Topic 6: Social Object Play Among Juvenile Japanese Macaques

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18.1 Introduction: Some of the Substantial Difficulties of Research of "Play"

Many authors have studied juvenile Japanese macaques (*Macaca fuscata*) for investigating various research topics for more than 60 years since Japanese primatologists started provisioning them at many sites, such as Koshima Islet in Miyazaki or Arashiyama in Kyoto. Our accumulated knowledge of Japanese macaques is vast and varied, as this book shows. Few expert primatologists have studied the play behavior of Japanese macaques as a main research topic, with the exception of early studies by Hayaki (1983), Koyama (1985), Imakawa (1990), and my recent study (Shimada 2006). The play of Japanese macaques is a largely unexplored field of research.

Several researchers from various fields have been interdisciplinarily interested in the play of animals (Fagen 1981). These researchers acknowledge the importance of studying play behavior among animals. A famous cultural anthropologist, Johan Huizinga (1955), called humans *Homo ludens* (Man the Player), stating that the play of humans is an essential part of humanity. We can, therefore, expect to develop our knowledge about the origin and evolution of humanity when we study play behavior of nonhuman primates, our close relatives in evolution.

Many ethologists, however, have experienced and noted the many difficulties in studying play behavior of any animal species, including primates (e.g., Fagen 1981; Burghardt 2005). I have discussed and summarized two main reasons why it is difficult for ethologists to study animal play behavior (Shimada 2009).

The first reason is simple but critical for ethological study. Since the sociobiologist Edward O. Wilson complained about the lack of ethological definition of animal play behavior in *Sociobiology* (Wilson 1974), no one has succeeded in proposing a definition of play behavior with which all researchers are satisfied,

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even though several researchers have made efforts to do so (Burghardt 2005). We have no common view on what behavior or which behavioral category should be called "play" thus far, although anyone can easily imagine and perceive the meaning of the word "play," or "play behavior."

The second reason is more practical. Many of the modern researchers studying animal behavior tend to design their research plans to reveal a function as an ultimate factor of the behavior they want to investigate. They build hypotheses about the function of the behavior, and then verify these hypotheses. Because many researchers agree to employ one of the criteria of play as behavior, which seems to have no direct function, most researchers who adopt the so-called hypothesis-verify approach inevitably hesitate or avoid studying play behavior.

Although these substantial problems to study animal play behavior are not easy to solve, it is logically possible to avoid approaching such difficulties directly and to research play behavior by finding "detours," to avoid debate on the definition of "real" play, and not to engage in identifying what the function of play is. The purpose of this paper is to introduce my own research of play behavior of juvenile Japanese macaques from a unique point of view as such a detour (Shimada 2006). For new ethologists, who hope to research primate play behavior, I would like to suggest some interesting phenomena of play among juvenile monkeys correlating with play among human children, and then call their attention to play behavior as a concrete and possible research topic.

Thus, hereafter, I will use the word "play" just for the sake of convenience and will not ask whether what I call "play" can really be defined as play or not. The word "play" in this paper indicates particular kinds of behavioral or interactive patterns, which some ethologists, including myself, agree to call play, but others do not.

18.2 "Social Object Play" Among Arashiyama Macaques

Researchers have traditionally divided animal play behavior into the following three categories and have conducted their studies on the structures and functions of each of the three categories: "locomotor play" as solitary activities, such as running, leaping, swimming, or rolling; "object play" as solitary activities holding detached portable objects, including pushing, pulling, or breaking an object; and "social play" as interactions among two or more individuals, such as "play-fighting" or "play-chasing."

Think of the following three patterns: two domestic dogs play tug-of-war by biting a tree branch and pulling it at both ends. A juvenile macaque runs dragging a tree branch and the other gives chase from behind. Human children play a game of baseball, or chess. All three examples include features of social and object play. We call such a combined category "social object play (SOP)." I broadly interpret the meaning of SOP to make it possible to address the many patterns of SOP observed in nature. For example, in the broadest sense, SOP includes cases in which one of the juveniles holds an object eventually during social play.

In its narrowest sense, it includes games where the objects must be moved according to the strict rules.

Even though SOP has been observed in many animal taxa and varies according to species (Fagen 1981), few studies have examined SOP incorporating characteristics of both categories of social and object play.

Primate researchers must be interested in SOP from the perspective of object possession among monkeys: when a limited valuable object is unclaimed, a dominant individual will most likely have access to it. However, there is also a so-called "prior possession rule" (Bakeman and Brownlee 1982), whereby individuals rarely compete directly for valuable portable objects such as food items that are already claimed by other individuals, even when the object holders are subordinates. If juvenile monkeys automatically and strictly apply this prior possession rule during SOP, nonholders should keep their distance from a possessed object or its holder during play, which means that stealing an object from a holder should be rare, and SOP would not be expected to continue for long periods.

Taking this background into account, let us examine the following description of an interaction observed among juvenile Arashiyama macaques.

Case 1: SOP between two juveniles (May 8, 2000)

Only two juveniles in the same matriline (*Momo*-matriline), whose abbreviations were "*M2*" (*Momo-597898*; 2-year-old female; *M1*'s aunt; dominant) and "*M1*" (*Momo-59789299*; 1-year-old female; *M2*'s nephew; subordinate), continued playing socially from 1300, intermittently, in the woods away from the other group members:

Time 13′20″28. Both of them sat on the ground 3 m away from each other. *M2* found an object in the bush where she sat, and picked it up. The object was a steel semicircular hoop, having a diameter of approximately 30 cm and a width of about 3 cm. *M2* handled the object.
13′20″56. *M1* ran toward *M2*, and *M2* ran in an attempt to escape with the object. *M1* chased *M2*.
13′21″09. The two animals sat 1 m away from each other.
13′21″30. *M2* ran away from *M1* with the object and *M1* chased *M2*.
13′21″47. *M1* stole the object and escaped immediately from *M2*. Now *M2* chased *M1*.
13′22″09. Both sat 1 m away from each other.
13′22″20. *M2* stole the object and escaped immediately from *M1*.
13′22″30. Both of them grappled with each other on the ground, while *M2* kept holding the object.
13′22″37. *M2* stepped 1 m away from *M1* and sat down.
13′23″04. *M2* dropped the object, picked it up immediately and walked away from *M1*, while *M1* kept sitting without reaction.

From the features such as continuous interaction including play-fighting and play-chasing with an object, we can judge their interaction as SOP.

During this observation period of ≥1.5 min, I noticed several features of the object they held and their interaction. First, the steel hoop was obviously trash

Fig. 18.1 A scene of "play chasing with a target object" (PCT) among juveniles of Arashiyama. A holder of a maple branch (*left*) escapes from a nonholder (*center*)

discarded by humans, which is inedible to macaques and thus has no value as food. Second, while playing socially with the hoop, they paid no attention to the other objects around them, even though it was easy to find several other kinds of portable objects in the woods, such as twigs. Third, although both of them experienced holding the hoop at least once, the holder was always chased during play-chasing. Fourth, at any given time only one individual held the object: there was never a situation when both of them held the object at the same time, like a tug-of-war. Finally, despite the differences in age and relative rank, both of them stole the object from each other without any agonistic competition over the object.

The features of interactions above can be summarized as follows: (1) multiple individuals use an object as a target of play; (2) the holder of the target escaped from nonholder(s). Hereafter, I define repetitive play-chasing that includes two features above as "play chasing with a target object (PCT)" (Fig. 18.1). PCT is logically a particular interactive pattern observed as a type of SOP, as well as "tug-of-war," or situations where a socially playing individual held two or more objects, or an object holder chases a nonholder, and so on.

These descriptions obviously contradict the prediction above, suggesting that SOP mechanisms differ from those applied in the prior possession rule. Thus, my research was focused on the mechanisms that made interactions such as PCT possible.

18.3 Methods

The subjects were all the juveniles (defined as 0- to 4-year-old individuals; $n = 41$) of the provisioned Arashiyama E group (hereafter, "Arashiyama") at Iwatayama Monkey Park in Kyoto Japan, which is open to both researchers and tourists.

All the macaques in Arashiyama have been identified (Koyama et al. 1992). Data collection was conducted in summer of 2000 (38 days; 246.7 h), after I identified every juvenile in the group.

To collect data on continuous interactions occurring around an object, I employed, so to speak, the focal "object" sampling method, which is a modified version of the sequence sampling method and focal animal sampling method (Altmann 1974): When I observed a juvenile holding an object by hand or in the mouth, I began to follow the object and the holder. If the focal object moved to a new holder, I recorded the time and continued following the object and the new holder until the object was finally abandoned. I made a note of the species and kinds of the objects whenever possible.

I successively recorded the name of object holder, the names of other individual(s) within a 3-m radius, and various types of interaction among them. I operationally divided these interactions into nine exclusive categories: (1) play-fighting, (2) play-chasing, (3) tug-of-war, (4) taking an object from a holder, (5) walking together, (6) other active interactions, (7) stopping, (8) clinging, and (9) unknown. I defined a bout of SOP as a continuous series of active interactions (1–6) concerning one focal object with between-play intervals of <1 min. Participants of an SOP bout were defined as individuals who actively interacted in the bout at least once, and a "long" SOP bout was defined as a bout, which continued for ≥0.5 min.

I noted the start of play-chasing between an object holder and nonholder(s). For each of these moments, I recorded the name of the holder and any nonholders within a 3-m radius, along with information about which individuals were chased. I analyzed the relationship between the role of an object holder and a chaser during play-chasing in SOP bouts. Detailed information on methods and definitions is given in Shimada (2006).

18.4 Summary of Results

I observed 298 bouts in total. An analysis of SOP revealed the following features: Ninety percent or more of juveniles (37 of 41) participated in SOP at least once during the observational period. Forty-four percent of the bouts that I could observe completely were long SOP bouts, and the longest bout lasted for >15 min. These results suggest that SOP was not a rare activity for most Arashiyama juveniles, and they often continued SOP for long periods.

I identified 135 objects held in long SOP bouts. Juveniles held almost any kind of portable objects that they could access in the environment. A total of 108 natural objects (80%) were held in SOP, consisting mostly of plants ($n = 107$), such as branches, rotting wood, ferns, or herbs, and a stone ($n = 1$). On the other hand, 23 artificial objects were held (17%), such as plastic bottles, or materials made of steel, as in Case 1. However, the juveniles were never observed to hold pieces of wild fruits they could access in the environment or food items such as soybeans or banana provided by the park staff or tourists. Within the range of natural objects, I

identified 28 tree species, and all of them (except *Clethra barbinervis*, which was held once) contained some parts that are edible to macaques in Arashiyama, according to lists of the Arashiyama macaques' food (Murata and Hazama 1968; Huffman 1984).

For ≥90% of the duration of SOP, an individual held only one focal object and others within a 3-m radius held no object. In contrast, situations where two or more individuals held the same focal object at the same time, as in a tug-of-war, or an individual held two or more objects, were observed only rarely and did not last for long.

I observed 373 starting moments of play-chasing between an object holder and nonholder(s) in total. In the case of play-chasing, there was a strong tendency for an object holder to assume the role of chasee, independent of the number of nonholders around (Fig. 18.2). In addition, the tendency was revealed to be independent of the relationship of attribution between them, such as sex, age, relative rank, or kinship.

Holder-reversal of a focal object occurred, on average, more than once per long SOP bout which I observed completely; this suggests that holder-reversals happened frequently. In most cases, the new holder assumed the role of chasee, and the former holder chased the new holder or just stopped playing.

Juveniles rarely exhibited serious aggression or submission concerning objects during SOP.

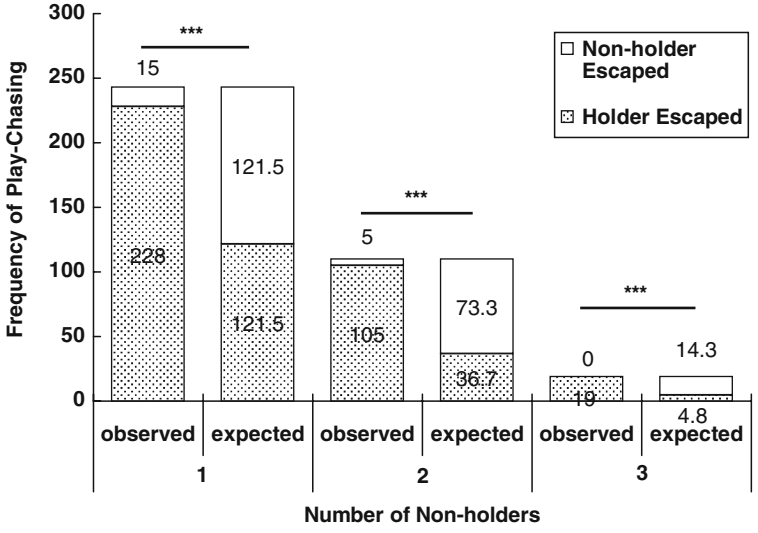

Fig. 18.2 Frequency of a holder or nonholder escaping in play-chasing during "social object play" (SOP). For this analysis, one case in which the number of nonholders was unknown ($n=1$) was excluded. Each expected frequency was calculated based on the assumption that all participants had an equal chance of being chased. ***$P<0.001$ (binominal test). [From Fig. 1 in Shimada (2006), with kind permission of Springer Science+Business Media]

In summary, most SOP among the juveniles of Arashiyama had two regulative interactive features. Multiple juveniles treated only one object as a target of play. The holder of the target escaped from nonholder(s) in play-chasing. As defined, such interactive patterns were considered to be PCT. Although PCT is only one of logically possible and typical play patterns of SOP, it was the most common interactive pattern among juveniles whenever SOP was observed.

18.5 Discussion

18.5.1 Juveniles' Perception and Continuity of SOP Bout

Juveniles of Arashiyama held almost any kind of objects they could find in their environment. It is interesting to note that most of the natural plants that the juveniles played with socially contained edible parts. Because they were provisioned with plenty of nutritious food, the macaques seldom or never fed on these wild plants, except for a few kinds of fruits, during the study period. Thus, the values of the objects as food juveniles held in SOP were considered to be very low for Arashiyama juveniles.

Although it was expected that SOP would not continue for long periods if juveniles apply the prior possession rule, the result was the opposite. Perception of the value of the objects as food for Arashiyama juveniles seems to explain the reason why SOP among them could be continuous: even though participants apparently perceived the ownership of the object, they did not seem to respect the possession of object, because they perceived the value of the object as food at the same time. In addition, I never observed juveniles playing socially with any food items provisioned by humans. That is, because the values of the objects as food they held in SOP were low, the prior possession rule rarely operated among juveniles.

18.5.2 Comparison Between PCT and Play-Tag

It is suggested that both the nature of the object and cognition of it by juveniles affected their interaction. As a result, they generated clear interactive regulation among SOP, represented by PCT: an object holder was chased by nonholder(s) in play-chasing, independent of differences in sex, age, relative rank, or matriline. In addition, holder-reversals were frequently observed, and new holders were likely to immediately assume the role of a chasee after the holder-reversal. These results suggest that "being a holder of a target object" was associated with "taking the role of chasee" in play-chasing in a level of the cognition of each juvenile.

When human children are engaged in play-tag, in their cognition, "being named as It ("Oni" in Japanese) by the others" is associated with "taking the role of

chaser." This common cognition among playing children makes smooth role-reversal in play-tag possible, in which, if a child who takes the role of It chases and succeeds in touching another, the child who has been touched takes over the role of It.

From the point of view of comparison between play-tag among human children and PCT among juvenile macaques, it is notable that their structures seem to be opposite to each other: in the former, one individual (It) will assume the role of chaser and all the others chasee, while in the latter, one individual (object holder) will assume the role of chasee and all the others chaser. Our observation, however, suggests that juvenile macaques mediated the concrete object instead of words such as "It" or "Oni" and could achieve role-reversals and continuous play-chasing in PCT as children in play-tag.

18.5.3 Semantics Among Monkeys?

Even though the object held in SOP had no value as food and there were several substitutes in the environment, it was the very object held by juveniles at the specific moment, not other similar substitutes, that had a particular value or meaning as a target of SOP for playing juveniles. In addition, as we discussed above, "being a holder of a target object" seemed to be associated with "taking the role of chasee" in SOP.

Researchers in fields of cultural sciences, such as semantics, may consider these phenomena important, because in a lexicon, semantics is the study of meaning: how a sign refers to particular phenomenon. From the semantics point of view, the phenomena can be interpreted in terms of new social value or meaning being generated in playful interactions among juvenile macaques, and the target object worked as a kind of "sign," which referred to the target of play and the chasee as one of the roles in play-chasing.

I often observed that when an object holder accidentally dropped the object, such as a twig from a tree, the holder and the nonholders attempted to pick up the very twig on the ground even though there were several other similar twigs around. Using some ideas of semantics, these observations can be understood as follows: once they regarded the twig as a sign referring to the target, the signification could continue, to some extent, even when no one held the twig.

We humans give social or personal meanings to external phenomena, which are not always derived from their primary meanings. For children who play with a doll house, a handful of plastic beans may be regarded as the dolls' dinner. When we think about semantics, we are likely to consider the human ability to use symbols, such as language, and therefore regard this as a matter of communication of only humans, not of animals. However, the observation of SOP suggests that even Japanese macaques, who never use language, can give a social meaning to a thing in certain situations.

18.5.4 Concentration of Interests and Continuous PCT

As shown in case 1, when one of the socially playing juveniles picked up an object, or when a juvenile approached another juvenile who held an object, juveniles eventually concentrated their interests on that particular object, and as a result, an SOP would be started. Even though SOP started with only two juveniles initially, as time passed, other juveniles participated one after another, and, as a result, the SOP bout would continue for a long period.

Figure 18.3 illustrates a concrete example of a long SOP bout (8.48 min) in which many juveniles participated. Throughout the bout, the timing to participate or quit SOP varied among the 11 juveniles. The decision of when to participate or quit SOP seemed to be up to each juvenile, and permission to do so was not required from the others. For example, some juveniles, such as *Ko9398*, held the cup and participated continuously, whereas others, such as *Me96* or *Mo99*, never held it and participated intermittently or only briefly. The absence of rules to regulate the participation or close of play made the boundary of SOP membership unclear, in contrast to play-tag of human children in which the boundary is normally clear and regulated by such rules.

The difference in the ways to participate in SOP among each juvenile is considered to reflect the variations of their interests in a particular object they targeted. When an object attracted many juveniles at the same time, the SOP would be observed to be "excited or fevered." On the other hand, the object in which they lost their interest might be abandoned, and SOP would cease naturally.

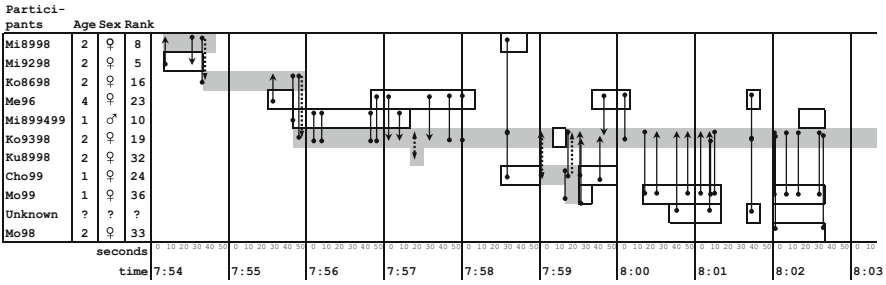

Fig. 18.3 The *left side* of the figure displays each participant, and the time axis for each individual extends from left to right. For convenience, bouts are displayed in 10-s units. *Hatched bars*, individuals holding the object (a broken, transparent plastic cup); *white bars*, individuals confirmed or estimated to be within a 3-m radius of the holder during that time unit; *vertical solid arrows*, play-chasing between a holder and nonholder(s) and the direction of chasing (the individual from which the *arrow* originates indicates a chaser, and the individual toward which the *arrow points* is the chasee); *vertical solid lines*, interactions other than play-chasing; *vertical dotted arrows*, transference of the cup among individuals (the *arrow* indicates the previous cup holder; the *arrowhead* points toward the succeeding cup holder). [From Fig. 2 in Shimada (2006), with kind permission of Springer Science+Business Media]

Although the regularity of the interaction represented by PCT is one of the most prominent features of SOP in Arashiyama, juveniles would never be forced to join in, leave, or obey any rules, that is, SOP were substantially "free" activity. They, however, generated regulative interaction once they joined in.

18.5.5 Future Perspective to the Study of Play

Any ethologist trying to study animal play behavior needs to find questions in the phenomena of play that are worthy of research and logical ways to solve the questions they identify. However, there are two inevitable and substantial difficulties in the study of animal play behavior to which no one has succeeded in giving clear solutions thus far: the definition and the function of play.

In this paper, I have used my study of SOP among juveniles in Arashiyama as an example of a logical "detour," not addressing these problems directly, and to clarify the proximate mechanism that make the interactive features of SOP possible. In this process, I discussed some interesting innovative views of SOP, although some of these are based on suppositions and need to be verified by future research.

As far as the study of animal play behavior is concerned, watching the phenomena well and finding a "detour" may sometimes be more fruitful than trying to stick to the ground theory or methodology of behavioral ecology and abandoning research.

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