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Role or Dominance in Macaque Response to Novel Objects[1]

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Forty-four juvenile rhesus, 30 stumptailed, and 6 pigtailed monkeys were tested individually and in stable quadrads for time to contact slightly and highly novel objects. When peer-group tested, dominant monkeys were the first to contact the slightly novel but not the highly novel objects, unlike preferences found when they were tested individually. A role analysis revealed better contact-order prediction, most groups having their habitual first contactor. When this contactor was overtly punished or covertly trained to avoid the object, group response was altered. The use of the term role *is discussed in detail, concluding that a role involves a particular individual who is expected to interact with others while in certain groups to complete some beneficial function.*

In 1965 Hall suggested that the concept of *role* is more important than that of hierarchical status in understanding social relationships. Some support for the usefulness of role has been found, for example, with respect to group control of aggression in capuchin and rhesus monkeys (Bernstein, 1966; Bernstein & Sharpe, 1966), although the concept of role has not been

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adequately defined (but see Hinde, 1974). The present paper investigates responses to novel objects that differ in the degree to which subjects approach them, using different groups of hierarchically stable, like-aged macaques. It attempts to answer the question "Does the rank of an animal determine its response to novel objects, or is a role analysis better in describing the subject's order of response?" The paper goes on to examine the function of novel-object contact.

It will be argued that the order in which animals contact slightly frightening objects reveals a social role and that this role (a) has the attribute of expectancy, (b) involves relationships between individuals, (c) has complex social consequences, (d) involves behaviors unique to a few individuals, (e) has a low genetic component, (f) is a specialized role limited to a small class of individuals, and (g) has an important function in the group.

METHOD

Subjects

A total of 80 laboratory-born macaques were tested. Thirty-six were rhesus macaques (*Macaca mulatta*), 6 were pigtailed macaques (*M. nemestrina*), and the remainder were stumptailed macaques (*M. arctoides*). All except 12 rhesus and 4 stumptailed macaques were separated from their mothers within the 1st week of life and were reared alone in cages for the 1st year of life, as described in Chamove (1981). During this time, the 64 individually caged monkeys were given daily social experience with peers, starting when 3 months old, and were continuously housed with these same animals in groups of 4 beginning at 1 year of age, thus ensuring relatively normal social development. The *main group* of monkeys was composed of eight quadrads of rhesus macaques and six quadrads of stumptailed macaques, aged between 2 and 4 years at the time of testing and having been housed continuously together in peer groups of 4 for a minimum of 12 months prior to testing. All rhesus groups except for two were exclusively male; two had three males and one male, respectively. All of the stumptail groups except for one were composed of one male and three females; the remaining group was sex-balanced.

In an attempt to generalize the findings to other species and other social conditions, the following *supplementary groups,* also mostly in quadrads, were tested: (a) a sex-balanced group composed solely of pigtailed macaques, (b) a group composed of 2 female pigtails and a male (dominant) and a female (No. 2) stumptail, (c) three groups of 4 rhesus raised and tested while with their parents in nuclear family groups, and (d) one group of 4 stumptail infants reared in a group with their mothers (details in Chamove, 1981). The rearing and testing of the pigtailed and mixed groups were similar to those of the main group described above. The testing of the 12 rhesus (c), however (part of an ongoing study by Harlow, 1971), and the mother-reared stumptail group (d) necessitated a change in procedure. Each of the rhesus monkeys was raised in one of three four-unit playpen devices, each pen containing four families—mother, father, and juvenile. The stumptailed monkeys were reared in a single enclosure with 1 adult male but were later tested in smaller pens with the male absent. The juvenile rhesus monkeys were able to leave or return to the enclosure containing the adult male and female at any time through a small opening in the mesh of the home unit and to enter or leave a central play area in which only, but all of, the 4 juveniles could interact. As most of the device was mesh, all parents and 4 juveniles constituting one group could see and hear one another clearly at all times. These 12 subjects averaged 12 months at testing, and these three sex-balanced groups of 4 juveniles had been housed continuously with the same neighbors and had daily social interaction with one another from birth.

Apparatus

Group testing both of the main group and of the supplementary groups and individual testing of the former were conducted in the home cages. These cages contained no other objects or toys. In the case of all monkeys, except those with mothers present during rearing and testing, the cage was of stainless steel wire mesh and measured 1.3 X .66 X .76 m or one 1.25 X .75 X .75 m. The testing area for those rhesus juveniles with parents was over twice as large, 1.8 X 1.2 X 2.0 m (see Harlow, 1971).

The novel objects used for group testing consisted of 18 objects plus an additional 4 objects for individual testing, and 3 "dangerous objects," that is, shock-producing (see below). All of these objects had been selected from a larger pool of stimulus objects that had been rated for their inferred novelty value by placing them in the home cages of four individually housed year-old rhesus and recording the elapsed time before physical contact was made, thereby scaling the objects. Of course, the time to contact the objects may reflect characteristics other than novelty, e.g., the attractiveness or some mix of novelty and fear (Humphrey, 1972, 1974). Nine "slightly novel objects," touched within 5 minutes by the four animals, and nine "highly novel objects," touched after 10 minutes, were thus classified. Within these two categories, objects were ranked in terms of degree of novelty, using the mean contact time of the animals. In order of increasing novelty, the slightly novel objects used were as follows: an irregularly cut wooden block, a square-cut wooden painted block, a snake-shaped wooden block painted with stripes, half a brown brick, a large black stove bolt, a red wooden cube with nails partly embedded into the top surface, a white hair brush, a mesh cylinder, a small clock (ticking). In similar order, the highly novel objects used were the following: a piece of brass pipe, a black rubber wheel, a length of black rubber tubing, a pair of vice grips, a large pair of tin snips, a black scrubbing brush, a small plastic turtle, an oilcan, and a toy robot. These 18 objects were used for testing all groups and were used in the above order, alternating between slight and high novelty. The lighter objects were fixed with a short length of brass chain clipped to the door of the test cage. Recording of time until first contact with the object was done with a stopwatch. Only 1 object was used each day.

Procedure

Dominance position was assessed prior to testing in all but the family groups by means of three water-bottle dominance tests. In this test, following 24 hours of water deprivation, animals were given simultaneous access to one water bottle. The time spent drinking was recorded on a bank of five standard electric timers, and each animal given a rank based upon the number of seconds elapsing before it had accumulated 30 seconds drinking from the bottle. The monkey accumulating 30 seconds of drinking time first on two consecutive tests was termed the dominant or No. 1 animal, the next monkey to complete 30 seconds of drinking was the No. 2, and so forth. This has been shown to be a reliable measure and to correlate well with the outcome of avoid/approach interactions, as detailed in Boelkins (1967) and Clark and Dillon (1973).

In the nuclear family groups, dominance position was ascertained by an independent experimenter who had observed and tested these monkeys daily from birth (J. Ruppenthal, personal communication). The pigtail, mixed, and family groups were tested in the group condition for a total of only 8 days, using eight novel objects.

Individual testing, performed on main group, pigtail, and mixed group monkeys, was carried out before main group testing. All animals in the group to be tested were removed from the cage and one was replaced for the test period. The test object of the day was then put in and left in the home cage until contacted or until 30 minutes had elapsed; no other behavioral measures were taken. If contacted, the object was removed after 15 seconds.

Group testing procedures were the same as those for individual testing except (a) subjects were not removed from the cage prior to testing and (b) the object of the day remained until all monkeys had touched it or until 30 minutes had passed. Again, only time-until-contact was recorded for each animal.

Finally, a series of four *dangerous-object* tests were run to ascertain whether the behavior of the first contactor or others toward the objects influenced the subsequent behavior of other group members. Two tests were run using two additional objects rated as highly novel, one on each of 2 days after all the other testing was complete. Only the main group monkeys were tested. The objects used were two abstract scrap metal forms. on a wooden base, the first quite flat, the second taller. A wire connected these objects with an electrical source. The first animal touching these objects with its hand was given a brief shock originating from a cattle prod for the duration of contact. The time until contact, as before, was recorded for all animals, and the test was terminated after 50 minutes if all group members had not touched the stimulus object. Order of testing for the pairs of objects was randomized for each group.

The third and fourth dangerous-object tests were undertaken to determine whether nonresponse by a member of the group in the group situation, in contrast to an avoidance response by a member of the group in the prior two tests, would alter the behavior of the remaining group members. A week following the previous tests all animals were withdrawn from the home cage and the most probable first-contractor was returned. While that animal was alone in the cage, a highly novel object, a metal lampshade, was placed in the cage facing upward. The animal received a mild shock on contact with it. This procedure was repeated on the following day, and if an animal did not contact the object within 5 minutes, grapes were placed in the center of the shade to encourage a punished contact. This procedure had the effect of ensuring that the trained animal would not contact the object when retested with its group members present. One hour after this second training session the intact four-member group was tested with the object now disconnected from the shock source.

One week later the same procedure was followed using a large metal funnel. This time one of the other animals was used. On half the remaining tests, the dominant monkey was given this pretraining; on the other half, one of the two remaining monkeys was used (see Wechkin, 1970).

Preliminary analysis on duration-until-contact scores was performed for the main group monkeys using two repeated-measures analyses of variance. The first evaluated the individual testing, the second the group testing. The factors in these analyses were dominance rank (four levels), degree of novelty (two levels), and days (five levels), which corresponded to the different objects used. Subsequent Fisher's Least Significant Difference

(LSD; Li, 1966) tests were used to answer more detailed questions subsequent to F values with a probability of less than .05. All tests were two-tailed.

RESULTS

As a Function of Dominance

As shown in Table I, for all subjects tested in groups of four, the animal most likely to touch the slightly novel object first was the dominant (No. 1) animal ($p = +.42$), the animal most likely to touch it second was the second-ranked animal ($p = +.31$), then the No. 3, and finally the most subordinate (No. 4) group member. This class of object was contacted on average after 28 seconds. This pattern of contact is as one might expect, and it parallels the type of behavior in response to food—the dominant animal controlling the source until satisfied and then the next most dominant taking control, and so on. Analysis of response to the more highly novel objects, however, yielded a different ordering. The No. 1 monkey only rarely touched this object first ($p = +.19$) (also found by Menzel, 1966), and instead, the No. 2 animal most often touched it first ($p = +.50$). The *second* animal to contact this object was most likely to be the dominant group member, followed by the No. 4 touching it third, and then the No. 3 monkeys, touching it last. This was revealed by a significant rank × novelty interaction ($F = 6.99, p < .01$) in the analysis of variance. Neither interacts significantly with days, although there appears to be some amelioration of the highly novel effect with repeated testing.

Thus, there was a common, but not universal, pattern. This most common pattern for contacting the *slightly* novel object was monkey No. 1, 2, 3, 4 and for the *highly* novel object was animal 2, 1, 4, 3.

Table I. Results of Rhesus Group-Testing in the Probability (× 100) of Contacting Objects as a Function of Dominance Rank, Order of Contact, and Degree of Novelty

Order of contact	Slightly novel object				Highly novel object			
	Dominant	2	3	Subordinate	Dominant	2	3	Subordinate
First	42	29	13	17	19	50	25	6
Second	33	31	26	11	48	21	13	19
Third	14	23	40	24	14	19	28	42
Fourth	12	18	24	47	21	9	35	34

As a Function of Role

From the results it appeared that there was some contradiction in the relationship involving degree of novelty, dominance position, and the order of contacting the objects. Inspection of the data revealed that, when high-novel objects were used, the same animal contacted the objects first within any one group. This led to the possibility that it was fulfilling some role. Probabilities of contact were then estimated post hoc. Table II presents comparative data examining role and rank contact probabilities. It must be stressed that role probabilities were estimated post hoc; that is, the subject showing the greatest degree of that behavior in the category of interest is selected. It is clear, when doing this, that higher probabilities of contact are obtained using roles versus rank as a selector. In 74% of the cases, the first animal to contact the objects in the group is the same animal on repeated tests. Using high-novel objects raises this value to 81%, whereas using low-novel objects it is only 69%. If low-novel objects are redefined as those objects most quickly contacted in the actual test situation instead of the a priori scaling evaluation, the probability value of low-novel objects being contacted first by the same individual is only raised by +.06 to +.75 and lowered by +.02 to +.79 for high-novel objects.

Table II. Probability (× 100) of Contacting the Objects in a Group Test as a Function of Rank (dominant) or Role (Contactor)

Order of contact		Novel object category			
		Slightly	Highly	All	All[b]
Dominant animal	1st	42 (30)	19 (30)[a]	30	25
Dominant animal	2nd	33	48	40	43
First-contactor	1st	69	81	69	74
Second-contactor	2nd	56	64	56	59
Third-contactor	3rd			59	62
Fourth-contactor	4th			66	69

[a]Those probabilities in parenthesis were ascertained by recategorizing the objects as determined by time to first contact, all those greater than the mean (48 sec) being defined post hoc as highly novel.
[b]Utilizes data from all monkeys in addition to main group animals, using both degrees of novelty.

Individual testing did not reveal any significant rank effects on time, although there was a slight tendency for the two most dominant animals to touch the objects before the others ($F = 1.20, p > .05$). The probability of this happening was only +.44. It should be noted that both analyses of variance performed showed the expected highly significant days and novelty main effects, which did not interact with each other or, in this individual analysis, with rank. Comparing socially mediated order of contact with contact in the individual test situation suggests that the social ranking is not merely a reflection of the monkeys' individual ability to perform the task.

During individual testing, the same animal had the lowest latency to touch the object when it was tested alone with that object on three out of four tests in four of the groups, and the same animal had the lowest latency twice in another four groups. In none of the four former groups was this animal the most common first-contactor when in the group tests; the first-contactors in the individual test held dominance ranks of 2, 3, 4 and 4 in their respective groups. The probability of the group's first contactor also touching the objects first in the individual test was only +.32. This lends only the slightest support to the idea of individual differences when housed alone but rather suggests that contact time and contact order is a function of the interactions of individuals rather than of characteristics of the individual. We have no evidence that it is some genetic or developmental aspect of bravery or curiosity, or at least not bravery when alone, that induces or allows the first-contactor to contact novel or fearful objects first. Rather, there appear to be different processes at work in the individual and group tests. There is some process, related to group structure or membership, that singles out a monkey to instigate the handling of moderately novel objects.

It is interesting to note that, in all cases except for one, the first-contactor contacted the object sooner when in the group situation than when alone. Of course, the objects were different, but the level of novelty was approximately the same, as determined by the pretest measures.

In the rare circumstances when neither the normal first-contactor nor the dominant animal was the first to contact the object, the latency to first contact was over 20 times as long as when the object was touched by the normal first-contactor.

Results of the first two tests using the *dangerous novel objects* were clear-cut. Not surprisingly, although the initial shocked responses were within the normal latency for the highly novel objects, the subsequent postshock contacts were of much longer latency. The subject shocked did not recontact the object. Although, on the 1st day using shock, the first monkey to contact the object prior to any shock was that member who characteristically contacted most highly novel objects in prior tests, the second animal to contact it, subsequent to the shock of course, was only once the normal second-contactor. This second contact was not punished.

On day 1 of the dangerous-object test, 46% of the monkeys never touched the object in 50 minutes, and 62% of those not touching it first, i.e., not shocked, never contacted it. This compares with a normal noncontact rates of 4% over the rest of the tests. The probability of the dominant group member touching the object at all after anyone was shocked was +.42 but was only +.28 for his touching it second under that condition. The probability of the dominant animal contacting the object after anyone, other than himself, received a shock was +.60 and was +.40 for his touching it in the second position. This suggests that seeing the first-contactor shocked considerably reduced the chances of the dominant animal contacting the object at all, but if the dominant animal contacts it at all, the chance of this animal contacting it in the second position are not markedly reduced.

On day 2 of the dangerous-object test, only 60% of group members contacted the object, surprisingly with about the same average time and order pattern to first contact. After the object had been first-contacted and shock had been administered, no dominant animal touched it, whereas 55% of all remaining animals did. On day 2 (only) one group had no members contacting the object at all.

In all except 1 of the 14 quadrads constituting the main group, there was a single individual who contacted the high-novel objects first on a minimum of 80% of tests. One might predict that in the one "leaderless" group, objects would not be contacted as soon as in other groups that have a first-contactor. Two-tailed Mann-Whitney *U* tests on both low- and high-novel objects supported this expectation ($p < .01$).

The 13 groups with a "leader" were those used in the third and fourth dangerous-object test. Although the time to first-contact using this dangerous object was within the range for high-novel objects on the 1st day in the individual training period, on the 2nd, refresher day, the first-contactor had to be encouraged (with grapes) to contact it. When group-tested, 10 of the 13 (77%) groups took longer to first contact the object (now no longer shocking) than to contact any previous nondangerous object. On all but one of these three occasions, the normal first-contactor behaved unusually and fearfully toward the object that had so recently shocked him. Some threatened it, some screamed, some ran around banging the sides of the cage.

In the three groups that contacted the dangerous object within the range of their normal contact time, two were at about 1 standard deviation above the overall mean for highly novel objects. In the third, a fight erupted and one animal hit the object (apparently unintentionally), sending it clattering and inverting it. It was not contacted soon again. The normal first-contactor did not contact the object in any group.

In the fourth and final dangerous-object test, when animals other than the first-contactor were preshocked with the object, these preshocked subjects did not contact the object and their behavior did not influence the latency to first-contact, second-contact, or third-contact of the objects.

DISCUSSION

It appears that in response to novel objects, two aspects of the social environment interact: A more dominant animal may expropriate an object in which he is interested, but certain group members characteristically investigate objects in such a way that the fears of other group members appear to be allayed or enhanced. Visual exploration does not do this, but contact and manipulation do. The response of these investigators is closely observed by the others. If the response subsequent to contact is one of fear or pain, then some of this information is retained and used by the others. Even if other animals then contact this "dangerous object," the behavior of some of the rest of the group is altered as a function of this first-contact reaction. There is support for the idea that the other members of the group "expect" their champion to ascertain the nature of these strange objects. When this first-contactor does not show this behavior (or when the group has no member who shows this behavior), the investigation and use (e.g., for play) of novel objects is curtailed. But can we term this behavioral constellation a role?

Despite considerable use of the term *role*, definitions are not easy to find. Social psychologists suggest that *roles refer to consistent patterns of expected reciprocal behavior (and perhaps attributes) between two or more individuals: These patterns are recurrent in interactions of consequence to them in a specific context* (Sarbin, 1954). When dealing with animals, however, this definition does not enable one to decide whether a behavior constellation can be termed a role (Sarbin & Allen, 1968) or whether labeling it as a role helps us to tackle particular problems (Hinde, 1978). Similar problems arise when one tries to decide if animals exhibit culture (McGrew & Tutin, 1978).

There are several important aspects of these definitions. One is the idea of *expectancy* (Benedict, 1969; Sarbin, 1954). In animals we can but infer expectancy. We infer it if animals act as though they expect a particular behavior in another animal, e.g., a more dominant animal to approach and take food; if animals alter their behavior in the absence of role behavior, e.g., milling around in the absence of a leader; or if they show surprise when their expectancies are not fulfilled.

The second important aspect to this definition is that of *interaction* (Jones, 1975). The very idea of expectancy of roles implies the presence of at least two animals and often involves interaction between the two. Nadel (1957; see also Reynolds, 1972) has stated that roles materialize only in an interaction setting. But the idea of interaction need not imply that roles are seen only when individuals are interacting. Rather, sometimes interaction is inferred, e.g., the role of sentinel where the animal is out of sight of other group members, or that of the role of the adult male as the focus of the troop even when such interaction is not obvious (Burton, 1972). What is observed is some relationship between individuals, one of which may not be interacting with the other. For example, animals receiving a large number of friendly approaches have distinct social roles according to Gartlan (1968). But is it the role of the infant to receive behavior from the mother? If receipt of behavior can be termed a role, then an individual can have a role thrust upon it. At the extreme, a role can involve no contribution from the individual at all. So can one speak of the role of a dead infant or the role of the scapegoat (Maxim, 1978)? If roles are specialized expected behaviors, then nonbehaving dead infants do not have roles, although they may have an effect upon the behavior of others (and perhaps even a function in the group). Also, the behavior of animals may not involve choice, and roles may imply choice. Hinde (1975, p. 21) states that "a peripheral male may act as a 'watchdog' because he is excluded to the periphery, not because he strives to fill that role."

In some cases, high levels of interaction lead to problems in the definition of role. Is there a role of infant or only that of mother? Is there a role of scapegoat or only of bully? Is there a role of leader or only of follower? When interaction between two individuals is essential for the existence of a role, the separation of role attributes between those interacting is difficult in some circumstances. When the performance of a role involves the exclusive interaction between two individuals, such as the role of the male and female of a consort pair or mother and infant, the problem becomes even more difficult.

Another important aspect is that of roles being *patterns* of behavior. In the statement "the major role of the alpha monkey is repression of intragroup aggression," the implication is that repression involves some patterns of behaviors. If we substitute the word *behavior* for *role* in that statement, we see how the functional connotation of role implies more than some simple behavior, and we also see how the term *role* implies patterns of behavior to some degree unique to the subject that is performing the role.

I would support the idea that roles must involve patterns of behavior, that "it is not a category at the data level with absolute properties" (Hinde, 1978, p. 33). It is difficult to conceive of a role at the data level, and the usefulness of the concept of "role" is when that item or pattern has complex social consequences. Role involves interpretation of the simplest behavior.

If we again substitute the word *behavior* for *role* in the following sentence, we can see how role has at times been unjustifiably used to imply more than simply behavior: "The major role of the mother is to feed and protect her infant.... Used in this way 'role' is equivalent to behavior and thus a redundant concept" (Hinde, 1978, p. 34). This example shows how the degree of *exclusiveness* of a role is important. In these examples we can also see how, as the time an individual is involved in behaviors associated with its role increases, the less valuable the concept of role is in that context. The role of the group member is of less interest than that of a mother, and that of a mother less than that of a control animal or group leader.

Another measure of exclusiveness is the degree to which roles are unique, and this is reflected in the interest people have in different roles. For as the number of individuals exhibiting a behavior decreases (e.g., eating behavior, infant behavior, maternal behavior, group leaders), the greater the interest in the behavior/role and the more likely it is to be called a role.

Wilson (1975), among others, suggests that the specialization of group members is a hallmark of advance in the evolution of social behavior. Coordinated specialists are more efficient than an equal number of generalists. It seems reasonable that one of the effects of roles is to make groups efficient; if everyone exhibits the behavior, then it is not a role. We do not speak of roles that are as general as that of the eater or the breather, but some speak of the role of the copulator and the social interactor (Benedict, 1969; Burton, 1977, p. 6).

Another dimension that influences interest in certain behaviors or roles is that of the degree of *genetic* control. In primate behavior, investigators seem more interested in roles that appear to be under only indirect physiological control (e.g., group leader, control animal, aunt, arbitrator), as opposed to the more essential but more directly physiological role, such as the role of the mother, infant, juvenile female, and so on. And some go so far as to say that fulfillment of basic roles is not biologically determined (Burton, 1977).

Nadel (1957) stresses two attributes of roles: (1) role behavior and (2) role name. If a particular animal leaves the troop for a few minutes and then returns, we can describe this behavior. If we can also describe the *functional* significance of the behavior, say, initiating movement or some vigilance function, then we may term this behavior part of a role (see also Bernstein, 1974, 1981). This does not mean, however, that the function of a group of behaviors and the role name by which we describe these behaviors are interchangeable, although the words *role* and *function* often seem to be used to mean the same thing. Sarbin (1954) feels that role theory is compatible with an interactional or functionalistic framework of social behavior.

Also, there is the minor problem of the *time scale* of roles. If one of the roles (or functions) of the infant is to promote group cohesion, as the infant grows this ability gradually decreases. Does the role gradually decrease also, or does the role change its nature?

Crook (1971, p. 247) defines roles "in terms of the relative *frequencies*. . . with which individuals perform certain behavioral sequences. When the behavior set of an individual or class of individuals is distinct, the animal is said to show a 'role'"; Reynolds (1970) agrees. Such a definition can enable one to detect roles by either beginning with a certain class or subgroup of individuals on the basis of some interaction of physiological traits, e.g., age, sex, or parity, and describing their behaviors, which are to some degree statistically unique to them, or starting with their behaviors and seeing if they are distributed nonrandomly, as are most social behaviors.

The first strategy leads to a multitude of roles, as the selection of the class can vary from the general to the specific. Using varying levels of classes, writers discuss the role of the monkey (Benedict, 1969, p. 206), the role of the mating monkey (Benedict, 1969), of the adult, of the peripheral male, of the dominant animals, the adult male, the male infant caretaker (Bernstein, 1974), the father, the uncle, and the control animal, the alpha male, or the beta male. Certainly the more narrow the class, the more valuable the concept of role (Rowell, 1972, p. 168).

The less common strategy, looking at the distribution of behaviors (Gartlan, 1968), leads to the assignment of most behaviors to different classes of individuals, each with different probabilities (Reynolds, 1972). Whether the classes are based on age/sex categories or on more individual labels seems not to influence the effectiveness of role analysis. When roles are more individual or more specialized, however, the chance that certain groups will not have a member playing a specific role will increase. Presumably there are roles that may or may not be used in a group. After the death of the sentinel, it is possible that no animal would take up the role and that animals would not alter their behavior in the absence of a sentinel. If group B does not have a member using the control role, how does control work in group B and is the control role an important innovation? (Hinde, 1971, 1978, discusses other problems of roles). The role of the consumer in human society or sentinel in some ungulates is an extreme example: Many individuals occupy the role; if one individual does not fulfill its role, this lack does not necessarily lead to changes in the behavior of others. Its presence does not lead to greater efficiency; its absence doesn't lead to an appreciable increase in inefficiency. In many ways the role of the solitary male is similar (Sarbin, 1954).

The two strategies used to detect the existence of role disclose another factor, namely, that roles are composed of behaviors of differing importance. The role of mother, alpha male, or core female is composed of a cluster of behaviors, any single one of which may be missing, especially if that missing behavior is supplied by another animal.

Another problem of both these strategies is that of the definition of age/sex classes. The problem goes beyond that of the lack of agreement as to the boundaries of classes and as to which classes are important ones. If one begins by looking at classes or by assigning behaviors to classes, this precludes the possibility of assigning roles that are operated by individual from more than one class. For example, if both adult males and females act as group leaders, defining roles as exclusively occupied by either males or females will cause one to omit "leader" as a role. It also means that individual specialized behavior within a class is not recognized as a role.

One way to escape from the difficulties posed by the two strategies used to define roles is to use factor-analytic techniques on interaction data (Fedigan, 1976; Chamove, 1974; Chamove, Eysenck & Harlow, 1972). This avoids answering the questions (1) Does every behavior at every second function as part of a role? and (2) Does every animal have one or more roles? The advantage of this approach is that it gives adequate descriptions of, but not definitions of or theoretical rationale for, roles without getting into endless subdivision of classes or individual descriptions of behavior. The disadvantage is the need to use many groups and that factor analysis is designed to detect clumps of behaviors and not single behavior patterns, such as "control role."

In conclusion, we might ask how the results of the present experiment fit with role analysis? It appears that dominant monkeys are *less* liable than subordinate ones to be the first to contact feared novel objects; the difference in order of response to novel objects is more predictably due to the *role* of one group member as "first-contactor." Once first contact has been made, the dominant animal may then expropriate the object for itself. We may hypothesize that this hesistancy gives the dominant monkey the opportunity safely to test this new object—if it induces fear or avoidance in the initial contactor, the dominant has the opportunity to so observe. It may then act on this information. The results of the punitive-object tests indicate that the dominant animal seems to engage in such a chain of behavior.

Finally, it is suggested that the role of the first-contactor fulfills the seven criteria previously set: (a) The animals act as though they expect an individual to contact a novel object. (b) If it does, there are consequences based on its response to that object, namely, further contact by others if it is safe but no further contact if it is dangerous. (c) If it does *not* contact the object, there are also consequences, namely, delay by others in contacting the object. (d) The role involves relationships between individuals. (e) The role appears to be fulfilled by only one individual, and (f) it is specialized in the sense that some rare groups do not have an individual who fills the role. And (g) there appear to be no obvious correlates with the behavior of individuals when isolated from the group.

The role of first-contactor has obvious benefit to the group and to the dominant group member, but what benefit does it bring to the first-contactor? Perhaps, at some risk to the first-contactor, it allows preferential access to potentially desirable resources. If so, then one might predict that the first-contactor would not be the dominant who already has the option of access to the resource or a close friend of the dominant, nor would it be either an enemy of the dominant, or very subordinate, where its contact of objects might evoke retaliation by the dominant after its first contact had been made.

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