slide when they could control the slide selection by lever pressing.

Sackett interpreted his findings as follows: there exist for socially naive infant monkeys certain stimuli which appear to have unlearned, prepotent activating properties. In particular, threat as a visual stimulus appears to function as an "innate releasing stimulus" for fearful behavior. The mechanisms underlying this activity are maturational in nature, not present at birth but emerging at 60–80 days of age. We tend to agree with Sackett's interpretation.

More generally, Sackett's data support our belief that the fear grimace is initially a socially elicited, fixed action pattern, which is universal among most nonprosimian primate genera. It differs from other forms of fear behavior in that it specifically represents *social* fear, which is elicited by certain social stimuli. It is precise in form and relatively precise in its chronological point of appearance. Its form and time of emergence are apparently independent of rearing environment. These are classic characteristics of fixed-action patterns.

The incidence of such activity is widespread across the primate order. In man there exists a similar, perhaps identical, reaction referred to as 8-months anxiety (e.g., Spitz, 1946), the chronological point when true social fears first emerge in human infants. Although the form of the response is not physically identical to that shown by rhesus monkeys, other aspects of it are. As the name implies, 8-months anxiety appears at the same chronological point relatively independent of social environment or culture. It is interesting to note that rhesus infants mature at a rate equivalent to four or five times that of human infants, and in this respect the point of emergence is the same developmentally for both species. In both species its occurrence follows, rather than precedes, the point at which specific social attachments are able to be formed by the infants.

SOCIAL REARING CONTINGENCIES THAT AFFECT THE EXHIBITION OF FEAR BEHAVIORS IN YOUNG MONKEYS

Once fear behaviors such as the fear grimace have emerged as part of the young monkey's repertoire, they become subject to a number of environmental contingencies. Obviously, the frequency and severity of fear behaviors are in part functions of the presence of fear-provoking stimuli in the infant's immediate physical environment. But in addition, a considerable body of data has convincingly demonstrated that propensity for fearful reaction is very much a function of the young animal's social rearing environment.

Perhaps the social rearing variable most crucial for responsivity to fear stimuli is whether the subject has had an adequate mother, or mother substitute, prior to the emergence of fear reactions. Indeed, any social object during this period appears to be better than none at all. Monkeys reared in total or partial social

isolation are far more prone to exhibit intense fear reactions toward most stimuli than monkeys reared with their mothers, peers, or cloth-covered surrogates. A stimulus such as a tennis ball, which is typically an object of exploration for mother-peer-reared monkeys is apt to elicit intense terror from an isolate monkey (Baldwin & Suomi, 1974). This enhanced susceptibility for fear reactions persists through adulthood for isolate-reared subjects (Mitchell, 1970).

Nevertheless, various social objects are not equal in their capability to modulate fear reactions in young monkeys. For example, Harlow's early surrogate work (Harlow, 1958; Harlow & Zimmermann, 1959) clearly demonstrated that cloth-covered surrogate mothers were effective fear-reducers for baby monkeys, whereas wire-covered surrogates were not. More recent data have shown that mothers are far more proficient in alleviating infant monkey fear than are peers. Infants raised with other infants but without mothers develop strong social attachments but little sense of security (Suomi & Harlow, 1975); they generally are timid as infants, adolescents, and adults.

Harlow has often argued that such findings provide monkey support for Erikson's concept of security and trust as a basic stage of human social development (c.f., Harlow & Harlow, 1965; Harlow, 1969). It is his position that a major function of a mother figure, be it monkey or human, is to establish a perception of security early in the life of her infant, so that the changing environment does not immobilize the infant via fright and/or retard its development. In this regard the data clearly show that most real monkey mothers are far superior to cloth or wire-covered artificial mothers or peers (Hansen, 1966; Harlow & Harlow, 1969; Suomi & Harlow, *in press*). The fear-reducing properties of the maternal figure can have benefits which persist long after the infant has left its mother. Later in this chapter we will discuss the implications of these findings at greater length.

Just as the lack of a mother, or mother substitute, before the maturation of fear responses can drastically increase an infant's propensity to exhibit fear reactions, so can loss of the mother, or mother substitute, once an attachment has been formed. Numerous researches have focused upon the immediate and long-term consequences of separating infant monkeys from their mothers after strong attachment bonds have been formed. The effect of such separations upon the exhibition of fear responses has consistently been found to be both profound and persistent. During the period of separation the incidence of fear grimaces increases several fold over pre-separation levels, not only in rhesus (Seay, Hansen, & Harlow, 1962; Seay & Harlow, 1965) but also in virtually every other primate species studied (Kaufman & Rosenblum, 1967; Preston, Baker, & Seay, 1970; Schlottmann & Seay, 1972). Similar findings have been reported for human infants unfortunate enough to have been separated from their mothers after attachment bonds had been formed (Bowlby, 1973; Spitz, 1946). "Separation anxiety" is probably a phenomenon universal among social animals.

Infant monkeys do not necessarily return to normal levels of fear-associated behaviors following reunion with mother. For example, Hinde and Spencer-Booth (1971) reported that subjects were overly timid and fearful a full six months after reunion following six days of maternal separation. A far milder form of maternal separation, consisting of removing an infant from its homecage and housing it for one 2-hour period every 2 weeks in a small transport cage, was demonstrated to have a marked affect on the animal's propensity for fear reaction through adolescence (Mitchell, Harlow, Griffin, & Møller, 1967). These and other researches strongly suggest that there exists a close relationship between the nature of an infant's social attachment relationships early in life and its reactivity toward fear stimuli later in life. Gross discrepancies from a normal social environment generally produce monkeys that are excessively and inappropriately timid. Mild differences among individual mother-infant pairs tend to be reflected in minor but statistically significant differences among the infants in fear reactivity (Hinde & White, 1974). The principle most likely generalizes to humans.

USE OF FEAR AS AN EXPERIMENTAL MANIPULATION IN STUDY OF ATTACHMENT

In the previous section we pointed out the affect of attachment relationships upon the exhibition of fear behavior in monkeys. Two recent experiments have taken the opposite approach and have studied the effects of repeated presentation of fear stimuli on the development of social attachments in young monkeys. These studies will be examined in detail, because their findings shed considerable light upon the apparent function of fear in monkey development.

In the first study, Sidowski, Harlow, & Suomi (1972) hypothesized that exposing infants periodically to an ostensibly intense fear-inducing stimulus could produce major effects upon the development of the monkeys' behavioral repertoire. Six infant monkeys were employed in this study, all of whom had been separated from their mothers at birth and reared for the first 30 days of life in the laboratory nursery, according to the procedure described by Blomquist and Harlow (1961). At this point they were placed in one of two rearing conditions: in one, two males and two females were housed as sex-matched pairs; in the other, the remaining male and female subjects were housed individually, and each was provided a heated, simplified surrogate mother, fully described by Harlow and Suomi (1970).

Considerable previous research had indicated that monkeys so reared would inevitably develop strong and persistent attachments to their partners and surrogates, respectively (Harlow, 1958; Chamove, 1966; Chamove, Rosenblum, & Harlow, 1973; Suomi & Harlow, 1971), as indicated by both adient and

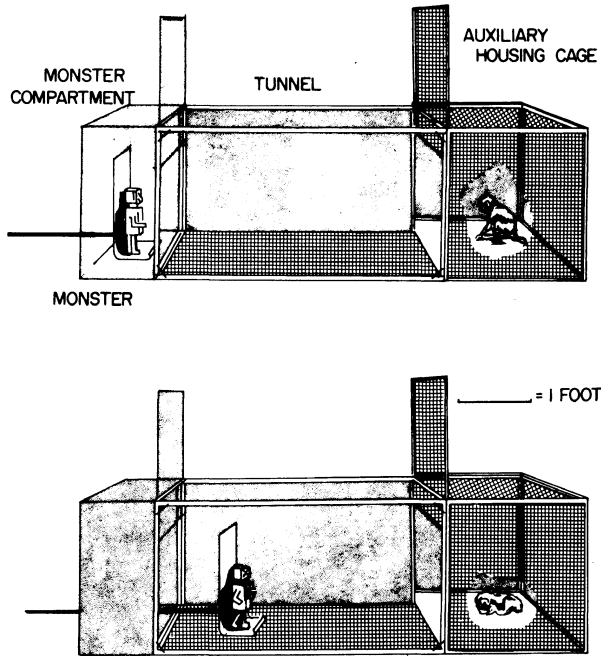


FIG. 8 The "tunnel of terror."

contact responses in the partner-surrogate's presence and protest in the partner/surrogate's absence (Harlow & Zimmermann, 1959; Suomi, 1973; Suomi, Harlow, & Domek, 1970).

Four weeks after being paired with their respective attachment object, subjects were periodically exposed to a fear-inducing situation. They were placed in an apparatus termed by Harlow the "tunnel of terror." The device is illustrated in Fig. 8 and is fully described by Suomi and Harlow (1969). Basically it consisted of a rectangular-shaped tunnel 48 × 18 × 24 inches, along which fear stimuli could be progressively advanced toward subjects housed in standard laboratory cages positioned at one end of the tunnel. Sliding doors at either end of the apparatus permitted concealment of the fear stimulus from the subject until the time deemed appropriate by the experimenter. The fear stimulus was nothing more than a J. C. Penney battery powered toy robot, which when turned on moved its arms and legs and opened its chest to expose flashing lights, accompanied by a "machine-gun-type" sound. The robot was attached to a 66-inch-long metal pole with the on-off switch at the opposite end, permitting the experimenter to control and advance the robot down the tunnel manually. Pilot work clearly established that the device was an effective fear stimulus for infant monkeys.

All subjects were exposed to the fear stimulus for a 5-min period once every 2 weeks, a total of nine times. During each presentation the stimulus was slowly

advanced until it was inside the subject's cage, where it remained for the final 30 sec. of the test period. Once each week subjects were placed in the tunnel with the stimulus absent for a 5-min control period. Subjects were always paired with their attachment object during the fear and control exposure periods. Their behaviors were continuously recorded during each session, beginning 5 min. prior to exposure and ending 5 min after the robot was removed from the subject's cage. Homecage observations were also obtained 2 days per week throughout the study, which concluded when the monkeys were 6 months of age.

Many findings of interest emerged from this study. First, the subjects clearly reacted to the stimulus as if it were fear inducing. Typical responses included backing away from the stimulus, intense clinging to the attachment object present, aversion of the eyes as the stimulus moved closer to the subjects, vocalizations, particularly coo and screech, and stereotypic rocking. Few of these behaviors were apparent during control periods, although there was a suggestion that some subjects were generalizing during the later control periods, exhibiting, for example, levels of stereotypy greater than those recorded in the homecage.

Second, a clear developmental trend was apparent in the data obtained during exposure to the fear stimulus. When subjects were 60 days of age, reaction to the stimulus was relatively mild. Reaction was most severe during the third and fourth exposures, when the monkeys averaged 88 and 102 days old, respectively. By the end of the study when subjects were approaching 6 months of age, the fear reactions had subsided to the point that some of the monkeys actually approached and threatened the stimulus. While some of the subjects' behaviors might be interpreted as reflecting adaptation to the test situation, the developmental data were basically consistent with previous findings that the fear response matures at approximately 90 days of age in rhesus monkeys.

In general, there were few clear qualitative differences between surrogate and peer-reared monkeys in the nature of their responses to the experimental sessions. Both groups of subjects stayed in contact with or close proximity to their respective attachment object during fear sessions. During early exposure periods both clung tightly to their objects, often using the object's body to block visual contact with the flashing robot. In later fear sessions and in most control sessions some subjects in both groups used their attachment object as a base for exploration of the apparatus. There appeared to be few gross differences between surrogates and peers in their effectiveness in reducing subjects' overt expressions of fear throughout the study. However, this finding may have reflected limitations of the testing environment rather than lack of real differences in fear-reducing qualities between surrogate mothers and equal-aged peers.

It was found that the presentation of fear stimuli affected subject behavior even after the stimuli had been withdrawn. Comparisons between data collected

immediately prior to presentation of the stimuli and data collected after each session showed that monkeys spent more time contacting their attachment objects after the sessions than before, and they showed lower levels of locomotion and exploration of the homecage. The subjects also exhibited higher levels of disturbance activity, characterized by stereotypy, self-clasping, and vocalizations. In contrast, there was little difference in levels of most behaviors prior to and following the control sessions in the tunnel apparatus.

Finally, considerable variation in individual reaction to presentation of the fear stimulus was apparent, both among subjects reared with surrogates and those raised with a peer partner. All subjects in both groups initially showed mild response to the stimuli, but after 80 days of age their reactions were more pronounced. Yet each monkey reacted in its own idiosyncratic manner. As it grew older, one surrogate-reared animal exhibited increasingly severe responses to the stimulus, clinging to the surrogate longer, rocking more extensively, and increasing its vocalizations. The other surrogate-reared monkey grew bolder with each session after 120 days of age, and by the end of the study it was alternately exploring the robot and threatening it, running back to contact the surrogate between bouts. Similar variability was observed among the four peer-reared subjects. Nevertheless, all subjects made use of their attachment objects when exposed to the fear stimulus, whatever their specific reaction to it. Interestingly enough, individual differences evident during the fear tests were relatively consistent with individual differences exhibited in the homecage. Dominant subjects in the homecage tended to be boldest in the fear tests, while subjects exhibiting the highest levels of self-clasping and stereotypic rocking at home consistently showed the most extreme reactions to the fear stimulus. In summary, Sidowski, Harlow, and Suomi (1972) found that repeated presentation of fear stimuli had measurable effects upon attachment behavior, generally enhancing its occurrence.

The effects of repeated exposure to fear-producing situations upon monkey attachment behavior were further investigated in a series of three studies by Novak. The first experiment (Meyer, Novak, Bowman, & Harlow, in press) was similar in design to the Sidowski *et al.* (1972) study, in that subjects reared with different objects of attachment were repeatedly exposed to fear stimuli in the presence of their attachment object throughout the first 6 months of life. However, subjects were reared under three different conditions—some were raised with mothers only, some with surrogates and 2 hour daily exposure to peers, while some were housed from birth with peers only. Also, fear tests were initiated at 3 weeks of age and were administered at weekly intervals. The fear-inducing apparatus employed was considerably more foreboding than the J. C. Penny robot used by Sidowski *et al.* (1972). It employed two “monsters,” each with flashing lights, flapping wings, and the capability to emit 13 different exceedingly noxious sounds from a speaker embedded in its chest. During each experimental session subjects were lowered into a compartment midway

between the fear stimuli where they remained for a 15-min period. The apparatus and "monster" are illustrated in Fig. 9. Finally, in addition to standard behavioral observations Novak took biweekly cortisol measures as a physiological index of subject stress throughout the study.

Numerous interesting findings were disclosed in Novak's first study. All subjects formed strong attachment relationships with their various attachment objects, although there were dissimilarities among the differentially reared subjects. In particular, infants reared with both surrogates and peers spent less time in contact with their attachment objects and explored more than all other subjects. In contrast, peer-reared subjects clung more than all other subjects, and locomoted and played less than mother- or surrogate-peer-reared monkeys. Generally speaking, the trend of behavioral development exhibited by these subjects was similar in sequence to that found in previous studies of differential rearing environment (e.g., Harlow & Harlow, 1969). However, the subjects appeared slightly chronologically retarded in development of new behavior patterns, a finding which can perhaps be attributed to the repeated presentation of fear stimuli.

There was little question that the mechanical devices employed were effective as fear stimuli. The subjects showed consistent and intense behavioral fear

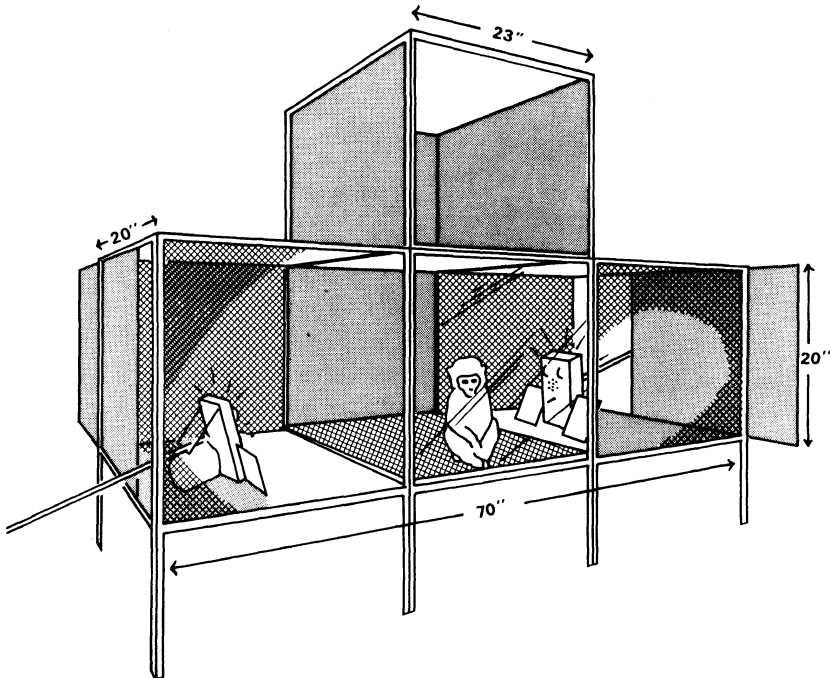


FIG. 9 Fear apparatus employed in Novak's study.