THE PRIMATE PLAY FACE: A POSSIBLE KEY TO THE DETERMINANTS AND EVOLUTION OF PLAY

by Suzanne Chevalier-Skolnikoff

Play has not yet received the attention or research investigation that many other categories of behavior, such as sexual behavior, aggressive behavior, feeding behavior, etc., have received; consequently play is still something of an enigma (Beach 1945; Dolhinow and Bishop 1970; Loizos 1967). The nature, functions, and determinants of primate play are yet to be ascertained. This paper focuses on the primate play face. Based on an examination of primate play, and particularly of the play face, it proposes that primate play is an adaptive response to novelty, and that it is based on a motivational state represented by the emotion "playfulness." Such a proposal provides a motivational basis for human play, illuminates its functions, and provides the phenomenon with an evolutionary perspective.

Konrad Lorenz has described the exploratory play behavior of a young raven confronted with a novel object:

> [The bird] first reacts with escape responses. He will fly up to an elevated perch and, from this point of vantage, stare at the object literally for hours. After this he will begin to approach the object very gradually, maintaining all the while a maximum of caution and the expressive attitude of intense fear. He will cover the last distance from the object hopping sideways, with half-raised wings, in the utmost readiness to flee. At last, he will deliver a single fearful blow with his powerful beak at the object and forthwith fly back to his safe perch. If nothing happens he will repeat the same procedure in much quicker sequence and with more confidence. If the object is an animal that flees the raven loses all fear in the fraction of a second and will start in pursuit instantly. If it is an animal that charges he will either try to get behind it and tease it by trying to repeat the attack or, if the charge is sufficiently impressive, loses interest in a very short time. With an inanimate object the raven will proceed to apply a number of further instinctive movements. He will grab it with one foot, peck at it, try to tear off pieces, insert his bill in any existing cleft and then pry apart his mandibles with considerable force. Finally, if the object is not too big, the raven will carry it away, push it into a convenient hole and cover it with some inconspicuous material. (Lorenz 1956:637)

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Lorenz emphasizes that the young bird approaches the novel object first as a potential enemy, and then as prey. His curiosity about the object and the sequence of behaviors directed towards it are adaptive, since they result first in protection and subsequently in the discovery of any potential functions of the object in the life of the bird. In this way the individuals of this species are able to develop different dietary habits, and different techniques of procuring food. Consequently, the species is able to adapt, through individual learning, to many different habitats.

Similarly, primates also react to novel objects (including conspecifics[1]) first with fear, then with careful inspection, which is visual, tactile, and olfactory, and which sometimes even includes tasting, and finally with experimentation and play, which will give the animals maximal information about the object (Bertrand 1969; Mason 1965; Menzel 1966; personal observations). The exploratory sequence is similar in the raven and in the primate.

For example, upon placing a doll inside an enclosure housing a social group of stumptail macaques (*Macaca arctoides*), the following observations were recorded:

> Stanford, 5/28/68, 1:30 P.M. [Description of film sequence.]
>
> The adult male approaches the doll while the other animals look on. He examines it, particularly visually and probably olfactorily. He hesitantly touches it, exploring it tactually. He picks it up, carries it up into a tree and drops it.
>
> The other adults approach the fallen doll one after the other, they look at it, evidently sniff it, and withdraw.
>
> The adult male has again approached the doll, which is still lying on the ground. He now proceeds tactually to investigate it more thoroughly. He grooms its hair—hair typically elicits grooming responses (Bertrand 1969). He picks it up and again brings it up into the tree and grooms it some more.
>
> (The doll falls to the ground again.) The adult male again approaches it, sits with his back to the camera and grooms it some more. All the other animals in the group gather around him and watch. He leaves and the adult females approach, and tentatively and nervously they also manipulate the doll.
>
> The subadult male now approaches the doll. He tactually examines it, particularly its eyes. As he looks at its eyes, he lipsmacks (as hair tends to elicit grooming, eye contact with the doll generally elicited lipsmacking).
>
> Again the other animals, particularly the adult females, approach. Now they tactually investigate the doll. An infant approaches and briefly touches the doll and then dashes off.
>
> Hesitant tactile investigation continues on the part of the females and infants, often followed by startled leaps backwards as they notice its eyes, or as their fingers get caught in its hair and the movements of their

hands cause the doll to move. The oldest infant in the group takes particular interest in the doll, and begins to approach it playfully from awkward, vulnerable positions (e.g., while hanging upside down from a tree branch by her hind feet she touches it with her hand). (All fear now appears to be gone, and the adults no longer pay much attention to the doll.)

The oldest infant continues to manipulate the doll, grooming it, turning it over and examining it, and occasionally leaping back as its hair gets caught on her fingers.

(She begins to run around with the doll and its hair gets caught on the wire top of the cage.) She pulls at it and chews on it. It becomes detached and she plays with it, hanging by her arms from a tree and holding it with her feet and then hanging upside down from the tree by her feet and manipulating the doll with her hands.

(This infant continued to play with the doll for three hours and thirty-seven minutes.)

Similarly, Loizos writes of a chimpanzee's first encounter with a novel object, a ball:

> I bounce a tennis ball in front of the cage several times so that she hears as well as sees it and place it inside on the floor. She backs away, watching ball fixedly—approaches with pouted lips, pats it—it rolls. She backs hurriedly to the wall. Hair erection . . . J. pokes at it from a distance, arm maximally extended, watching intently; looks at me; pokes ball and immediately sniffs finger. . . . She dabs at ball and misses, sniffs finger; she backs away and circles ball from a distance of several feet, watching it intently. . . . Pokes with extended forefinger, connects and it moves; she scurries backwards. . . . Tries to pick ball up between thumb and forefinger very gingerly . . . fails. . . . Picks it up and places it in front of her—*just* touches it with lips—pushes it into straw with right forefinger—touches it with lower lip pushed out—pokes, flicking up hand at end of movement, but backs away as it rolls towards her. . . . Examines own lip, squinting down, where it touched ball. Picks at it with forefinger and covers ball as it rolls (walking on all fours, with head down to watch ball as it rolls along at a point approximately under her belly). . . . Stamps on it, dabbing at it with foot. Sits on it, rolls it with foot; carries it gingerly in hand and puts it on the shelf, climbing up to sit beside it. It drops down—she holds it in one hand and pats it increasingly hard with the other. Holds it in right hand, picks at stripe on ball with her left. Rolls it between two hands. Rolls it between hand and shelf. Holds and pats; bangs it on shelf. Holds and *bites*, examining ball after each bite. Ball drops from shelf and she pats at it on ground with right hand. Lies on her back, balances ball on her feet; holding it there with hands; sits up, holds ball under chin and rolls it two or three times round back of neck and under chin. It rolls away and she chases it immediately and brings it back to shelf. Lies on back and holds it on feet. Presses it against teeth with her feet and bites—all fear appears to be gone—lies and bites at ball held in feet, hands. Rolls it in feet, hands. Climbs to ceiling, ball drops and she chases it at once. J. makes playface, rolls and tumbles with ball, around, over, under ball, bangs it, bites it, rolls it over her own body. (Loizos 1967:194-195)

Among primates, as among ravens, curiosity, exploration and play with objects may also lead to the acquisition of new dietary habits and to various adaptive innovations. Among the Japanese macaques (*Macaca fuscata*)

it has been observed that new and unusual food items were adopted only by young animals, and only after they had been carefully examined visually, tactually, and olfactorily, were they finally tasted. On Koshima Island, experimental introduction of a new food item, sweet potatoes, fed to the monkeys on the beach, led not only to the acquisition of a new dietary habit, but to a whole series of innovative behaviors that were incorporated into the group subculture. Feeding and exploration on the beach, an area of the island hitherto avoided by the monkeys, led to the development of the food preparation technique, potato washing, which repeatedly brought the animals to the water's edge, led to water play, swimming, and diving, which in turn led to the discovery of edible underwater sea life which became a new food source for the monkeys (Kawai 1965; Kummer 1971).

Exploration and play typically consist of rapid shifts between motor patterns. During active play, behaviors characteristic of other functional systems (e.g., aggression, sex, and maternal behavior) often occur, but are reordered, exaggerated, fragmented, or repeated over and over again (Loizos 1967). One of the salient features of play is that combinations of motor elements often occur that would normally be maladaptive in terms of the other functional behavioral complexes. For example, a monkey may make a play attack from a vulnerable position, or an aggressor might follow an "attack" with a withdrawal, thereby reversing his role. Such shifts between behavior patterns of different functional systems increase the likelihood of producing unique behaviors and unique combinations, and observers have noted that "unique" behaviors do occur during mammalian play (Ewer 1968; Fedigan 1972; Van Lawick-Goodall 1968a).

One of the most prominent features of play is the play face. Among the Madagascar lemurs (*Lemur fulvus, Lemur catta,* and *Propithecus verrauxi*), representatives of the more primitive primates, the prosimians, the play face consists of an open mouth with parted lips covering the teeth (Jolly 1966; Sussman 1974), and the ears very obviously drawn back (Sussman 1974). In stumptail macaques (Figure 1), this expression consists of an open mouth, with parted lips covering the upper teeth, but often showing the tips of the lower teeth. The ears are drawn back against the head, and partial eye closure is effected by slight to extreme lowering of the upper eyelids. Eye-to-eye contact is avoided (Chevalier-Skolnikoff 1973a, 1974). Among chimpanzees the lips may partially cover the teeth, as in monkeys, or they may be vertically retracted, thereby displaying the teeth. In chimpanzees the expression may be accompanied by vocal laughter (Van Hooff 1971, 1972; Van Lawick-Goodall 1968b). In man, as in chimpanzees, both the covered-teeth and displayed-teeth forms of the expression (now called a laughing face) occur. The lip corners are often raised. The human expression, also, is often accompanied by vocal laughter (Blurton Jones 1967; Ekman 1972; Van Hooff 1971, 1972).

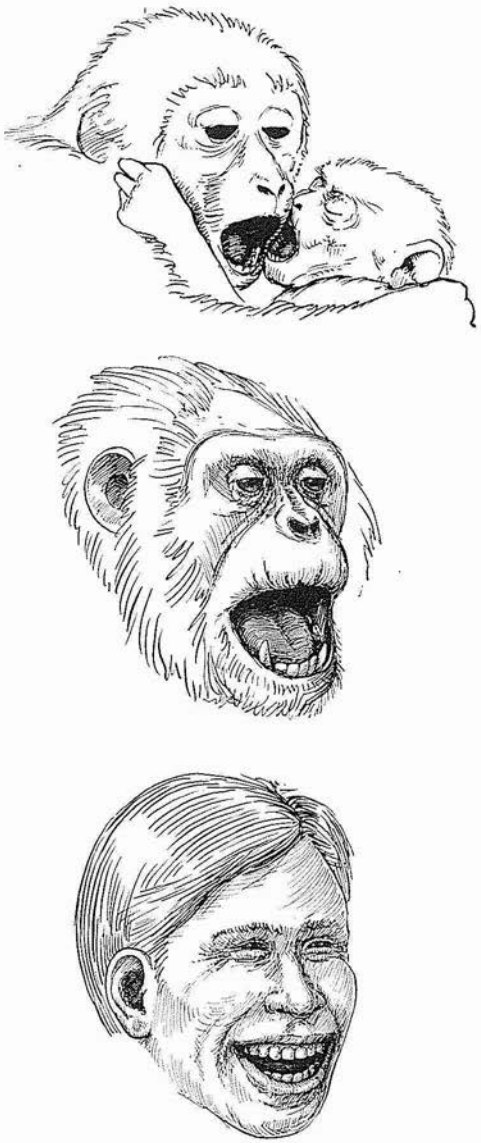

FIG. 1. THE PRIMATE PLAY FACE

a. The open-mouth eyelids-down play expression made by two stumptail macaques as they wrestle. Drawn from a Super 8-mm. motion picture frame (from Chevalier-Skolnikoff 1974).

b. The chimpanzee play face (from Chevalier-Skolnikoff 1973b).

c. The human laughing face (from Chevalier-Skolnikoff 1973b).

Van Hooff (1971, 1972) has traced the evolution of the human smile and the human laugh. In the macaques—as well as in lemurs (Jolly 1966; Sussman 1974)—the "grimace," which is the formal equivalent of the human smile, is generally associated with fear, and the play face is associated with play. In chimpanzees the "grin"—the formal equivalent of the macaque grimace and the human smile—is associated with positive intentions, while the play face is associated with play. It appears that, in man, the ape grin and play face have converged and become so closely associated with each other that they essentially form a single facial display. However, Van Hooff has found, chiefly by means of questionnaires, that the human smile is associated primarily with positive intentions, while both the smile and the laughing face are associated with playfulness. (See Figure 2.)

FIG. 2. PROBABLE EVOLUTION OF THE HUMAN SMILE AND LAUGHING FACE

Lemur	Grin (Fear)	Play Face (Play)
Macaque	Grimace (Fear)	Play Face (Play)
Ape	Grin (Positive Intentions)	Play Face (Play)
Man	Smile (Positive Intentions and Play)	Laughing Face (Play)

The ontogenetic development of exploration and play behavior follows the same general sequence as occurs in initial encounters with novel stimuli. Exploration appears earliest, and play develops later (Harlow 1971; personal observations).

I have observed the development of early play behavior, and particularly the play face, during a laboratory study on the ontogeny of behavior in stumptail macaque infants living in a social group. *Stage I:* Small infants first approached both animate and inanimate objects with open-mouthed reflexive rooting movements; oral contact was followed by sucking. *Stage II:* As the infants grew older, the side-to-side movements of the head, which were characteristic of rooting, ceased, and inanimate objects and other monkeys were directly approached with the open mouth; once contacted they were extensively mouthed. *Stage III:* Subsequently, the infants began making social approaches of ambiguous intentions toward other monkey infants with open-mouthed expressions; these approaches also usually culminated in contact and mouthing. *Stage IV:* Finally the ambiguous open-mouthed social approaches ceased. At the same time, social approaches distinguishable as threats (which were accompanied by the open-mouthed stare threat expression) and approaches distinguishable as play approaches (which were accompanied by the open-mouth eyelids-down play expression and followed by play biting) appeared (Chevalier-Skolnikoff 1973a, 1974).

It has been widely reported that the function of the play face is to signal play (Altmann 1962, 1967; Bateson 1955; Bekoff 1972; Dolhinow 1971; Dolhinow and Bishop 1970; Haley 1955; Loizos 1966; Symons 1973). Bateson (1955) first advanced the argument that the primate play face

functions as a metacommunicative signal. Altmann (1962) defined the term "metacommunication" simply as a "communication that affects the interpretation of other communication." A metacommunication alerts the receiver as to how the other behavior must be interpreted. Bateson (1955) and Haley (1955) suggest that the signaler himself is aware that the metacommunicative behavior will be treated as a message regarding the interpretation of the other behaviors. Such metacommunicative signals would not be responded to *automatically* by conspecifics (as a sign is) but, rather, would be *interpreted* for their signal value. Bateson writes:

> The non-human mammal is automatically excited by the sexual odor of another; and rightly so, inasmuch as the secretion of that sign is an "involuntary" mood-sign; i.e., an outwardly perceptible event which is a part of the physiological process which we have called a mood.

and:

> It is evident that a very important stage in this evolution occurs when the organism gradually ceases to respond quite "automatically" to the mood-signs of another and becomes able to recognize the sign as a signal: that is, to recognize that the other individual's and its own signals are only signals, which can be trusted, distrusted, falsified, denied, amplified, corrected, and so forth.

and:

> The occurrence of meta-communicative signs (or signals) in the stream of interaction between the animals would indicate that the animals have at least some awareness (conscious or unconscious) that the signs about which they meta-communicate are signals. (Bateson 1955:40)

Bateson noted that the "play" of monkeys is similar to aggression. He theorized that such behavior could occur and not turn into a fight only if the animals were capable of some kind of signal which would carry the message "This is play," or "These actions in which we now engage do not denote what those actions for which they stand would denote." Bateson, seeking such a signal in a nonhuman animal, found metacommunication in the primate play face.[2]

While Altmann's and Bateson's characterization of the play face as a metacommunicative signal may be useful on an interactive, descriptive level, there is compelling evidence that the play face first evolved as a facial expression of emotion,[3] and still functions primarily as an emotional expression in the nonhuman primates. In my opinion, the label "metacommunication" reads more into the behavior than we are sure is there, and it obscures some of the more basic biological functions and causes of the expression, and of play.

Among nonhuman primates, the play face is an expression which is associated exclusively with play. Other facial expressions, which are generally associated with other emotional states, such as threat and submission expressions, hardly ever occur during play (Bertrand 1969; Symons 1973, 1974b; personal observations). While the play face may occur during the

initiation of a play sequence, it has not been reported to co-occur consistently with the beginning of play, as the literature implies. Among free-ranging rhesus monkeys (*Macaca mulatta*) on La Cueva Island, Puerto Rico, Symons has observed that the play face consistently occurs at the beginning of play sequences among adult males, but occurs less regularly at the initiation of play among infants (Symons 1974a). Among chimpanzees in a zoo colony, Loizos (1967) reported that the play face occurred most often at the start of a play session. However, among free-ranging chimpanzees at the Gombe Stream Reserve, Van Lawick-Goodall (1968a) reports that play usually started without the initiator showing the play face, and that only one animal at her study site fairly regularly initiated play with the expression. She observed that it was after play was well under way and particularly during contact play that the play face became evident. Similarly, Fedigan (1972) writes of vervet monkeys (*Cercopithecus aethiops*) living in a social situation in a laboratory, that the play face usually occurred at the initiation of play, but was most noticeable as a correlate of close contact play, and was always seen during wrestling. Among lemurs (*Lemur fulvus* and *Lemur catta*), Sussman (1974) observed that the play face rarely or never occurred as a play solicitation, but did occur when the animals were in close contact and about to play-bite. I have found that among stumptail macaques also, the play face is most prominent during contact play. When it occurs in this context the play partner is often already engaged in play biting and may be unable to receive the expression as a communication. The play face sometimes occurred during play initiations, but was only one kind of behavior that appeared to function as an initiation of play. Other behaviors that have been noted to occur during the initiation of play in various primate species are: peering backwards between the legs at another, approach with a capering, cantering, or bouncing gait, alternately hiding and looking, cuffing, pulling (especially tail-pulling), leaping at, flipping over, walking or hanging upside down by the feet, running with or dragging an object, etc. (Bertrand 1969; Fedigan 1972; Symons 1973; Van Lawick-Goodall 1968a; personal observations). Interestingly, Loizos (1967), in the quote presented above, also observed a chimpanzee making a play face during intense play with a ball, an inanimate object; and Redican and Mitchell (1974) have observed infant rhesus monkeys making play faces during solitary play. These observations on the contexts in which the expression occurs suggest that the play face may not be essential in order for potential play partners to treat an interaction as play. Furthermore, the expression appears to occur most frequently in the context of intense play.

It seems reasonable to suggest that the play face serves primarily as the expression of an emotional state associated with intense playfulness. While it is not possible to know what an animal is thinking, behavioral analyses offer additional evidence that the play face, and a number of other primate facial expressions, are related to emotional states (Chevalier-Skolnikoff

1973b), as the facial expressions of laughter (which is probably the human homology of the play face), smiling, fear, anger, sadness, surprise, and disgust are related to emotion in man (Ekman 1972, 1973). Through a series of cross-cultural studies, Ekman and his colleagues have found evidence that particular facial muscular patterns in man are universally associated with discrete emotional states. Human subjects of different races and from different cultures ascribed the same emotions to photographs of facial expressions, and made the same expressions in the same situations (Ekman and Friesen 1971; Ekman, Sorenson, and Friesen 1969). Contextual (Shirek-Ellefson 1967) and sequential (Van Hooff 1971) analyses of facial expressions among nonhuman primates have demonstrated a number of regularly occurring expressions that are regularly associated with other behaviors that can, as behavorial groups, be interpreted functionally as play, affinity, submission, aggression, etc. Among macaques virtually *all* regularly reoccurring facial expressions (and there are around a dozen of them in most species, other than those related to food-getting and mastication) are associated with contexts that can be functionally interpreted as emotional.[4] This evidence suggests that the macaque and chimpanzee play faces, and the human laughing face, are emotional expressions.

The view that facial expressions in nonhuman primates represent emotional states is further supported by similarities in the forms and activities of the brains of human and nonhuman primates. In all primate species facial expressions of emotion are evidently mediated by the subcortical structures of the limbic system. Pine (1963, cited in Berlyne 1969), presents evidence that the motor control centers for human laughter are in the hypothalamus, a subcortical region of the limbic system. Because of their mediation by subcortical brain structures, structures incapable of mediating variable or complex learned behavioral sequences, these emotional expressions are stereotyped in form. The play face, like the other emotional expressions of primates, is stereotyped in form, further evidence that it is an expression of emotion. During primate evolution there has been a distinct trend toward increased voluntary control over the face and over expressive behavior. This trend is correlated with the enlargement of the cortex, and particularly the association areas of the brain which are involved in the mediation of learned and voluntary behavior. There is some evidence that among nonhuman primates, and certainly in man, the cerebral cortex has some control over emotional expressions, making it possible for emotional expression to be voluntarily repressed, or even voluntarily altered or simulated. Myers (1969) found that while cortical damage in man results in complete paralysis in voluntary—but not involuntary[5]—use of the muscles of the opposite side of the lower face, cortical removal in rhesus monkeys results in only mild contralateral facial weakness. This suggests that while man has great voluntary control over his facial musculature, monkeys have only limited cortical control—presumably voluntary—over their facial expressions. Simulated

expressions, even if they mimic emotional expressions, are not really "emotional" expressions, for they are cortically mediated and are not associated with the adaptive functional motivational "feeling" states that comprise emotional behavior. However, only for man do we yet have good evidence that facial expressions are voluntarily simulated regularly (Ekman and Friesen 1969b). Consequently, if the play face is an emotional expression, its phylogenetically earliest manifestation was undoubtedly involuntarily determined. Furthermore, if it is an emotional expression it is still problematical whether any of the nonhuman primates would have the ability voluntarily to simulate play faces. It is even more unlikely that mammals of other orders, who also make play faces, would have this ability. As we noted above, among the lemurs the play face appears to occur exclusively during contact play, and as a prelude to play biting. It does not precede or initiate play, is evidently involuntary, and may have no signal function. Observations of rhesus macaques and of crab-eating macaques (*Macaca fascicularis*) suggest that animals of these species may be capable of making play faces voluntarily. Adult males have been observed to make particularly obvious and exaggerated play faces at the initiation of play with other adult males (Reynolds 1974; Symons 1974a), and particularly during intergroup play (Symons 1973). These observations suggest that the animals voluntarily make exaggerated play faces when they are most "needed" to define otherwise dangerous interactions as play. However, such interactions are undoubtedly accompanied by intense emotional feelings on the parts of the animals involved, and it is possible that playful feelings are particularly prominent during these interactions, and that intense playful feeling states are responsible for the manifestation of these exaggerated expressions.

I suggest that the nonhuman primate play face is basically an emotional expression representing the emotional feeling state, playfulness (which probably feels subjectively similar—pleasurable and exciting—both to nonhuman primates and to man). It is probably phylogenetically derived from infantile rooting, from investigatory or play biting, or possibly from the threat expression, behaviors which it closely resembles, and from which it differentiates during ontogeny in macaques. The eye-contact avoidance aspect of the expression is probably what most clearly differentiates it from the threat face, for eye-contact is probably the most prominent aspect of the threat face, since it is characteristic of all the threat faces of all primate species.[6] The eye-avoidance and retracted ears probably do denote the expression as being not a threat. But these characteristics of the expression probably developed during evolution; they probably function adaptively to distinguish the play expression from the threat. The play face probably functions as a sign of what the animal is feeling. Only after primates had attained considerable voluntary control over their facial expressions would the expression have acquired the signal value to mean, "This is play."

The nonhuman primate play face is just one aspect of play that functions

as a sign that a particular sequence is play behavior and not aggression. The *whole* play sequence differs from aggression, and the other functional behavior categories it may resemble, in the aspects noted above: it consists of rapid shifts between motor patterns; it is re-ordered, exaggerated, and fragmented. Furthermore, as Sade (1973) has described, movements that occur during play contrast with those associated with other kinds of moods, for only playfulness is characterized by rotatory body movements in the transverse plane. Consequently, no metacommunicative signal is theoretically necessary to signal that a playful interaction is play.

Consideration of the play face as an emotional response elucidates one of the most perplexing issues which for so long have plagued researchers in this area. It theoretically provides a motivational basis (the emotion playfulness) for play behavior, implying mediation of the phenomenon by the limbic system (although we still have only a vague notion of the neurophysiological mechanisms involved in its mediation). Furthermore, the notion of play as an emotional response to novelty provides a point of departure for investigating its evolution. The adaptive value that such a mechanism might serve, and its possible evolutionary development, can be deduced to some extent from the available data on the nature and functions of play.

In this brief discussion, I must limit myself to examining only a few of the many functions that curiosity, exploration, and play appear to serve. The regular sequencing of curiosity, exploration, and play, in that order, in novel contexts, suggests that they represent a single adaptive complex: a single functional response to novelty. However, their more precise functions and determinants may be different; for example, the emotional state motivating initial exploration, the feeling state accompanying it, and the neurophysiology mediating it, may be different from the states and mechanisms involved in active play. The functions of object exploration have already been briefly discussed; it provides information for escape and defense, information about suitable food objects, and an opportunity for innovation.

In 1898 Groos proposed that play functions as direct training for adult activity, and particularly it exercises "instincts" in preparation for later life. Among nonprimate mammals, observations such as those of Poole (1966) on polecats, in which he found that aggressive patterns are highly stereotyped and unmodified by experience, and the observations of Fox (1969) in which naive infant coyotes who had never played with peers or encountered rats were seen to go through the normal adult prey-killing sequence during their first encounter with live rats, suggest that Groos's proposal may be incorrect. However, observational studies on primates suggest that locomotive play and social play may provide situations in which these animals acquire the locomotive skills suited to their specific environments. The newborn primate is not a pre-programmed master of his environment, capable of safely climbing and leaping through the branches of the hundred-foot tall trees that often make up the forests in which he lives. Schultz's (1939, 1944, 1956) and

Bramblett's (1967) findings on the frequencies of bone fractures among nonhuman primates attest to this.[7] Muscular coordination for climbing and leaping, distance judgment, and the properties of potential supports must evidently be learned. Van Lawick-Goodall (1968a) notes that young free-ranging chimpanzees move through the trees with extreme caution when they are feeding and trekking; and should one move over a dead or brittle branch, the infant's light weight will seldom break it. Furthermore, she notes that when danger appears, and the chimps are forced to flee, small infants are generally retrieved and carried off by their mothers. Thus, while adults and subadults often took wild leaps through the trees, infants did not—except during play. During play, youngsters were observed to leap upon dead branches, and these branches sometimes did break under their weight, precipitating falls. Many leaps may be made before an animal will experience one fall, but only one fall is necessary for learning about danger. One infant was observed to fall as a brittle branch upon which she was swinging during play broke off. On three subsequent occasions, this same infant was observed, when climbing this same kind of tree, to hold firmly onto a thick branch as she tested smaller branches with her weight before climbing onto them. It appears, as Van Lawick-Goodall has emphasized, that infants take chances and learn the skills of leaping only in the relatively safe context of play. And they learn these skills when they are young and their bones are less calcified and more supple, and when they are lighter and less likely to be hurt from falling than an older animal would be. Furthermore, referring to evolutionary adaptation, should a youngster fall and be killed, an immature animal is more dispensable than a mature breeding animal. Symons (1973) has made similar observations on free-ranging rhesus monkeys. During play, young animals were seen to use the environment in ways rarely seen in adults (e.g., trees were used for running and high speed climbing, leaping, and falling). However, it appeared that these same uses of the environment were characteristic of adults' responses only to emergency situations.

The well-known work of Harlow and his colleagues indicates that at least for rhesus monkeys peer contact, and presumably play, during infancy may be essential for the subsequent adult manifestation of appropriate sexual and maternal behaviors. While animals raised in isolation or in the exclusive company of their mothers do not attain normal adult sexual or parental competence, animals raised with peers do (Harlow 1971; Harlow and Harlow 1965; Harlow, Harlow, and Suomi 1971). Since the most salient interaction in which peers engage is play, these experiments imply that peer play is essential to the normal ontogenetic development of these adaptively vital behavioral complexes. In two subsequent experiments, six-month-old and one-year-old isolation-raised, and consequently abnormal, animals were given the opportunity to interact with three-month-old infants (Harlow and Suomi 1971; Harlow, Harlow and Suomi 1971).

The isolates first responded to the tiny infants with fear and retreat. But the infants persistently followed the retreating isolates and clung to them as they would have clung to their mothers. Soon the isolates, unable to avoid contact with the persistent infants, began to respond to them with infant-like clinging. Clinging was followed by exploration, and within weeks play began to develop between the isolate-infant pairs. The more infantile play patterns appeared first, and the more mature kinds of play patterns appeared later. Within six months of interaction with their infant "socializers" the isolates' behavior, including their play behavior, appeared to be normal. Harlow (1971) has suggested that as play progresses from one ontogenetic stage to another, each stage may prepare the way for the subsequent stage. The finding that the older isolation-raised animals went through the same play stages as infants normally pass through during ontogenetic development strongly supports this theory. It may be that while early developmental stages may not function as *direct* practice for adult behavior, the complete series of stages may ultimately lead to the ability to perform adult behavior patterns.

It should be emphasized that play undoubtedly has different primary functions in different species (e.g., see Ewer 1968). These differences may be due to phylogenetic differences, or they may be social or ecological adaptations. Consequently, one must be extremely cautious in extrapolating from one species to another. Play may not provide direct training for future adult activity in the phylogenetically remote polecats and coyotes, species which manifest relatively elaborate stereotyped behavior sequences. For these species, play may function only to put the animals in touch with their environments, or perhaps for improving the speed, strength, and timing of performing the behaviors, as Symons (1973) has suggested. Nevertheless, play may have more specific training functions for the higher primates, species which are adapted to meet environmental requirements through individual learning.

The preceding are some of the functions of primate play. There is also evidence that primate play functions as a learning situation for the development of fighting and bluffing, for the development of sublimation of aggression, for the development of dominance and submission, for the development of "sociability," and for cultural transmission.

Curiosity, exploration, and play appear to serve one general adaptive function: to put an animal in touch with his animate and inanimate environment. They provide a motivational mechanism that will *insure* assessment, experimentation, and learning about the environment. Thus an animal will be able to escape or defend itself from danger, to acquire food, or to learn social or other skills. The available evidence on the phylogenetic development of the exploration-play complex indicates that behaviors to cope with escape, defense, and food-getting (the most vital needs) were acquired first, and that behavior which provides for more complex non-

social learning (such as innovative behavior) and for social learning developed later.

Welker (1961), in his review on animal exploration and play, found distinct phylogenetic differences in the manifestation of these behaviors. Virtually all animals have been reported to bring their sense organs to bear upon novel stimuli and to explore. However, invertebrates will do so only under the stresses of food-deprivation, excessive stimulation, etc., whereas vertebrates will explore under less stressful circumstances. Only birds and mammals—the phyla possessing the highest learning potentials —are reported to engage in vigorous play. Again, one finds the same general sequence of development as occurs during individual bouts of exploration and in the ontogenetic development of the behavioral complex in advanced mammals.

Unfortunately, there is still insufficient systematically collected data for valid phylogenetic comparison within the whole primate order. However, there are notable differences between the exploratory and play behavior of the Old World monkeys (exemplified by the macaques and baboons), the great apes (exemplified by chimpanzees), and man.

A comparison between the Old World monkeys and apes shows a striking elaboration of object play. Macaques will examine and play with novel objects, but do so less frequently than chimpanzees (Menzel 1966, 1972; Symons 1973). Furthermore, object-play among chimpanzees is far more complex than in macaques. Chimpanzees, who are probably the most manipulative nonhuman primates, will play with poles and will use them for vaulting (Köhler 1931; Menzel 1972). They will play with cloth, paper, or plant parts, draping these over themselves (Yerkes 1943). They will manipulate and play with sticks, poking them into holes and crevices (Van Lawick-Goodall 1967, 1968a). A two-year-old male infant was once seen to use a long twig to inspect the genital area of a female, poking the twig at her vulva and then sniffing the end of his probe (Van Lawick-Goodall 1968a). Young free-ranging animals have been observed to play at nest building. Van Lawick-Goodall (1968a) observed one infant making six nests in a one-hour period, sitting in each for only a few minutes. Youngsters often used their play nests for bouncing and somersaulting.

A comparison between the nonhuman primates and man shows a striking elaboration of play patterns. Besides showing an elaboration of some play patterns common to both nonhuman and human species, such as object-play, categories of play occur in man that are practically or completely nonexistent in the play of other animals. These are the categories of creative play (Harlow 1971); or model building (Sutton-Smith 1971)—which is rudimentarily existent in chimpanzees; symbolic play (Piaget 1951); and verbal play. These are the kinds of play involved in the child's acquisition of human culture and language.

Thus it is evident that the tremendous elaboration of play in the higher

primates is an evolutionarily recent development probably adaptively related to the development of increasingly complex culture and of language.

Conclusion

Exploration and play appear to be based on an emotional motivational system (playfulness), which has a neurological basis as yet undefined. It is an adaptation to the environment that enables the animals to assess danger, discover food, and learn non-social and social techniques that have adaptive value in the lives of particular species.

NOTES

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1. Exploration and play with novel, inanimate objects decreases relatively rapidly, as an animal evidently becomes more familiar with the potentials of the object and as novelty wears off. More complex objects will be the focus of longer periods of attention (Welker 1956a, 1956b, 1956c). Conspecifics probably continue to elicit play because their complexity and their almost infinite behavioral (play) repertoire renders them almost infinitely novel.

2. The threat expression was also given by Bateson as a metacommunicative example. Chevalier-Skolnikoff (1973b) has argued, as Darwin did in 1872, that threats are expressions of emotion.

3. Groos (1898) and Ewer (1968), after considering play in various animal species, and Brownlee (1954), after examining the play of cattle, have also proposed that play has an emotional basis.

4. In man there are many more facial expressions than in the other primates. Many of them have been found to be associated with emotional states, but the number of emotional states is about the same as that described for macaques and apes—about six to nine states. Evidently in man there is more variability in the forms of the expressions that signify particular emotional states. Furthermore, man is capable of making non-emotional facial expressions (Ekman 1973; Ekman and Friesen 1969a; Chevalier-Skolnikoff 1973b).

5. Individuals with cortical damage who were unable to make facial expressions on command could make appropriate involuntary facial responses in emotionally relevant situations.

6. Primate species characteristically have several kinds of threat faces which represent different degrees of intensity and different shades of emotion on an anger-fear continuum (Chevalier-Skolnikoff 1973b).

7. Schultz (1944) reported that between 28% and 50% of adult gibbon samples displayed healed bone fractures. 30% to 36% of orang samples possessed fractures, and 13% and 18% of small chimpanzee and gorilla samples had fractures. Bramblett (1967) found that from 80% to 100% of adult baboon samples had healed bone fractures.

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