



Triadic Interactions with Tools in a Gorilla

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Abstract - Triadic interactions are an important developmental milestone for young human infants, ultimately enabling them to acquire language. When an infant and a caregiver share attention regarding an object, the label given to the object becomes linked with the object, hence referential communication is established through which infants learn to associate words with meanings. In fact, triadic interactions are considered so crucial to human language development that their phylogenetic origins have become the focus of investigation to study the evolutionary history of language. In this paper, we report a communicative instance of a captive zoo gorilla apparently trying to engage zoo visitors in a joint task of retrieving food. The gorilla seemed to initiate a series of combined triadic interactions with different tools used as pointing devices while attempting to recruit a human for help. Even though it is a single observation event, we argue that the gorilla possessed relevant knowledge about the various purposes for which a specific tool can be used and utilized sophisticated communicative means in her interaction with humans.

Keywords – Gorilla communication, Pointing gesture, Triadic reference, Shared attention, Social tool use, Flexible gesture-tool combinations

The pointing gesture has attracted considerable research attention in developmental psychology in the past as such gestures have been shown to play a crucial role in the language acquisition and development process in human infants (see e.g., Bates, Camaioni, & Volterra, 1975; Butterworth, 2003; Feinman, 1982; Goldin-Meadow & Beilock, 2009; Kita, 2003). The triadic interaction between infant, caregiver and an external entity (e.g., object) that becomes included in the communicative dyad by virtue of the referential point lays the foundation for shared cognition between the interactants as they focus simultaneously on the entity under discussion (Bates, Benigni, Bretherton, Camaioni, & Volterra, 1979; Bruner, 1981; Trevarthen & Aitken, 2001). This sharing of attention constitutes the basis for linguistic exchange in humans.

Given the tight concatenation of language, human cognition, and pointing (Kita, 2003), and the near-ubiquitous nature of pointing in human culture (e.g., Enfield, Kita, & de Ruiter, 2007; Haviland, 1993; Kita, 2003; Sherzer, 1973), the occurrence of pointing in great apes seems intriguing for the larger question of the communicative function and cognitive underpinnings of triadic interactions in the primate lineage. Although pointing for conspecifics is less common among the great apes (see e.g., Douglas & Moscovice, 2015; Hobaiter, Leavens, & Byrne, 2014; Pika & Mitani, 2006; Vea & Sabater-Pi, 1998), points are a frequent occurrence in ape-human interactions in captive settings (see e.g., Leavens, Hopkins,

& Bard, 2005, 2008; Patterson, 1978; Savage-Rumbaugh & Fields, 2000). This indicates a role of animal husbandry and an influence of human behavior upon the development of pointing in apes. Especially under the physical constraints of being confined to an enclosure, distal pointing behavior can emerge to cope with environmental challenges posed by being spatially limited (Gómez, 2007; Leavens et al., 2005).

Referential communicative interactions of great apes with humans are often characterized by an imperative nature where the ape requests the human's help in order to obtain something (Tomasello, Carpenter, & Liszkowski, 2007). Orang-utans (*Pongo pygmaeus*) and chimpanzees (*Pan troglodytes*) have been shown to use points to guide humans to objects that they need for the purpose of providing food. This includes pointing directly at distant food sources (Leavens et al., 2005) as well as pointing at tools with which the humans can retrieve food for the ape (Call & Tomasello, 1994; Gómez, 2004; Gómez & Teixidor, 1992; Menzel, 1999). The ability to use those two different pointing gestures in interactions with humans has also been observed in language-trained gorillas (*Gorilla gorilla*) (Bonvillian & Patterson, 1999). According to Gómez (2007), these two circumstances of pointing in apes indicates that their pointing is not just ritualized reaching but demonstrates a clear referential or indicative meaning to identify targets for others' actions (see Leavens et al., 2005 for a similar argument).

Intentional triadic interactions with objects have been reported in the communication between humans and bonobos (*Pan paniscus*) (Pika & Zuberbühler, 2008), chimpanzees (MacLean & Hare, 2013), and orang-utans (Gruber, 2014), albeit referential pointing seemed absent. Gorillas have previously been described as using different types of pointing gestures (Tanner & Byrne, 2010; Tanner, Patterson, & Byrne, 2006). While pointing with the index finger can be observed in language-trained gorillas, a group of captive zoo gorillas uses a *knocking* or *pounding* gesture to point out locations and objects to conspecifics (Tanner et al., 2006). However, other studies of gorilla gestures in captivity (Luef & Liebal, 2012; Pika, 2007; Pika, Liebal, & Tomasello, 2003) and in the wild (Genty, Breuer, Hobaiter, & Byrne, 2009) did not report any type of referential gestures in the natural communication of gorillas. In an experimental task that elicited requesting (including pointing) gestures in all four great ape species, gorillas were shown to produce the least amount of pointing gestures and tended to engage their human partner in a communicative bout less often than the other great apes (Pelé, Dufour, Thierry, & Call, 2009). A study specifically focusing on triadic interactions of a young captive gorilla and a human also found no referential behaviors such as showing and/or pointing (Gómez, 2010). Aside from the issue of captive-versus-wild great ape populations and the different study designs, pointing may be a rare phenomenon in gorillas that is hardly ever used and thus recorded as a communicative strategy (see Hobaiter et al., 2014 for a similar interpretation of pointing in wild chimpanzees).

In this paper, we report a case of a captive gorilla using tools to presumably point and communicate triadically with humans. The gorilla seemed to initiate a series of combined triadic interactions with different tools and the seen, but, for the animal, unreachable, food object to try to recruit a human for help. We analyze the gorilla's communicative turns and the gestures she used to communicate with the human helper for the purpose of obtaining food. Furthermore, we investigate whether the instance represents a case of intentional referential communication on the part of the gorilla and how the gorilla uses her communicative repertoire to signal her intentions to the humans. According to Bruner (1982; also see Sievers & Gruber, 2016), intentional acts can be assumed

when an individual operates persistently toward achieving an end state, chooses among alternative means and/or routes to achieve that end state, persists in deploying means and corrects the deployment of means to get closer to the end state, and finally ceases the line of activity when specifiable features of the state are achieved. (p. 313)

When investigating whether a communicative instance is intentional, important characteristics include the social use of communication (Butterworth, 1998), attention-getting behavior in case of non-responsiveness of the addressee (Bates et al., 1975), and alternation of eye gaze between receiver and object of the triadic interaction (Bruner, 1981; Tomasello, 1999). Of further importance are mechanisms

of communicative repair, such as the adaptation of behavior in the face of communicative failure by showing persistence or elaboration of signaling (Bates et al., 1975). Research on the cognitive and communicative abilities of gorillas, in particular concerning tool use and referential gestural communication, is relatively scarce and thus our observation can contribute to our understanding of communicative cognition in gorillas.

Method

Setting

The described behavior was observed during data collection for a study of communicative behavior in western lowland gorillas from captive groups at Howletts Wild Animals Park in Kent, United Kingdom (for details see Luef & Liebal, 2012, 2013).

Subject

Female Matibe was born in March 1988 at Howletts Wild Animal Park in Kent, United Kingdom. As an infant she was hand-reared by the Aspinall family (see Aspinall, 1976) and spent many years in close proximity to humans. In 2010 she had been living in a stable social group and had had one offspring that had died shortly after birth. At the time of data collection, Matibe was part of Kifu's group, a large family group consisting of 13 individuals housed at Howletts.

Data Collection

Data was collected between April and June 2010 with 4 to 6 hrs of observation time per day (sampling rules: focal sampling, behavior sampling; recording rule: continuous recording, see Martin & Bateson, 1994). Focal samples were conducted for 15 min per individual in a family group with a focus on gestural communication in the gorillas; one family group was observed per morning or afternoon session. Instances of behavioral sampling occurred when an individual engaged in a social interaction where the probability of gestural communication was judged as being high. In such cases, focal samples were interrupted and behavior sampling started. Video clips were made from the visitors' area of the zoo with a digital camcorder; in this way, a total of 58 hrs of video observations were recorded from four gorilla family groups at Howletts.

The described behavior was one single incident lasting 6.5 min that occurred on June 3, 2010. On the afternoon of that day, the adult female Matibe who took part in the gesture study was observed to communicate with zoo visitors and recruit them to help her obtain a food item that had fallen outside her enclosure ([see Supplementary video](#)).

Coding and Reliability

The following actions were coded:

1. Gorilla places tip of stick near grape
2. Gorilla holds stick in front of visitor
3. Gorilla holds stick loosely in hand, no action
4. Gorilla bites stick with teeth
5. Gorilla moves stick vertically near grape (termed 'tap')
6. Gorilla pauses, no interaction with stick or visitors
7. Gorilla drops/throws stick
8. Visitor takes stick from gorilla
9. Gorilla takes stick from visitor

10. Gorilla looks at grape
11. Gorilla puts stick in lap
12. Gorilla takes grape

These behaviors were coded every 5 s as they occurred during the 6.5 min incident and their durations were noted. The behavioral coding of the video data was checked for accuracy by both authors after a period of 1 hour of reliability training during which coding actions were jointly discussed and established. The reliability test was conducted with Cohen's Kappa, the coefficient of which is defined on a square 12 x 12 contingency table, measuring the agreement of two independent observers and correcting for the possibility of chance agreement. The two raters agreed with a kappa value of 0.8 which is considered as "excellent agreement" (Fleiss, 1981).

Ethics Statement

The research adhered to the legal requirements of the country in which it was conducted (United Kingdom) and to the principles of 'Ethical Treatment of Non-Human Primates,' as stated by the American Society of Primatologists. Howletts Wild Animal Park granted permission to publish the manuscript and the accompanying video.

Results

Succession of Events

A grape had fallen outside the gorillas' enclosure during feeding and Matibe was sitting close to it. Numerous zoo visitors had gathered around the area and were watching the gorilla. We observed Matibe performing the following activities over a time span of six and a half minutes (see Table 1 for exact durations of each behavior and Figure 1 for an overview of the behavioral sequences).

Matibe had pushed a stick through the mesh of her enclosure and was holding it in front of a zoo visitor. Then she retrieved the stick and held it in front of another zoo visitor on the left of her before she dropped the stick to the ground. After a pause during which she was just sitting and visually scanning the area, Matibe got up and got another stick from the back part of her enclosure. She then pushed this new stick through the mesh on the ground and placed its tip near the grape, an action which was followed by pushing the stick through the upper part of the mesh again and holding it in front of a visitor. After some time, Matibe retrieved the stick and pushed it toward a visitor who was standing to the left of her. She then retrieved the stick and pushed it toward the grape on the ground and then toward a visitor to the right of her, followed by moving the stick toward a visitor on her left again. Matibe then bit off parts of the tip of the stick and then moved it toward the grape on the ground again. Then she moved the stick toward visitors on her left, held it there for some time before she retrieved the stick and held it close to her while sitting. After a little pause she continued to hold the stick in front of visitors first on her left and then on her right again. Matibe then pushed the stick toward the grape on the ground again, moving it vertically up and down twice near the grape. Then she held the stick toward visitors who were standing in front of her, which was followed by her throwing the stick toward those visitors. Matibe then got a third stick from the back part of her enclosure, tore off leaves and smaller twigs, and pushed it through the mesh toward the grape on the ground. Right after that, she pushed it toward a visitor standing in front of her. When the visitor took the stick from Matibe, she looked down at the grape. The visitor held on to the stick briefly and then returned it to Matibe. She took it with her right hand still holding it toward the visitor, all the while getting a small twig with her left hand which she pushed in the direction of the grape on the ground. Matibe then retrieved the stick and pushed it again toward the grape on the ground and then toward a visitor in front of her. Another visitor took the stick from Matibe and she looked down at the grape again. The visitor returned the stick again and Matibe took it and immediately pushed it toward the

grape on the ground and then toward the visitor again. The visitor took the stick again and Matibe got another small twig to push toward the grape but the visitor returned the stick. Matibe pushed the stick toward the grape again and then toward the visitor in front of her. The visitor took the stick again from Matibe and while he handled the stick, Matibe looked down at the grape and pushed another small twig through the mesh toward the grape on the ground. While the visitor attempted to spike the grape with the stick, Matibe was watching him and looking at the grape. The visitor – having presumably understood the intention of the gorilla – then handed the grape spiked on the stick to Matibe who took the stick instantly, put the grape in her mouth and left the scene of the event to retreat toward the back part of her enclosure.

Table 1
Succession of Behaviors and Their Durations

Number	Behavior	Parallel Behavior	Duration (s)
1	Hold stick in front of visitor		10
2	Hold stick in front of visitor		10
3	Drop stick to ground		(1)
4	Pause, no interaction		>20
5	Place tip of stick near grape		3
6	Hold stick in front of visitor		3
7	Hold stick in front of visitor		9
8	Pause, hold stick in hand		2
9	Place tip of stick near grape		2
10	Hold stick in front of visitor		12
11	Hold stick in front of visitor		7
12	Bite stick		4
13	Place tip of stick near grape		1
14	Hold stick in front of visitor		14
15	Pause, hold stick in hand		20
16	Hold stick in front of visitor		14
17	Hold stick in front of visitor		3
18	Place tip of stick near grape, move vertically		5
19	Hold stick in front of visitor		5
20	Drop stick		(1)
21	Pause, no interaction		33
22	Throw twig toward visitor		(1)
23	Pause, no interaction		>10
24	Bite stick		7
25	Place tip of stick near grape		2
26	Hold stick in front of visitor		3
27	Visitor holds stick	Matibe looks at grape	3
28	Hold stick in front of visitor	Matibe pushes small twig toward grape	3
29	Place tip of stick near grape		3
30	Hold stick in front of visitor		2
31	Visitor holds stick	Matibe looks at grape	5
32	Pause, no interaction		8
33	Place tip of stick near grape		2
34	Hold stick in front of visitor		6
35	Visitor holds stick	Matibe pushes small twig toward grape	5
36	Place tip of stick near grape		2
37	Hold stick in front of visitor		3
38	Visitor holds stick	Matibe looks at grape and pushes small twig toward it	75
39	Matibe takes stick with spiked grape		(2)
40	Matibe leaves		

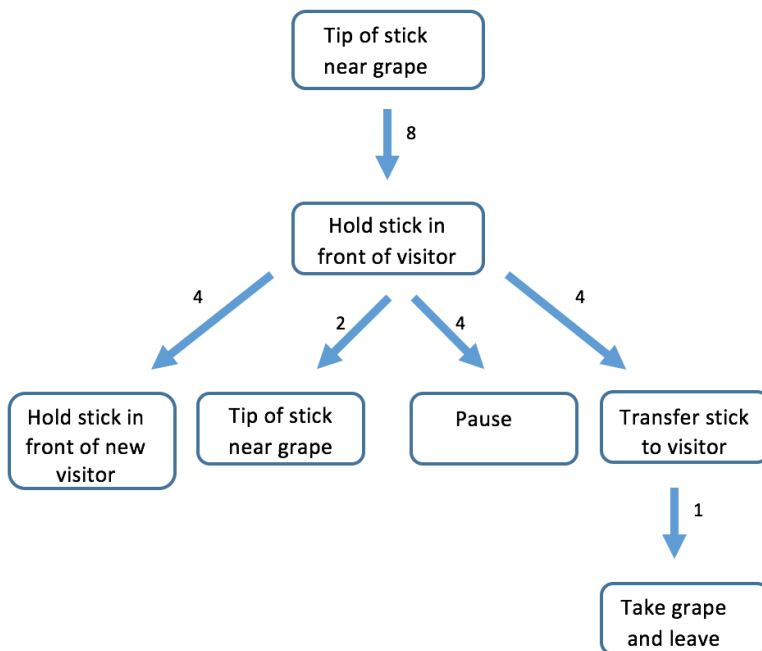


Figure 1. Sequence of behavior patterns observed during triadic interaction between gorilla and humans: “place tip of stick near grape” was always followed by “hold stick in front of visitor” ($N = 8$), which could be followed by one of four different behaviors: “hold stick in front of new visitor” ($N = 4$), “place tip of stick near grape” again ($N = 2$), “pause” on the part of Matibe ($N = 4$) or – the first step toward success – “transfer stick to visitor” ($N = 4$). As soon as the grape was obtained from one of the visitors, Matibe left (“take grape and leave”).

Discussion

Our observation suggests that a captive female gorilla initiated and combined a series of triadic interactions with multiple tools to recruit zoo visitors to help. In order to get the visitors to obtain the grape for her, Matibe used a wooden stick and moved it close to the grape. We interpret this behavior as a “pointing gesture.” Matibe brought the tip of the stick close to the grape for a short time ($M = 2.45s$, $SD = 0.80$, $N = 8$) and it seemed she did not show any attempt to spike the grape herself. On one occasion, Matibe moved the stick vertically near the grape and tapped on the ground, presumably an additional attempt to draw the visitors’ attention to the food item. In sum, we conclude that Matibe used the stick to point out the location of the grape to the visitors.

These pointing instances were typically followed by Matibe holding the stick in front of the visitors ($N = 14$). We interpret this behavior as “presenting” the stick to the visitors. Matibe’s goal may have been that a visitor take the stick and retrieve the grape, which could only be done by using the stick to reach over the fence that separated the location of the grape from the visitors’ area. Matibe was persistent and held the stick toward various visitors who were standing to her left and right and in front of her. Most visitors initially thought that Matibe wanted to play a stick-passing game (listen to sound track of video) and handed the stick immediately back to her. When a visitor held on to the stick ($N = 4$), Matibe used small twigs from her enclosure and pushed those in the direction of the grape, presumably to further direct the visitors’ attention to the grape ($N = 3$). As soon as one visitor was in the process of spiking the grape (he had pushed the grape in his direction under the fence), Matibe stopped providing communicative cues to the visitor, i.e., she stopped gazing at the grape and did not provide additional pointing cues with twigs. When the grape was finally obtained and handed over to Matibe, she immediately left the interaction and retreated to the back part of the enclosure. It seems that after having achieved her goal, Matibe was not interested in communicating any longer, a fact that indicates that the whole communicative instance was only performed in order to manipulate the zoo visitors in front of the

enclosure into obtaining the food for her.

Matibe's behavior seems to fulfil criteria for purposeful intentionality (Bruner, 1982; Sievers & Gruber, 2016). She seemed to persistently try to achieve the end state of obtaining the grape and used alternative means to get the grape: one strategy seemed to be pointing at the grape and offering the stick to the visitors in order to provide them with the required tool; another strategy seemed to be pointing with a small twig when a visitor held the stick to further inform the visitor of what to do with the stick. Matibe finally ceased her line of activity as soon as the end state was achieved, i.e., when she obtained the grape (Figure 2). Matibe apparently communicated intentionally and used her presumed pointing gesture socially (Butterworth, 1998) and in front of an attending audience (O'Neill, 1996). Although Matibe did not alternate eye gaze between zoo visitors and the grape, (possibly due to eye gaze avoidance in gorillas, see Peignot & Anderson, 1999), she looked at the grape once a visitor held the stick, possibly to guide the visitor's attention to the grape. Gorillas are quite sophisticated at attending to the attentional state of humans (Poss, Kuhar, Stoinski, & Hopkins, 2006) and in this instance, attention-getting behavior as such was not necessary as the visitors were already paying attention to Matibe. As a consequence, Matibe simply continued to pass the stick to visitors and offered the stick to a different visitor as a response to the previously addressed visitor not reacting appropriately.



Figure 2. The moment when Matibe finally obtains the grape after repeated communicative bouts with humans.

The communicative instance observed can be defined as consisting of two inter-dependent triadic interactions. The first triad consisted of Matibe, a zoo visitor, and the grape on the ground as the external object; the second triad included Matibe, a zoo visitor, and the stick that was offered to the visitor as the external entity. It is of interest that Matibe, in the first triadic interaction, used the stick as a pointing device, whereas in the second triad the stick was the external object that was referred to in the communicative dyad. This indicates quite a sophisticated level of cognitive flexibility in the use of a tool for different purposes. Ultimately, it could signify that the whole communicative act included the flexible relationship between two different external objects, put into words as (1) “look here to the grape on the ground that is just too far away for me to reach it“ and (2) “please spike it with this stick and then pass it over to me!“

Matibe's behavior may be explained by her growing up in captivity, where she developed an

understanding of humans as ‘social tools’ to solve problems (Gómez, 2010; Leavens et al., 2008). Apes that have been reared in socio-communicative environments with humans show increased abilities in the communicative domain in general (Russell, Lyn, Schaeffer, & Hopkins, 2011), with one of the largest influences on this “improved cognitive state” presumably being the treatment of apes as intentional agents by humans during their early ontogeny (Tomasello & Call, 2004). An enriched zoo environment such as that at Howletts Wild Animal Park can well provide the adequate conditions for that phenomenon. Zoo keepers at Howletts reported that pointing behavior had been repeatedly observed in different gorillas at Howletts in the past, without video records however. It is quite possible that pointing with or without tools is more frequent among the gorillas at Howletts in general.

The present observation provides a fascinating glimpse into how far the cognitive abilities of gorillas can possibly reach. The fact that at least one of the human visitors correctly understood the specific request made by the gorilla as well as the subsequent applause given by the other visitors (end of video) is the best proof of the underlying communicative capacity that enabled Matibe to successfully communicate with naive humans about a specific goal. It will be crucial for future research to gather additional and more systematic information on triadic referencing in both captive and wild gorillas to allow for a more accurate assessment of the animals’ true communication strategies and the role that tools can play in their socio-communicative lives.

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