PLAY IN WILD, IMMATURE WHITE-FACED CAPUCHINS (*Cebus capucinus*)

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Play is a costly and sometimes dangerous behavior found in most mammals and many birds and proves something of a challenge to explain in evolutionary terms. Theories on the evolution of play suggest that it imparts some benefit that exceeds the costs associated with the behavior. This study examines the relative rates of different types of play in a population of wild, sub-adult white-faced capuchins a small, arboreal monkey, in northeastern Costa Rica. This species in particular is known for being manually dexterous and highly manipulative foragers. The purpose of this study is to investigate the possibility of a link between these skillful mature behaviors and early learning obtained through play in sub-adults.

Play behavior is ubiquitous among mammals and very common in birds.[1,2] In contrast, few examples of play exist beyond these two vertebrate classes.[3,4] Attempts to operationally define play have not led to immediate consensus. Some scholars distinguish play by its lack of immediate benefit,[5] while others claim that play does, in fact, have not only immediate benefits,[6,7] but deferred ones as well.[8,9]

As an energetically costly, often dangerous behavior without obvious immediate benefits, the existence of this expensive behavior must be justified by some evolutionary trade off. While benefits may not be immediate, obvious, or intentionally sought after, many have been proposed,[10,11] These include building physical strength, forming social bonds, and developing adult skills.[12] Play may also allow for the behavioral flexibility necessary for approaching novel situations during dispersal events, as when adult individuals leave their natal group to establish their own,[13] providing cognitive benefits which will be useful later in life.[14] Another proposed benefit suggests playful animals develop lean body mass – a trait which would facilitate predator evasion and increased resistance to cold stress.[15] Animals at play however risk injury,[16] predation,[17] and energy expenditure.[18]

Important categories of play for animals include: locomotor, social, and object(see Tab. 1 for definitions). Each of these subcategories emphasizes a particular pattern of behavior and subsequently may be linked to specific long term benefits. In the case of social play among immature animals, the most thoroughly studied category, social play is correlated to a higher degree of sociality in adulthood. If play exists to prepare the individual for later stages of life, then the rates and types of play present in a species may help us understand adult behaviors. Additionally, studying play can further our understanding of the evolution of social behavior and organization.[19]

It is important to recognize variations in the expression of play. Play may be species specific.[20] Play may also be population specific.[21] In this study, I examine the play behavior

of a group of feral capuchins (genus Cebus) living in northeastern Costa Rica. Members of the genus Cebus are noted for their expressive intelligence.[22] It has been suggested that the evolution of such brainpower may have been spawned by ecological pressures. This genus specializes in foraging hard-to-access food sources,[23] which requires a more cognitive approach to feeding than easy-to-access food sources such as leaves. Hunting vertebrate prey, avoiding the stings of arthropods, cracking nuts, and opening the hard shells of some tropical fruit all require the dexterity and manipulation used by capuchins.[24] This species has also been observed using tools in the manner of anvils and hammers in order to crack nuts.[25] Mastering such difficult foraging techniques requires practice and it was my intention to test whether this practice may have been acquired through object play during development.

Study Area

The study was conducted at the La Suerte Biological Field Station in northeastern Costa Rica. The area surveyed, referred to by researchersas the "large forest", comprised an area of approximately 30-40 hectares (between 75-100 acres) of mature, secondary, lowland tropical rainforest fragment.[26] The population observed consisted of 16 individuals, of which eight were juveniles and two were infants. The six adult members of the group included two males and four females. This study group had been recently habituated to the proximity of humans over a period of three months, allowing for relatively close encounters.

Methods

Observations were restricted to juveniles and infants over a 32.5

hour period divided among nine days of data collection. Animals were typically followed from shortly before 5 am until they were lost (on average about 5 hours).

I used an all-occurrence, scan-sampling method, recording every observable bout of play behavior among all immature individuals during the observation period and further distinguishing it as social, object, or locomotor play. This made it possible to record a fairly large volume of bouts within a short amount of time. Some forms of play were more conspicuous than others; social play in particular was often announced by loud vocalizations and crashes throughout the canopy. It is possible that I would have observed a more proportionate amount of solitary play had I utilized a continuous, focal method, following the behaviors of one individual over an extended period of time and rotating subjects. Play bouts were de-

Table 1: Categories of play and descriptions of behavior

Nomenclature	Description
• Play	Behavior consisting of repeated and incomplete sequences of sometimes exaggerated and incomplete segments of other behaviors, often out of context, mixed, and with reverted or mixed sequences. Play intention can be expressed by specific postural or mimic signals and/or accompanied by meta-signals (e.g. play face).
• Social	Play consisting of interactions between two or more individuals. Frequent expressions include chasing, wrestling/rough and tumble play, and play fighting.
• Locomotor	Solitary play consisting of mainly repetitive, incomplete, and out of sequence motor movements. Examples include repetitive and seemingly purposeless climbing movements and extended periods of hanging and swinging from tree branches and vines.
• Object	Solitary manipulation (with no immediate benefit) of a food or non-food object (e.g. rocks, branches). Does not include foraging or feeding manipulations.

clared concluded when partners had been separated for more than one minute, or when new participants joined the bout and others left.

Results and Discussion

Play behavior observed included repetitive and rapid climbing and jumping, hanging upside down by the tail and swinging on vines, chasing, rough and tumble play, play fighting, stick dangling or twirling. All three categories of play were observed.

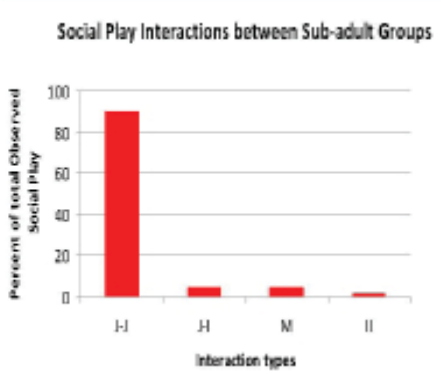

Figure 1 - "J-J:" Juvenile, Juvenile Interaction, "J-I:" Juvenile, Infant Interaction; "M:" Mixed interactions consisting of both juveniles and infants; "II:" Infant, infant interactions

Figure 2: "I:" Infance, "J:" Juvenile

Of the 94 instances of play observed, 70 bouts included at least two individuals, and 17 of those bouts included more than two individuals. All play occurrences, with one exception, occurred in the lower canopy. Juveniles mostly played with other juveniles (Fig. 2). They engaged in twice as much motor play as did infants (Fig. 3). Only three bouts of object play were observed, two in infants and one in a juvenile. All three object play bouts involved the manipulation of sticks and twigs.

Contrary to my expectation, object play was a rare occurrence in wild capuchin infants and juveniles, even though this behavior has been

observed in captive capuchins.[27] One possible explanation for this is that captive populations are often provided "toys" to enrich their environment. These objects are provided specifically to provoke play and are one of few opportunities for stimulation in the captive environment. Wild populations may obtain practice at accessing food sources through direct experience during development. For instance, infants begin to self-feed while the infant is still nursing, possibly providing a buffer period to facilitate learning.

As with many other species of primates, social play was the most common type of play occurring throughout 73% of all play bouts.[28] In contrast, a time budget on this population conducted in 2009 (see Tab. 1) revealed that adults spend only 3.1% ±1.3% of their time engaged in social activities. This low percentage is in direct contrast to the hypothesis that the most frequent-play behaviors exhibited in immature animals corresponds directly to the most vital behaviors in adult life.

Figure 3- N total= 94, Locomotor N= 21 ,Social N= 70, Object N= 3

It is important to note that 93.7% of all social interactions observed in the time budget were affiliative,[29] suggesting a tightly bonded social group with little antagonism. Thus one can make the argument that the social skills and bonds required to guarantee strong social cohesion are likely to have been forged in the juvenile or even infant stage. While total time spent socializing may not be great, the importance of social

Adult Time Budget	
Feeding	20.3%
Foraging	52.6%
Traveling	15.1%
Socializing	3.1% ±1.3% (of which 93.7% of interactions were affiliative)

Table 2- Adult Time Budget

cohesion is implied by the very high instance of affiliative social contact.

The group under study played often and vigorously. Bouts occurred at a rate of approximately 9-10 per hour and occasionally persisted for over thirty minutes, lasting on average approximately 2-3 minutes. Social play usually included chasing and fighting and individuals engaged in the sport would often run the whole length of the group's periphery. Play fights were distinguished from altercations by the use of meta-signals such as 'play face', lack of alarm calls, and context.

Conclusion

Play is an important part of development in mammals.[30] While play has many costs, it also provides both immediate and deferred benefits to the lives of participants. Play provides necessary skills and establishes social bonds important in adult life. It also confers physical benefits to the fitness of maturing animals who engage in it, such as increased leanness and resistance to cold.

Following the hypothesis that play in the immature stages may be indicative of behaviors of significance in the adult stage, I set out to examine the relative rates of play in a population of white faced capuchins.

Capuchins are known for the dexterous and manipulative techniques used in food acquisition, and it was reasonable to believe that

this behavior would be acquired during immaturity, possibly through play. I expected to see a high occurrence of object play and anticipated a correlation with the activity budget of adults in the same population, assuming that the time spent in immature object play would correspond to the time adults spend foraging for difficult to access food sources. This was not the case. Immature capuchins engaged in greater instances of social play than any other play behavior. Object play was rare, observed in only three cases. Despite the fact that social play consumed such a large percentage of the play budget, social behaviors occupied a very small percent of the adult time budget. It is worth noting that of the social behaviors observed in adults, over 90% were affiliative. This implies strong social bonding and may explain the importance of social play in the immature stage.

The sample size in this study was smaller than desired, and the short length of the study precluded more in-depth analysis. In the future a longitudinal study of the life course of infants in a population may serve to elucidate the same questions with more depth, following more reliably the patterns of play in individuals and later expressions of analogous behaviors in adulthood. Topics for future research may include whether social play in the juvenile stage corresponds to social affiliation in the adult stage.

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