

Social Games Between Bonobos and Humans: Evidence for Shared Intentionality?

SIMONE PIKA* AND KLAUS ZUBERBÜHLER

School of Psychology, University of St Andrews, St Andrews, Scotland, United Kingdom

Triadic social games are interesting from a cognitive perspective because they require a high degree of mutual social awareness. They consist of two agents incorporating an object in turn-taking sequences and require individuals to coordinate their attention to the task, the object, and to one another. Social games are observed commonly in domesticated dogs interacting with humans, but they have received only little empirical attention in nonhuman primates. Here, we report observations of bonobos (*Pan paniscus*) engaging in social games with a human playmate. Our behavioral analyses revealed that the bonobos behaved in many ways similar to human children during these games. They were interested in the joint activity, rather than the play objects themselves, and used communicative gestures to encourage reluctant partners to perform their role, suggesting rudimentary understanding of others' intentions. Our observations thus may imply that shared intentionality, the ability to understand and shares intention with other individuals, has emerged in the primate lineage before the origins of hominids.

Key words: *Pan paniscus*; social games; social intelligence; cooperation; cognitive evolution

INTRODUCTION

From early childhood, human infants interact with others dyadically in coordinated turn-taking play sequences, so-called social games [Trevarthen, 1979]. As objects are integrated, these games become more complex and triadic, requiring coordination of attention both to a task and object and to one another [Ratner & Bruner, 1978]. Triadic games have also been documented in interactions between dogs and humans [e.g. Mitchell & Thompson, 1993], humans and dolphins [Kuczaj & Highfill, 2005], and between dolphins [McBride & Hebb, 1948]. In contrast, social games in nonhuman primates (hereafter

Contract grant sponsor: German Science Foundation (DFG); Contract grant sponsor: EU Nest Pathfinder initiative.

*Correspondence to: Simone Pika, School of Psychological Sciences, University of Manchester, Coupland 1 Building, Oxford Road, Manchester M13 9PL, Lancashire, England, UK. E-mail: simone.pika@manchester.ac.uk

primates) are almost always dyadic, rarely involve objects, and if so usually in a competitive way [Pellegrini & Smith, 2005]. Apes sometimes show triadic engagement, but these interactions appear different from those observed in children, especially with regard to joint attentional episodes [e.g. Tomasello et al., 2005]. Consistent with this view are recent results by Warneken et al. [2006], who compared the cooperative skills of children and human-raised chimpanzees in two problem-solving tasks and two triadic social games. In the social games, the adult human partner was instructed to suddenly stop participating to provoke the subject into responding in ways that might reveal their understanding of the cooperative nature of these games and the roles required. Although most children tried to encourage the human playmate to resume his role by using communicative signals, this was never observed in the chimpanzees. One interpretation of these results is that primates may be interested in achieving individual goals, whereas children are also capable of pursuing shared goals [Warneken et al., 2006]. It has been argued that such observations provide evidence for what might be a uniquely human form of social intelligence [Tomasello et al., 2005], the ability to share intentions [Bratman, 1992; Gilbert, 1989]. Shared intentionality refers to collaborative interactions in which participants (1) are *mutually responsive* to one another, (2) pursue a shared goal, (3) and coordinate their plans of action for pursuing the shared goal [Bratman, 1992; Gilbert, 1989].

Here, we report observations of four bonobos (*Pan paniscus*), who engaged spontaneously in different types of triadic social games with human playmates. In line with previous methodology [Ross & Lollis, 1987], we deliberately interrupted these games to investigate if the bonobos encouraged the recalcitrant partner to perform her role by using communicative gestures.

METHODS

Study Site

The sanctuary Lola ya bonobo houses about 50 wild born individuals of all age–sex classes in four enclosures, containing natural forests, water basins, and numerous objects (e.g. balls). The two enclosures concerned in this study were 14 and 10 hectares woodland areas, which included 12 and 13 individuals, respectively.

Participants and Data Collection

Observations took place during February–April 2006, for 6–7 days a week, for about 6–8 hr per day. Social games were initiated between three humans (SP, AK, and CP) and four bonobos: KD and ML (infants), LS (subadult female), and KW (adolescent male). In each case the human playmate tried to instigate a social game involving various objects on an ad libitum basis. Once a triadic interaction was established and was relatively stable, the human playmate suddenly and deliberately stopped the interaction. Interactions were filmed using a digital camcorder (Panasonic NV-GS 250). We recorded the number of gestural signals that individuals produced before and after the interruption. We defined gestures as expressive movements of limbs or head or body postures directed towards a recipient in a goal-directed and mechanically ineffective way, receiving a voluntary response [Pika, in press]. Gestures were coded as intentionally produced, if accompanied by eye contact and/or waiting after signal production, expecting a response [Pika, in press].

Table I lists the different gestures considered for this study.

TABLE I. Communicative Gestures Produced by Different Bonobo Individuals Before and After Disruption of Triadic Social Games

Beg	Signaler outstretches her right or left hand with palm facing up toward the recipient.
Grab	Signaler takes hold of the recipient with the whole hand; fingers are bent.
Head bob	Signaler bows the head up and down toward the recipient.
Offer	Signaler extends her arm with an object in her hand and holds it in front of recipient.
Palm open and close	Signaler outstretches her right or left hand with the inside facing sideways while opening and closing the hand.
Protruded lips	Signaler sticks out her lips and upends her upper lip; the teeth are visible.
Touch	Signaler does a gentle and short (<5 sec) contact using her flat hands, body part or feet.
Stomp with foot	Signaler brings the sole or heel suddenly and forcibly against or upon the ground, object, or walks in a pounding manner.
Wiggle leg	Signaler shakes the lower extremities from side to side in front of the recipient.

Data Analysis

SP coded all gestures from videotapes. About 10% of all videotapes were recoded by a second observer. There was 80.0% agreement between coders concerning classification of gestures, using a Cohen's κ reliability test [Altmann, 1991].

RESULTS

We observed four different triadic social games with four different bonobos interacting with a human playmate. When a game was deliberately interrupted (only the object splash game stopped naturally), individuals reliably produced gestures in an attempt to reengage the reluctant partner. All the observed gestures were part of the bonobos' natural repertoire [Pika et al., 2005].

Social Game 1, "Hand-Splash"

This game was observed on 2 different days with the two infants. KD, sitting alone in the waterbasin, initiated the first game by splashing water with his legs. SP also splashed water, using her hand as the object of play. In response, KD approached SP, sat down next to her, whereas SP continued splashing more water. Then she abruptly stopped the game, leaving her hand in the water. KD responded by *grabbing* and *touching* her hand. SP splashed more water and then stopped the game for a second time, this time taking her hand out of the water. KD responded by *touching* SP's hand. SP did not react, and KD then *grabbed* her hand. SP responded by continuing the game a total of seven times (see supplementary video clip 1). No communicative gestures were recorded during the game but as soon as it was interrupted the infant generated the gestural signals *grab* and *touch*. This game was also instigated three times with ML, who also used the gestures *grab* and *touch* as soon as the game was interrupted.

Social Game 2, "Object-Splash"

This game occurred between SP, the infant KD, and a round, hard Makalakonki fruit. The interaction started when SP lifted the fruit out of the

water and let it drop, producing a splash in the direction of KD. The floating fruit was retrieved by KD, carried to SP, and *offered* to her. SP took it and repeated the procedure. Again, KD went off to retrieve and *offer* the fruit to SP. The game was repeated four times until KD started interacting with a conspecific. KD only produced communicative gestures (*offer*) as soon as the game was interrupted.

Social Game 3, “Fruit-Ball”

This game was observed on two different occasions between CP, the bonobo male KW, and a grapefruit. It started with KW playing with two grapefruits while facing CP through the wired mesh of the enclosure door. KW pushed both fruits through the door mesh, joggled, and rolled them on the ground. Accidentally, one fruit rolled out of reach. CP initiated an interaction by rolling it back. KW played with it, but then lost it again. Again, CP rolled it back. KW joggled it around, pulled it into the enclosure, and pushed it out with two feet, this time letting it roll to CP. Then CP and KW rolled the fruit back and forth repeatedly. Suddenly CP stopped the game, and joggled the fruit in front of KW. KW looked at CP and used different gestures (*beg*, *stomp* against the door, *head bob*, *palm open and close*, *protruded lips*) until CP rolled the fruit back. The game went on for 10 min, interrupted two more times by CP. Each time KW looked at CP and subsequently used the gestures *head bob*, *palm open and close*, *protruded lips*, *stomp*, *palm open and close* to reinstate the game (see supplemental video clip 2). In addition, the game was interrupted twice by other group members who tried to get the fruit or wanted to play with KW. KW played shortly with them, always protecting the fruit. Both times he returned and restarted the game with CP by rolling the fruit to him.

Social Game 4, “Object-Throw”

This game was observed on 3 different days between the bonobo LS, the human playmate AK, and a nut. LS found a nut in the sand of the enclosure, stuck her hands through the door mesh and spontaneously threw it to AK. AK handed it back and LS threw it back to her. This time AK also threw it back to LS. After a few more iterations, AK suddenly stopped the game. LS first looked at her then performed a variety of gestures (*wiggle* her leg, *beg*; see supplemental video clip 3). Suddenly she found a different object, a yellow cap, and restarted the game by throwing it to AK. AK threw the nut back, but LS now preferred the cap. When AK stopped the game again, LS used different gestures (*wiggle* her leg, *protruded lips*, *beg*). Then AK restarted the game throwing back the yellow cap. On the second occasion, AK threw the cap, and LS threw it back. Then AK stopped the interaction and LS performed the gestures *protruded lips* and *beg*. Other animals then interrupted the game. On the third occasion, AK and LS played with a nut again. When AK stopped the game, LS *wiggled her leg* and *protruded the lips*. AK continued to play more rounds and then stopped the game again. This time LS used the gestures *beg* and *protruded her lips*.

DISCUSSION

We described four different social games played by four bonobos interacting with human playmates and different objects. Our observations showed that bonobos readily engaged in these kinds of triadic games, by playing different but complementary, interdependent, and parallel roles. These observations are in line

with previous observations in some nonprimate animals, particularly dolphins [e.g. Kuczaj & Highfill, 2005] and dogs [e.g. Mitchell & Thompson, 1993]. Similar observations have been described for primates, but they were anecdotal and restricted to language-trained and/or human-raised apes, who received extensive training [e.g. Crawford, 1937; Gomez & Martin-Andrade, 2002; Matevia et al., 2002]. The bonobos of this study used gestures in a flexible way to achieve a social goal, namely to reengage a suddenly passive partner. Our results contrast with a recent comparative study on children and chimpanzees [Warneken et al., 2006]. In that study, upon encountering a reluctant partner, the chimpanzees immediately switched from a superficially social action to an individual attempt or complete disengagement. Contrarily, children tried to reorient the experimenter toward the game and his part in the cooperative interaction [Warneken et al., 2006]. The authors suggested that the children, but not the chimpanzees, had learned to form with others a joint goal and joint intentions for reaching that goal. Importantly, the chimpanzee results were used to argue in favor of a fundamental cognitive difference between humans and primates in terms of the ability to share intention. Our study suggests that it may be premature to draw firm conclusions about an animal–human difference in this cognitive domain. We are less pessimistic also because (a) in other paradigms chimpanzees have been observed to use communicative gestures to solicit reluctant partners [e.g. Crawford, 1937; Hirata & Fuwa, 2007]; (b) gorillas have been observed to initiate triadic games with humans [e.g. Gomez & Martin-Andrade, 2002]; and (c) dog–human play may fulfill criteria for shared intentionality outlined before [Mitchell & Thompson, 1993]. However, attempts at reengaging a reluctant partner are only one observational criterion for shared intentionality, and may not represent the right tools to elucidate the underlying psychological processes. In addition, it might be argued that the described games may be familiar or ritualized between the bonobos and their human caretakers, suggesting that their behavior was the outcome of simple operant conditioning processes. We do not think that this is a valid interpretation because the *object-splash* and *object-throw* games were spontaneously invented and most likely novel to the infants. It could also be argued that the bonobos used the human playmates as simple tools to restart interesting events, rather than perceiving them as partners in a joint activity with a shared goal. Although this interpretation seems plausible for the games played by the infants, it is more difficult to defend in the case of the *object-throw* and *fruit-ball* game played by the older individuals, in which both participants behaved as if they had joint and complementary goals. Crucially, the bonobos were not interested in gaining possession of the objects per se, but they used them to enable a joint social activity.

In sum, the bonobos' performance in these cooperative interactions resembled those of human children [e.g. Ratner & Bruner, 1978] and, following Bratman [1992], showed two crucial criteria for shared intentionality: the partners were *mutually responsive to one another*; and together they were pursuing a *shared goal*, the social game. Children may go a step further by coordinating their plans of action and joint intentions to allow role reversal. This requires that both participants understand and jointly attend to both roles of the interaction and implies a true understanding of communicative intentions: to help the other with the complementary role. The communicative attempts of the bonobos to restart the game seem to provide evidence that they understood and attended to both roles of the game, although they never attempted to take on the role of the human playmate, perhaps pointing to a crucial difference between apes and humans.

ACKNOWLEDGMENTS

We thank C. André for permission to work at the sanctuary, all staff for invaluable assistance, and C. Paluku and A. van de Kuilen for helping with the data collection. We are grateful to T. Behne, J. C. Gomez, C. Hobaiter, H. Rakoczy, M. Tomasello, and two anonymous reviewers for comments and discussion. We thank the German Science Foundation (DFG) and the EU Nest Pathfinder initiative for financing this research. All research reported in this manuscript adhered to the ethical guidelines of the ASAP and was conducted in compliance with animal care regulations and applicable national laws.

REFERENCES

- Altmann D. 1991. Practical statistics for medical research. CRC: Chapman and Hall. 616p.
- Bratman ME. 1992. Shared cooperative activity. *Philos Rev* 101:327–341.
- Crawford MP. 1937. The cooperative solving of problems by young chimpanzees. *Comp Psychol Monogr* 14:1–88.
- Gilbert M. 1989. On social facts. New York: Routledge. 512p.
- Gomez JC, Martin-Andrade B. 2002. Possible precursors of pretend play in nonpretend actions of captive gorillas (*Gorilla gorilla*). In: Mitchell RW, editor. Pretending and imagination in animals and children. Cambridge: Cambridge University Press. p 255–268.
- Hirata S, Fuwa K. 2007. Chimpanzees (*Pan troglodytes*) learn to act with other individuals in a cooperative task. *Primates* 48:13–21.
- Kuczaj SAI, Highfill LE. 2005. Dolphin play; evidence for cooperation and culture? *Behav Brain Sci* 28:705.
- Matevia ML, Patterson FGP, Hillix WA. 2002. Pretend play in a signing gorilla. In: Mitchell RW, editor. Pretending and imagination in animals and children. Cambridge: Cambridge University Press. p 285–306.
- McBride AF, Hebb DO. 1948. Behavior of the captive bottle-nose dolphin, *Tursiops truncatus*. *J Comp Physiol Psychol* 41: 111–123.
- Mitchell RW, Thompson NS. 1993. Familiarity and the rarity of deception: two theories and their relevance to play between dogs (*Canis familiaris*) and humans (*Homo sapiens*). *J Comp Psychol* 107:291–300.
- Pellegrini AD, Smith PK. 2005. The nature of play: great apes and humans. New York: The Guilford Press. p 1–308.
- Pika S. In press. Gestures of apes and pre-linguistic human children: more similar or more different? *First Lang*.
- Pika S, Liebal K, Tomasello M. 2005. Gestural communication in subadult bonobos (*Pan paniscus*): gestural repertoire and use. *Am J Primatol* 65:39–51.
- Ratner N, Bruner J. 1978. Games, social exchange and the acquisition of language. *J Child Lang* 5:391–401.
- Ross HS, Lollis SP. 1987. Communication within infant social games. *Dev Psychol* 23:241–248.
- Tomasello M, Carpenter M, Call J, Behne T, Moll H. 2005. Understanding and sharing intentions: the origins of cultural cognition. *Behav Brain Sci* 28:1–17.
- Trevarthen C. 1979. Communication and co-operation in early infancy: a description of primary intersubjectivity. In: Bullowa M, editor. Before speech. Cambridge: Cambridge University Press. p 321–347.
- Warneken F, Chen F, Tomasello M. 2006. Cooperative activities in young children and chimpanzees. *Child Dev* 77:640–663.