When apes point the finger

Three great ape species fail to use a conspecific's imperative pointing gesture

Sebastian Tempelmann[1,2,3], Juliane Kaminski[1] & Katja Liebal[1,2,3]
[1]Department of Developmental and Comparative Psychology, Max-Planck Institute for Evolutionary Anthropology, Leipzig, Germany / [2]Freie Universitaet Berlin, Berlin, Germany / [3]University of Portsmouth, Portsmouth, UK

In contrast to apes' seemingly sophisticated skill at producing pointing gestures referentially, the comprehension of other individual's pointing gestures as a source of indexical information seems to be less pronounced.

One reason for apes' difficulty at comprehending pointing gestures might be that in former studies they were mainly confronted with human declarative pointing gestures, whereas apes have largely been shown to point imperatively and towards humans. In the present study bonobos, chimpanzees and orangutans were confronted with a conspecific's imperative pointing gesture in a competitive context, therefore mirroring former studies that have investigated apes' skills at producing these gestures.

However, apes in the present study did not use their conspecific's pointing gestures. Apes have been shown to use indexical information when provided non-communicatively and to interpret other individuals' actions in terms of motives. Thus, it is discussed whether apes treat a pointing gesture as intentional act of indexical reference.

Keywords: pointing; referential communication; great apes; triadic communication; indexical reference; evolution of communication

1. Introduction

In the last two decades there has been much interest in apes' engagement in pointing behaviour (e.g. Call & Tomasello 1994; Krause & Fouts 1997; Menzel 1999; de Waal 2001). Indeed, a growing body of evidence suggests that chimpanzees do point referentially and intentionally, which in many ways seems to resemble human infants' pointing behaviour (e.g. Leavens & Hopkins 1998; Leavens, Hopkins & Thomas 2004; Leavens, Hopkins & Bard 1996, 2005; Leavens, Russel & Hopkins 2005). The

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importance of trying to ascertain the detailed cognitive processes underlying apes' pointing derives from the fact that pointing, and therefore the ability to communicate about entities beyond the 'self' by referencing them, is thought to mediate the ontogenetic development of the capacity to communicate iconic and symbolic reference (Baldwin 1995; Bates, Benigni, Bretherton, Camaioni & Volterra 1979; Butterworth 2003; Csibra & Gergely 2006; Tomasello 2008). This transition from dyadic to triadic communication enables a new quality in terms of learning and teaching, and effects the development of the human linguistic system. Therefore, apes' pointing behaviour might constitute some kind of evolutionary missing link between apes' natural communication with conspecifics and humans' communication via arbitrary symbols (Leavens et al. 2004).

However, in sharp contrast to apes' seemingly sophisticated skills at producing pointing gestures referentially and following them visually (e.g. Itakura 1996; Povinelli, Reaux, Bierschwale, Allain & Simon 1997), they seem to comprehend a pointing gesture only in exceptional cases (e.g. Call & Tomasello 1994; Lyn, Russel & Hopkins 2010; Mulcahy & Call 2009) as a source for indexical information, e.g. to locate hidden food (e.g. Hare, Brown, Williamson & Tomasello 2002; Itakura, Agnetta, Hare & Tomasello 1999; Tomasello, Call & Gluckman 1997).

This is puzzling as apes have shown in several independent studies that they assign intentional motives to the actions of other individuals (e.g. Call & Tomasello 1998; Call, Hare, Carpenter & Tomasello 2004). Therefore, apes' intentional and flexible use of pointing gestures and their obvious consideration of other individuals as intentional beings should lead one to predict the ability to use those gestures for their own benefit when perceiving them. As a consequence, when apes do not comprehend the indexical information of a pointing gesture, this could suggest that when they produce this gesture themselves they do not intentionally index a specific location. However, the discrepancy between production and comprehension skills could be due to differences in the methodological approach of former studies investigating apes' comprehension skills. Indeed, studies which have examined the comprehension of pointing gestures did not accurately mirror those studies which investigated their production skills.

There are different types of pointing gestures known in the literature. The two basic types are imperative and declaratives pointing gestures. Pointing behaviour is called imperative when it used to request actions from other individuals, whereas declarative points are used to share attitudes on some outside entity or to cooperatively inform a communicative partner. However, the majority of previous studies, which preferentially investigated chimpanzees' ability to understand other individuals' pointing gestures, used declarative pointing gestures, whereas apes have only in exceptional cases (e.g. Greenfield & Savage-Rumbaugh 1991) been reported to produce those gestures declaratively. On the other hand, those studies investigating apes' pointing behaviour in terms of intention and reference (e.g. Leavens et al. 2005) focus on apes' imperative pointing behaviour (Tomasello 2006). Declarative pointing needs a highly cooperative context, in which the producer provides information to the *receiver*. Apes are shown to be more skilful at using others' behaviour for their own benefit in competitive rather than in cooperative social tasks (Hare & Tomasello 2004), which might be explained by their more competitive group structure or a lack of cooperative motives in communication. Therefore, it is likely that apes in highly cooperative contexts do not understand the intention of the social partner, as they do not subscribe those cooperative motives to a social partner's behaviour and therefore do not care at all about the counterpart's pointing gesture (Tomasello 2008). For example, although they do not use a cooperative pointing gesture, they are able to use a human's unsuccessful reaching behaviour in a competitive task, which superficially resembles a pointing gesture (Hare & Tomasello 2004).

Another aspect is that most studies have used a human experimenter to indicate the food location to the ape. One exception was a study by Itakura et al. (1999) who investigated the comprehension of conspecific pointing gestures in chimpanzees. The chimpanzees in that study performed no better with a conspecific than with a human, which may suggest that the identity of the other individual does not affect apes' behaviour. However, in that study a chimpanzee was trained to produce a declarative gesture in order to indicate the location of food to a conspecific (Itakura et al. 1999). Here we modified this study in order to investigate chimpanzees', bonobos' and orangutans' comprehension of *imperative* conspecific pointing gestures.

The apes in our study did not communicate directly with each other, but with the human experimenter and therefore competed for the support of the human. The *demonstrator* ape observed the food being hidden, while the other ape (the *receiver*) was naive to the location, but aware of the fact that the other ape had witnessed the baiting. This has three main advantages over the standard design of comprehension studies. First, apes are confronted with the same contextual background in which they themselves point (imperative pointing directed to a human). Second, due to the third party context there is no need to establish a joint attentional and intentional communicative framework. Third and related, as in all former comprehension studies, the situation established in the Itakura et al. (1999) study is highly cooperative, as the *demonstrator* displays a behaviour that seemingly has no personal benefit. The present study used a competitive setup by establishing a situation in which superficially both individuals had to compete for the human's support.

Furthermore, the "pointing gesture" of the *demonstrator* in our study is not artificial and not trained to resemble the human way of pointing but is the ape's regular pointing behaviour, which is used in countless experiments. Also, we reduced the distance between *demonstrator* and *receiver*. This may increase the motivation for competition between individuals (as has been shown in other contexts, see Bräuer, Kaminski, Riedel, Call & Tomasello 2006) and it may also make it easier for the *receiver* to perceive the gestures of the *demonstrator*.

However, a positive performance of the subjects in the present study would strongly support the assumption that apes do treat pointing gestures in general as intentional acts of referential communication.

2. Method

As mentioned in the introduction, the goal of the following study is to test whether apes do use a pointing gesture of a conspecific to infer the location of hidden food and, more specifically, we are interested if apes really understand the referential, deictic character of the gesture. Nevertheless the successful use of such a gesture may also be the result of local enhancement, which is caused by the low distance between the demonstrator's fingers and the target. To control for local enhancement effects in addition to a communicative pointing condition apes were tested in a non-communicative pointing condition. For details see below.

2.1 Subjects

Four individuals from each species (chimpanzees, orang-utans and bonobos) were tested. For each species, an additional individual was selected to function as *demonstrator* (see Table 1). The *demonstrator* was the same for all four subjects of each species. The *demonstrator* was also of a high or middle rank in the respective group hierarchy.

Table 1. Subject Info; Demonstrators in bold

	Subject	Gender	Age	Rearing history	1st Condition
Chimpanzee	Gertruida	female	15 years	parental rearing	Communicative
	Annett	female	9 years	hand reared	Communicative
	Alexander	male	7 years	hand reared	Non-communicative
	Alexandra	female	9 years	hand reared	Non-communicative
	Jahaga	**female**	**15 years**	**parental rearing**	-

(*Continued*)

Table 1. (Continued)

	Subject	Gender	Age	Rearing history	1st Condition
Bonobo	Ulindi	female	15 years	parental rearing	Communicative
	Limbuko	male	13 years	hand reared	Communicative
	Kuno	male	12 years	hand reared	Non-communicative
	Joey	male	26 years	hand reared	Non-communicative
	Yasa	**female**	**11 years**	**parental rearing**	-
Orang Utan	Dunja	female	35 years	parental rearing	Communicative
	Padana	female	11 years	parental rearing	Communicative
	Bimbo	male	28 years	hand reared	Non-communicative
	Pini	female	20 years	parental rearing	Non-communicative
	Dokana	**female**	**19 years**	**parental rearing**	-

2.2 Apparatus

A platform (79.5 cm × 88 cm) was placed between two Plexiglas panels of two separated cages in a testing booth (80 cm × 97 cm), which was located just outside the enclosure. A sliding board (94 cm × 16,5 cm) with three angled cups (12 cm × 7.5 cm) on it was attached to the platform (see Figure 1). The apparatus allowed the three cups to move back and forth between the two opposite panels without removing them from the table. At the bottom of each Plexiglas panel were three holes (each 3.6 cm in diameter) arranged in a straight line. The holes were 29 cm apart, as measured from the centre of one hole to the centre of the next.

Each cup had two separate compartments. One was solid and closed to all sides; the other was open to one side such that the *demonstrator* could see a piece of food hidden within. The cups were positioned in such a way that if both compartments were baited, one subject (the *receiver*) could not see the food whereas the other subject (the *demonstrator*) could see the food in the open compartment. A clamping system for a removable opaque barrier (50 cm × 79 cm) was fixed on the sliding table (see Figure 1). This allowed baiting the cups while being blocked from the *receiver*'s view. An occluder made of rubber was fixed to one side of the barrier and could be pulled over the cups. This allowed the cups to be baited beyond the view of the *receiver* and *demonstrator* (see Figure 1c).

The food rewards were grapes, or food-pellets depending on the individuals' preference and diet.

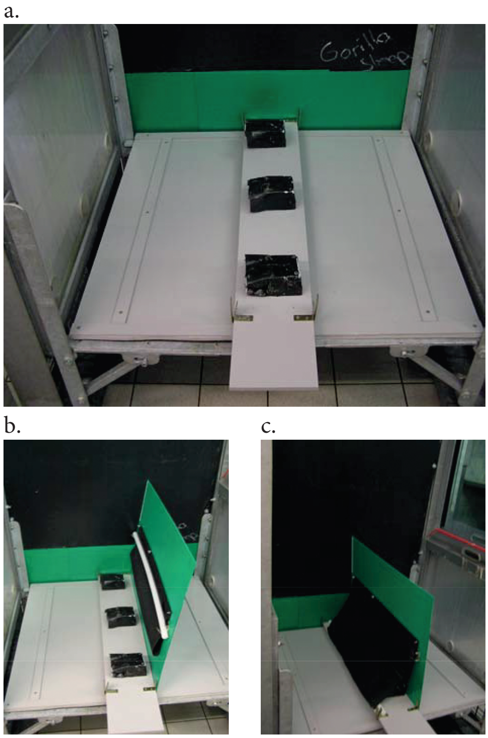

Figure 1. Apparatus and experimental setting; (a) barrier removed, sliding table with cups in middle position, (b) barrier as used in communicative pointing condition, (c) barrier as used in non-communicative pointing condition

2.3 Procedure

2.3.1 *Pre-training*

At the beginning of each testing day, each subject received a pre-training session to ensure they understood that they were required to indicate a specific cup to receive the food. The procedure was as follows: the sliding table always remained in the starting position in the middle of the platform. In full view of the subject, the Experimenter (E) baited the closed compartment of one of the cups. Then E waited until the subject indicated the correct cup by inserting one ore more fingers through the corresponding hole in the Plexiglas panel. If the subject indicated the correct cup, s/he received the food. If the subject indicated an incorrect cup, E first showed the subject the empty cup and then the baited one, but the subject received no food. If the subject needed more than two attempts to indicate the correct cup, the trial was repeated. If the subject's fingers were inserted into more than one hole at a time, E waited until the subject's fingers were inserted into just one hole. The pre-training consisted of six trials (in the event of failure up to three repetitions were allowed). The order in which the cups were baited was counterbalanced and semi-randomized such that each cup was baited two times. A session was considered successful if the subject had pointed correctly to each of the containers twice.

2.3.2 *Warm up*

Subsequent to the pre-training, each subject received a warm up session. The function of the warm up was to establish a competitive situation between the *demonstrator* and the *receiver*. The procedure was similar to that in the pre-training phase except that now the *demonstrator* was positioned opposite the subject such that both individuals were facing each other. E then baited one of the three cups in full view of both individuals and then waited for both individuals to indicate the location by inserting one or more fingers through the corresponding hole in the Plexiglas panel. If only one individual indicated the correct cup, E shifted the table in front of this individual and offered the content of the cup to it. If both individuals indicated the correct cup, E chose that ape to whom he had offered the reward based on a fixed testing scheme. The *receiver* ought to get the reward at least three times. The warm up consisted of six trials; each cup was baited twice. After the warm up phase, subjects entered the experimental phase in which they received one of two possible conditions:

2.4 Experimental design

The experiment consisted of two different conditions (communicative- and non-communicative pointing condition). Half of the subjects started with the communicative pointing condition, while the other half started with the non-communicative pointing condition (see Figure 1). Each individual received 18 trials in each condition (presented over at least two different days, depending on the motivation of the participants) creating a total of 36 experimental trials altogether. The pre-training and the warm up were the same for both conditions. In addition to the experimental trials, subjects received 12 filler trials per session, creating a total of 24 filler trials altogether. These served as a motivation for the *demonstrator* and to enhance the competitive context. The food location was counterbalanced and semi-randomized across trials, with the stipulation that food could not be in the same location over more than two consecutive trials. Also the order of filler and experimental trials was semi-randomized, with the stipulation that there were no more than two consecutive filler trials.

2.4.1 *Communicative pointing condition*

The table with the three empty cups was positioned in the middle of the sliding platform. E obscured the *receiver*'s view by placing an opaque barrier in front of her, so that only the *demonstrator* could see the baiting. Then E baited (both compartments of) one of the cups with food such that the *demonstrator* could see a piece of food (the one in the visible compartment) throughout the entire trial, ensuring that she would point reliably to the corresponding cup. E waited until the *demonstrator* indicated the correct cup before he removed the barrier for the subject to see the *demonstrator* and the cups. E waited approximately 5–10 seconds for the *demonstrator* to indicate the correct cup. If the *demonstrator* switched her choice during this period, and did not directly move her finger(s) back to the correct location, the trial was repeated. The same was also true if the ape kept indicating the correct cup simultaneously with another cup or stopped indicating. After successful demonstration E shifted the table to its position in front of the subject's cage and let her choose. A choice was considered as made if one or more fingers were inserted through one of the holes in the panel after the sliding table came to rest. If fingers were inserted through more than one hole, E waited until one hand (or finger) had been taken back. If this was not the case for up to 10 seconds the trial was repeated. After the subject had made a choice, E lifted the cup that had been indicated. If the choice was correct, E offered the food to the subject; if the choice was incorrect, E tilted the correct cup in such a way that the subject could see the food in the closed compartment. Then E slid the table to its starting position, replaced the barrier on the sliding table and then offered the content of the open compartment to the *demonstrator*.

Filler trials were conducted between the experimental trials. They were used to motivate the *demonstrator* and to boost the competitive context. The procedure was similar to that of the experimental trials except that the table was moved to the *demonstrator* not the *receiver* and she was allowed to choose subsequently.

2.4.2 *Non-communicative pointing condition*

The general procedure was the same as in the communicative pointing condition apart from the following aspects:

After setting up the barrier, E covered the cups and then just baited the closed compartment of one of the cups with food. Therefore neither individual witnessed the baiting process and the *demonstrator* stayed naïve to the food location the entire time. Then the *demonstrator* witnessed E smear peanut butter or a banana-honey cream around one of the holes in the Plexiglas panel (the one in front of the baited cup). To obtain the food the *demonstrator* had to produce an action resembling the pointing gesture (the insertion of one or more fingers through the hole), but with no intent toward any food other than the peanut butter. From observing the demonstrator's behaviour this could clearly be differentiated from the communicative condition as in contrast to the communicative pointing condition, there was unambiguously peanut butter around the hole and the demonstrators whole behaviour targeted on getting this peanut butter. The demonstrator inserted her finger through the hole, brushed aside the peanut butter, retracted the respective finger towards her mouth and licked away the peanut butter.

3. Results

Due to the relative small number of individuals we used non-parametric statistics throughout. P-values are exact values and unless stated differently they are two-tailed.

The order in which the individuals were assigned to the conditions (non-communicative pointing condition first vs. communicative pointing condition first) did not affect their performance. This is true for the non-communicative pointing condition (correct choices when communicative pointing condition first: MEAN 32.41% (SD ± 6.49) and when non-communicative pointing condition first: MEAN 41.67 % (SD ± 16.39), Mann-Whitney U-test: $z = -1.63$, $p = .103$) and for the communicative pointing condition (correct choices when communicative pointing condition first: MEAN 38.89% (SD ± 16.48) and when non-communicative pointing condition first: MEAN 37.04 % (SD ± 6.73), Mann-Whitney U-test: $z = -.736$, $p = .462$). Therefore we pooled the results of the respective conditions for further analyses.

Furthermore, the correct performance in the respective conditions did not differ between species, neither for the communicative pointing condition (correct choices: bonobos MEAN 37.5% (SD ± 8.3), chimpanzees MEAN 41.67% (SD ± 9.62), orangutans MEAN 34.72% (SD ± 18.36); Kruskal-Wallis test: $\chi^2 = .612$, $p = .733$), nor for non-communicative pointing condition (correct choices: bonobos MEAN 44.44% (SD ± 9.08), chimpanzees MEAN 26.39% (SD ± 11.45), orangutans MEAN 40.28% (SD ± 12.32); Kruskal-Wallis test: $\chi^2 = 4.663$, $p = .103$). In addition, there were no differences in performance based on the participants' rearing history (for communicative pointing condition: Mann-Whitney test, $z = 0$, $p = 1.0$; for non-communicative pointing condition: Mann-Whitney test, $z = -.83$, $p = 1.0$), based on gender (for communicative pointing condition: Mann-Whitney test, $z = -.332$, $p = .755$; for non-communicative pointing condition: Mann-Whitney test, $z = -.579$, $p = .639$) or based on individual performance (for communicative pointing condition: Kruskal-Wallis test: $\chi^2 = 11.0$, $p = 1.0$; for non-communicative pointing condition: Kruskal-Wallis test: $\chi^2 = 11.0$, $p = 1.0$). As a consequence, we grouped the data of the different species for the respective conditions for further analyses.

The performance of the apes in both conditions did not significantly differ from chance (for the communicative pointing condition: MEAN 36.96% (SD ± 12.04), Wilcoxon test, z = –1.591, *p* = .115; for the non-communicative pointing condition: MEAN 37.04% (SD ± 12.83), Wilcoxon test, z = –1.384, *p* = .203). Furthermore, if tested against each other, the apes performance did not differ significantly between conditions (Wilcoxon test: z = –0.236, *p* = .836) (see Figure 2). Overall, the apes did not prefer to choose one position over another in a significant manner (for the communicative pointing condition: Friedman test: $\chi^2 = .044$, df = 2, *p* = .995, N = 12; for the non-communicative pointing condition: Friedman test: $\chi^2 = .174$, df = 2, *p* = .931, N = 12). Therefore, the apes had no bias toward a specific container.

When considering only the first trial of the respective conditions, the apes chose at random in both conditions (communicative pointing condition: in 6 out of 12 times subjects chose the baited cup, binomial test, *p* = .177, one-tailed; non-communicative pointing condition: in 3 out of 12 times subjects chose the baited cup, binomial test, *p* = .393, one-tailed). Further, there is no significant difference regarding the first trial performance between conditions (Fisher's exact test, *p* = .400).

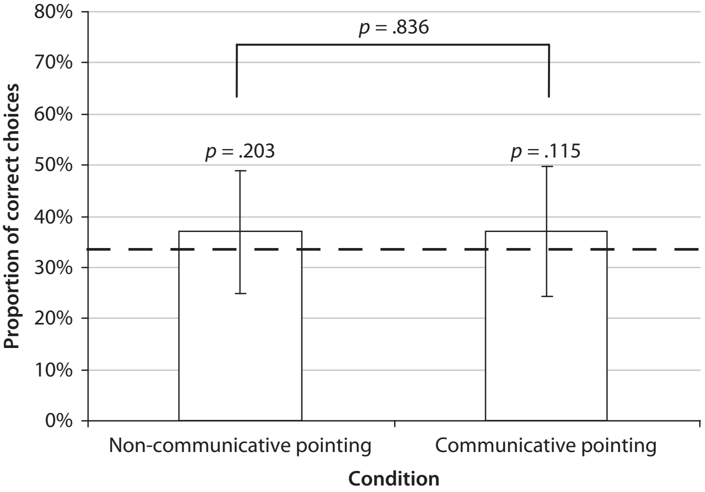

Figure 2. Performance of apes in both conditions (SD); chance level in dashed line

The position of the target in the first trial performance had no influence on the apes' choice (for communicative pointing condition: Fisher's exact test,

p = .351; for non-communicative pointing condition: Fisher's exact test, p = 1.00). When comparing the first and second half of the trials of each condition against chance, no significant deviation from chance is found (communicative pointing condition, trial 1–9: correct choices MEAN 40.74% (SD ± 15.95), Wilcoxon test, z = –1.697, p = .117; trial 10–18: correct choices MEAN 35.18% (SD ± 14.86), Wilcoxon test, z = –0.784, p = .532; non-communicative pointing condition, trial 1–9: correct choices MEAN 40.74% (SD ± 15.23), Wilcoxon test, z = –1.630, p = .137; trial 10–18: correct choices MEAN 33.33% (SD ± 15.71), Wilcoxon test, z = –0.144, p = .922). No learning effect was found when comparing the first half of trials with the second half (communicative pointing condition, Wilcoxon test: z = –0.930, p = .402; non-communicative pointing condition, Wilcoxon test: z = –1.672, p = .098).

4. Discussion

The apes tested in the current study were not able to use the conspecific's imperative pointing gesture successfully to infer the location of the food. Although the apes permanently witnessed that the conspecific's gesture indicated the correct location, they did not improve their performance. Furthermore, we could not detect any species differences.

In contrast to previous studies investigating apes' comprehension of pointing gestures, apes' production of pointing had mainly been investigated in imperative contexts. In the present study the pointing gesture observed by the subject was imperative and occurred in a context familiar to the subject. Due to the third party context no joint attentional and intentional communicative framework had to be established, and no understanding of cooperative motives was necessary. Therefore, the context-based argument fails to explain the general discrepancy between pointing production and comprehension skills. The apes in the present study were not able to infer information from an observed pointing engagement, which accurately matched their own in terms of appearance, underlying motives and intentions.

Interestingly, as mentioned above, under certain circumstances some apes seem to be good at using (declarative) pointing gestures. One such exception are apes raised with extensive human contact, so-called enculturated individuals (Lyn et al. 2010; Okamoto-Barth, Tanaka, Tomonaga & Matsuzawa 2008; Itakura et al. 1999; Call & Tomasello 1994). One reason for being so sophisticated at using human pointing could be that apes with such a background learned that such gestures are relevant when produced by humans, as they have experienced humans being cooperative, especially in the food context (see Tomasello & Call 2004 and

Kaminski 2011 for a discussion of this topic). However, a recent study by Mulcahy and Call (2009) suggests that apes raised in a more natural group structure are also able to comprehend a declarative pointing gesture if it is presented in a more distal setting. In their study the authors compared a distal setting with a more proximal setting, which had been repeatedly used in other studies. In the distal setting the two referents (the cups containing the food) were presented in two different rooms and the experimenter stood between them and pointed to one or the other. The apes were successful in this version of the task but failed in the proximal version in which the two referents were presented in close proximity to each other on a table between the experimenter and the subject. The authors argue that it may be the additional cost of moving between the rooms, which motivates subjects to attend to the gesture more closely. Losing the food would be more costly in the distal setting than in the proximal setting. However, an alternative explanation of these results is that the pointing gesture is indeed not a triadic gesture anymore and instead a spatial directive conveying the information in which direction the ape should move (a situation that apes in a zoo-like setting are very familiar with). While the apes receive the gesture, the referents are never in view simultaneously, which is why the apes do not have to attend to the referential nature of the gesture at all. Once the subject has moved in the indicated direction, the respective cup to be found in that room is the only possible referent (Kaminski 2011). Furthermore, this kind of use of the pointing gesture is encouraged daily by the human caretakers in order to lead the apes from one cage to the other. As Itakura (1996) showed in a study with non-enculturated subjects, apes do indeed follow a human pointing gesture visually; they are just not able to use it for their own benefit. Under these circumstances a training effect easily arises which allow apes to use this device somehow (this is true in general for declarative pointing gestures in the context of food).

However, as mentioned above, to date apes have, by and large, been found to point imperatively and in food requesting contexts. The present results suggest that they do not comprehend an imperative gesture, uttered in a parallel setup (in the requesting context). Therefore, production and comprehension skills regarding the pointing gesture are found isolated; up to date apes were found to produce pointing gestures imperatively, but to comprehend them only (and in exceptional cases, see above) when used declaratively. This might indicate that they do not use this gesture bi-directionally. However, apes' failure to use pointing in this context is not due to a general inability to understand other individuals as intentional beings. Apes have shown in several independent studies that they assign intentional motives to the actions of other individuals. For example, they discriminate accidental from intentional actions (Call & Tomasello 1998; Call et al. 2004) and rationally integrate their knowledge about another individual's intentional state in their own behaviour (Tomasello & Carpenter 2005; Buttelmann, Carpenter, Call & Tomasello 2007; Warneken & Tomasello 2006; Warneken, Hare, Melis, Hanus & Tomasello 2007).

Nevertheless, in the present study subjects did not extract indexical information from their counterparts pointing behaviour.[1] This might be due to a general inability to do so or to their excitement which might be caused by the competitive context. However, those reasons are improbable, as apes have not only shown to extract indexical information from other individuals' behaviour, but also to do so in competitive contexts (Hare & Tomasello 2004; Hermann & Tomasello 2006).

Many studies other than this one have tried to investigate whether apes comprehend the pointing gesture. Nevertheless, only subjects exposed to intense human contact (Lyn et al. 2010) or those with significant experience of the concrete testing situation (Mulcahy & Call 2009) were able to use those gestures. However, assuming apes' ability to interpret other individuals' actions in terms of motives/intentions, the fact that apes are in the position to extract indexical information from other individuals' behaviour and their ability to follow a pointing gesture visually, one might assume that apes do not view a pointing gesture as an intentional act indexing a specific location. Referential pointing in terms of mental agency is a conventional gesture, thus bidirectional. Apes failure to comprehend the gesture in our study might suggest that when they produce it, they do not necessarily discretely reference a specific location and do in consequence not extract indexical information when they perceive it. In terms of production they might just have learned to insert their fingers through the caging at the location, which is enhanced through a previous action on it or the pure existence of food; it may thus be conducted with no intention to inform the human about a location. This would imply that the apes learned how to use the gesture appropriately to manipulate the humans' behaviour in the desired fashion, with no deeper knowledge of how their gesture works on their communicative partner's mind. We might, therefore, conclude that the apes in the present study did not subscribe to the motive/intention of their counterpart's pointing behaviour to index a specific location, but instead interpreted it as a dyadic attention-getter, saying: "give food to me" and not "give me the food from this cup". Important in this context, a recent study by Tempelmann, Kaminski and Liebal (2011) shows that apes, when begging for food from a human, act according to the human's attentional state; but only when the human and the food are linked in a way that dyadic communication towards the human is sufficient to get the food. These results suggest that apes' have a problem referring to third entities in general.

In contrast to apes, human infants' production and comprehension skills occur around the same age (see Carpenter, Akhtar & Tomasello 1998, for further evidence), with only some exceptions which could be explained by different perception efforts (Franco & Butterworth 1996). This indicates a general understanding of the pointing gesture as an act of indexical reference. Some authors assume this difference between apes' and humans' communication is due to the fact that apes, as opposed to humans, do not have the motivation to share information and attitudes with others (e.g. Tomasello 2008). Therefore, irrespective of other fundamental cognitive skills that are potentially involved, the motivational framework may function as some kind of catalyser for skills necessary to communicate referentially.

Apes only point in captivity (but see Vea & Sabater-Pi 1998) and for the majority it is directed imperatively towards a human. The cumulating reports of pointing production in apes living in captivity and the isolated cases of pointing comprehension reported from enculturated apes provides at least an 'artificial' motivation for communicative interaction with outside entities. It is reasonable, that unlike living in a natural environment, captivity and the related dependency on human food-givers somehow creates a conducive environment for the development of a means to manipulate third entities through influencing other individuals (communicatively). This development seems to constitute a motivational step in the direction of triadic communication, and might shed light on the evolution of human communication. From the present study one cannot make statements about apes' general skills regarding triadic, referential communication, particularly since sample sizes were rather small. However these findings suggest that living in captivity and the related close contact with humans does not cause an understanding of pointing as an intentional act of indexical reference per se.

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Note

1. One might suggest that the apes in the present study were inattentive and did not notice their counterparts' behaviour. That is unlikely since only those trials were counted in which the subjects were attentive towards their conspecific counterparts' behaviour.

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Corresponding Author

Sebastian Tempelmann,
Department of Psychology,
Freie Universitaet Berlin,
Berlin,
Germany

email: sebastian.tempelmann@phz.ch

Author's biography

Sebastian Tempelmann is a biologist and psychologist. He is employed as a lecturer and investigator at the University of Teacher Education Central Switzerland. He did his Ph.D. on "The origins oft intentional and referential communication" at the Freie Universitaet Berlin (Germany) and the University of Portsmouth (UK). Before that he did research at the Max Planck Institute for evolutionary Anthropology in Leipzig (Germany), where he also did his Diploma thesis. He is interested in the evolution of communication and questions of learning and teaching.

Juliane Kaminski is a lecturer in Psychology at the University of Portsmouth. Before that she was the principle Investigator of the research group "The evolutionary Roots of Human Social Interaction" at the Max Planck Institute for evolutionary Anthropology in Leipzig/ Germany where she also did her PhD.

Katja Liebal is an Assistant professor for Evolutionary Psychology in the interdisciplinary research cluster Languages of Emotion at the Freie Universitaet Berlin. Her research centers on the investigation of primate communication by using a multimodal approach. Current projects include the development of a Facial Action Coding System for gibbons (with Bridget Waller from the University of Portsmouth), a cross-species, cross-cultural project on the ability to detect and react to emotional expressions (with Isabella Wartenburger, University of Potsdam), and the investigation of the role of emotions that researchers experience while they are in the field (with Oliver Lubrich, University of Bern and Thomas Stodulka, Freie Universitaet Berlin).