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PAPER

Different social motives in the gestural communication of chimpanzees and human children

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Abstract

Both chimpanzees and human infants use the pointing gesture with human adults, but it is not clear if they are doing so for the same social motives. In two studies, we presented chimpanzees and human 25-month-olds with the opportunity to point for a hidden tool (in the presence of a non-functional distractor). In one condition it was clear that the tool would be used to retrieve a reward for the pointing subject (so the pointing was selfish or 'for-me'), whereas in the other condition it was clear that the tool would be used to retrieve the reward for the experimenter (so the pointing was helpful or 'for-you'). The chimpanzees pointed reliably only when they themselves benefited, whereas the human children pointed reliably no matter who benefited. These results are interpreted as evidence for the especially cooperative nature of human communication.

Introduction

The most fundamental form of uniquely human communication is not language but gesture, especially the pointing gesture. Humans are the only species that uses the pointing gesture as an important part of their natural communicative repertoire (Call & Tomasello, 2007), and all human cultures – despite some significant variations of form (e.g. lip pointing) – have ways of spatially indicating things for others in the immediate environment (Kita, 2003). Almost all human infants in Western cultures communicate via the pointing gesture for several months before they acquire any productive language (Carpenter, Nagell & Tomasello, 1998).

Human communication, including the pointing gesture as prototype, is unique both cognitively and motivationally. Cognitively, humans point (and use language) to direct the attention of others to external entities – that is to say, they refer others to things. Motivationally, the pointing of human infants already, before language, relies on highly cooperative communicative motives. Classically, infants point for the 'selfish' motive of requesting things imperatively, as well as for the 'sharing' motive of attending to and emoting about things together with others declaratively (Bates, Camaioni & Volterra, 1975). Recently, it has been established that infants also point for the 'helpful' motive of informing others of things they want or need to know (Liszkowski, Carpenter, Striano & Tomasello, 2006; Liszkowski, Carpenter & Tomasello, 2008; though see Southgate, van Maanen & Csibra, 2007, for a different interpretation). The informative motive is remarkable evolutionarily because it represents a form of altruism – offering information that is useful to another individual with seemingly no benefit to the self.

Humans' closest primate relatives, the great apes, also gesture to one another regularly. Unlike their basically hardwired vocalizations – unlearned and used with almost no flexibility (Tomasello & Zuberbühler, 2002) – apes' gestures are often learned and used with much flexibility in pursuing various social ends (Liebal, Call & Tomasello, 2004). Their gestures are of two main types. First are so-called intention-movements in which the first part of a social interaction sequence is used intentionally to instigate the entire sequence (e.g. pulling down Mom's back in order to climb on is ritualized into just touching the back lightly to spur Mom into back lowering). Second are so-called attention-getters in which an individual does things such as slap the ground or throw something at others in order to get them to attend to her. These attention-getters are arguably the closest thing to human referential communication in the animal kingdom, as they have the goal of manipulating others' perception/attention (Tomasello, 2008). However, ape attention-getters are used almost exclusively dyadically, to draw attention to the self, not triadically toward external objects (as in humans' communication).

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Great apes thus do not, as a matter of course, point for one another triadically to external entities.[1] However, great apes in captivity quite often do point for humans to external entities that they want the human to fetch for them or give to them. These gestures are not simply reaching attempts, as apes point only when humans are present (Leavens, Hopkins & Bard, 1996), and they do this intentionally and referentially, that is, persistently to obtain a specific object (Leavens, Russell & Hopkins, 2005). The motive of chimpanzees' and other apes' pointing for humans, however, is almost always imperative/directive. Although chimpanzees sometimes help others with behavioral problems like fetching out-of-reach objects (Warneken, Hare, Melis, Hanus & Tomasello, 2007), there are no unambiguous reports of apes pointing for others with an informative motive (though see Savage-Rumbaugh, McDonald, Sevcik, Hopkins & Rubert, 1986, for language-trained apes pointing at things they seemingly do not want – their more precise motive being uncertain).

There is one set of experiments with apes that might conceivably be interpreted in terms of an informative motive. Call and Tomasello (1994; see also Gómez, 1998; Zimmermann, Zemke, Call & Gómez, 2009) presented two orangutans with a situation in which a human needed a tool so that he could retrieve food for them. The tool had previously been hidden by another human as the orangutan watched. The human-raised orangutan (and after some training the captive orangutan as well) pointed for the human to the hiding location of the tool. One could call this informative: they are informing the human of the location of the tool (so that he can then use it for their benefit). However, since it was ultimately for the orangutans' benefit (they got food), it is also possible to interpret this pointing as an imperative/directive gesture: something like 'Get the tool to get me food with it!' This directive interpretation is plausible because quite often the apes in this study pointed to the food as soon as the human obtained the tool. In this interpretation, then, the ape is not informing the human by giving her needed information but rather directing her behaviorally to the tool and then to the food.

As a follow-up to this study, Zimmermann, Zemke, Warneken, Call, Gómez and Tomasello (2008) gave orangutans and bonobos the opportunity to point to the location of hidden objects that either they wanted for themselves (i.e. a tool that the human could use to get the ape food) or the experimenter wanted for herself (i.e. a pen she needed for writing). The apes pointed almost exclusively for their own benefit, thus providing no evidence for informative pointing. However, it is possible that the apes in this study did not point for the human's benefit because they might not have understood the usefulness of the human's desired object. This is supported by the fact that several apes occasionally pointed in a control condition for worthless objects that no one wanted. Also, sometimes both objects were out of sight, so the subjects had to remember what was in which location – which may have made things more difficult as well. Finally, and most importantly, in none of these studies was there ever a comparison to human children. Although it has been demonstrated that young children point informatively for adults who need help in finding things, children have never been tested in a situation in which their motives in 'selfish' and 'helpful' situations are directly compared – perhaps children, too, would point much more readily in selfish 'for-me' situations than in helpful 'for-you' situations.

In the current study, therefore, we specifically compared the social motives of chimpanzees and young human children in both selfish for-me and helpful for-you situations – with all potential referents visible, and with using the same referential objects in both situations. Based on the analysis of Tomasello (2008), who claims that human communication is cooperative in species-unique ways, we hypothesized that the chimpanzees would point mainly when it was to their ultimate benefit, whereas the human children would point equally often no matter who benefited.

Study 1a: Chimpanzees

In the first study we gave chimpanzees the opportunity to point for one of two visible tools, which a human experimenter (E) would then retrieve and give to them to use. In one condition it was clear that the ape would be using the tool to retrieve a reward for herself (so the pointing was selfish or for-me), whereas in the other condition it was clear that the ape would be using the tool to retrieve a reward for E (so the pointing was helpful or for-you).

Method

Participants

Eight chimpanzees (*Pan troglodytes*; two males, four females, and two juveniles) ranging from 4 to 31 years of age participated in this study. All individuals were housed at the Wolfgang-Köhler-Primate-Research-Center (WKPRC) in Leipzig, Germany. In addition, six chimpanzees (one male, five females) took part but were not included in the study because they failed in the training. The subjects were tested individually in familiar testing rooms (47 m^2) and were separated at all times from E by caging. Subjects had participated previously in object-choice studies in which they indicated for humans desired objects (e.g. Call, 2004; Hare & Tomasello, 2004). However, none of the chimpanzees had been explicitly trained to point. All subjects were also experienced tool users.

[1] There are two isolated instances of apes in the wild doing something that a human observer interpreted as pointing triadically, but these have not been replicated (Inoue-Nakamura & Matsuzawa, 1997; Vea & Sabater-Pi, 1998).

Materials and design

The experimental setup comprised firstly an opaque food box (33 × 28 × 33 cm) which was fixed on the caging between the ape and E and which could be baited from E's side. A cylindrical tool had to be inserted into the box by the ape to make the food drop out at the bottom of the box. Additionally, a piece of foam rubber served as a non-functional distractor. Further there was a long, low cabinet (150 × 30 × 20 cm) located in the human area 70 cm across from the subject's cage (following Leavens, Hopkins & Thomas, 2004). At each extreme of the cabinet there was a chamber (20 × 30 × 20 cm) with a hole towards the front side. The cabinet was covered with an occluder so that only the ape could readily see the inside of the chambers but into which E could not see as she sat on top of the cabinet. The holes of the two chambers were blocked by a Plexiglas panel in front. By sliding the panel to one side, E could extract the contents of one chamber while the opening of the other one got irreversibly closed. All trials were recorded by cameras from frontal and side views (see Figure 1).

The study comprised two experimental conditions: a selfish for-me condition and a helpful for-you condition. In the selfish for-me condition the food box was affixed inside the ape's cage so that the food was available only to the ape after tool use, whereas in the helpful for-you condition it was affixed outside the ape's cage so that the food was available only to E after tool use (see Figure 1). These conditions were arranged in an ABA design: an initial selfish for-me block, a middle helpful for-you block and a final selfish for-me block (12 trials of each).

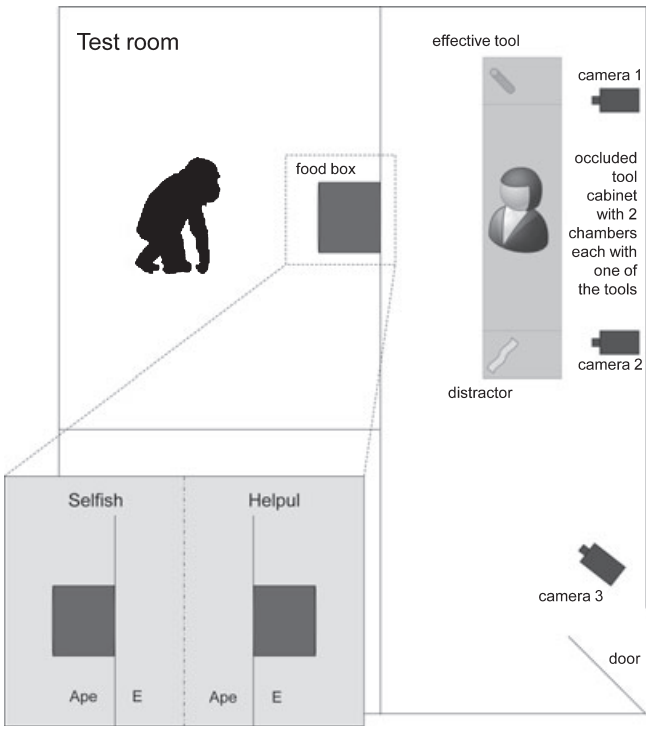

Figure 1 *Experimental setup of Study 1.*

This design was used because we feared that starting some subjects with the helpful for-you condition, in which chimpanzees received no reward, would quickly lead to non-participation. During each of the ABA blocks, subjects also had eight filler trials (in which E simply gave the ape the correct tool) mixed in semi-randomly (for a total of 20 trials per block). Each block was run over 2 days (four filler and six experimental trials each day), with no more than 1–2 days in between. Prior to each block we conducted a warm-up of six trials to introduce the subjects to the respective condition. Before any testing there was a training of two phases to ensure that the subjects knew how to use the effective tool (phase 1) and to differentiate between the effective tool and the distractor (phase 2).

In each trial two tools were presented: the effective tool and the distractor. These were either put on top of the cabinet in full sight of everyone (warm-up and filler trials) or hidden inside the chambers of the cabinet (experimental trials). For each subject the distribution of the tools left and right was randomized across trials, such that the effective tool was never placed in the same location for more than two consecutive trials.

Procedure

Training. In both phases an assistant baited the food box (always on the ape's side, with food available only to her) and put the tools on top of the cabinet, with the ape and E both present and watching. In phase 1, E simply gave the effective tool to the ape, who could then use it to get the food. In phase 2, E threw both tools simultaneously into the cage, so that the subject had to choose between them. If the ape used the correct tool, the reward fell out. If the ape did not use the correct tool within 1 minute, the assistant removed the reward from the food box and traded the tools in for a less preferred piece of food. Eight out of 14 chimpanzees finally learned how to use the tool, i.e. they used the effective tool accurately within 1 minute and (additionally in phase 2) did not touch the distractor in five out of six trials in a day. These individuals proceeded with the study.

Warm-up. This worked just as the training except that the food box was affixed according to the condition at the respective side: on the ape's side before the two A blocks so that the ape received the reward and on E's side before the B block, so that E received the reward. The subjects had to use the tool at least once within six trials to see who received the food. All eight subjects performed successfully in the warm-up trials.

Experimental sessions. After the warm-up conducted before each block, subjects began the corresponding experimental trials – administered, as noted, in an ABA design: selfish (12 trials), helpful (12 trials), selfish (12

trials). The eight filler trials within each block were identical with the training trials (phase 1): E simply gave the ape the correct tool so she could use it.

In the experimental trials the ape watched the assistant hide the tools inside the chambers of the cabinet and bait the food box with food, with E outside the room. The assistant then centered the ape in the cage with juice reward while E entered the room – completely blind to the location of the two tools. As E came in and sat down on the cabinet, the assistant left the room. Upon not finding the tools in their usual location on top of the cabinet, E displayed surprise in an escalating manner of two phases over time: (1) E looked at the location where the tools previously had been, raised her arms, palms up, frowned, looked around and said: 'Hmm?...strange…' (2) After about 10 seconds, E further said: 'Where are the tools? [Name], where have the tools gone?' If the ape pointed, E followed the gesture and upon finding a tool, took it and gave it to the ape. When the ape pointed to and used the correct tool, either the ape (in the selfish for-me condition) or E (in the helpful for-you condition) received the reward. In the helpful for-you condition, E pretended to eat the reward and did not reinforce the subject with voice or food. In cases in which the ape either did not point or received the tool but did not use it within 1 minute, or pointed to the wrong tool, the assistant removed the food and tools.

Coding. Since E was blind to the location of the effective tool, she had to rely totally on the ape's behavior for choosing a location. Clearest were pointing behaviors, including both whole-hand and finger points (typically with hand/finger inserted through and resting on the mesh). However, E accepted other behaviors clearly indicating a location such as hand-clapping, cage-banging, or holding onto the mesh while clearly oriented to one of the locations. Change of body position from the centered location towards the direction of a target-object in combination with staring and/or rocking towards the direction of a tool for longer than 3 seconds was accepted as well. E did not react in cases of ambiguous gestures or actions. E's response to clear indications was to take the tool from the designated location deliberately and give it to the subject.

For data analyses the number of trials interpreted as points, trials with a point to the effective tool, and trials with tool use after correct pointing were coded live. Data used in the analyses of gesture types came from subsequent coding of the videotapes by E. Coding started as soon as E entered the study area and ended as soon as (a) either the ape or E received the reward (successful trial) or (b) at the latest after 1 minute (unsuccessful trial). To assess interobserver reliability, a second coder, unaware of the hypotheses and the procedure of the study, coded 25% of the videotapes. Agreement on whether a gesture occurred was high at 98.6% (Cohen's K = 0.933). Given that the two observers agreed that a gesture occurred, further reliability estimates were determined for accuracy of pointing and tool use. Excellent agreement was achieved in both calculations: Cohen's K = 1.0.

Results and discussion

Chimpanzees indicated the tool they wanted using various means (20% finger points; 55% whole-hand points; 22% attention-getters + orientation; 3% change of body position + rocking in a direction). For all analyses, all of these were considered pointing gestures. Importantly, analysis of the selfish for-me filler trials indicated that all individuals continued to use the correct tool once they obtained it at 100% levels throughout the experiment, clearly demonstrating their understanding of the effectiveness of the correct tool. There were no significant differences in pointing accuracy between conditions; chimpanzees pointed significantly more often to the correct tool (93% of trials) than to the distractor (7% of trials) in both conditions. Since interpretation of pointing for the incorrect tool is problematic, all further analyses are based on the correct gesture trials.

The chimpanzees pointed significantly more often in the selfish for-me condition (57%) than in the helpful for-you condition (29%): $t(7) = 2.521$, $p = .04$. They also used the tool significantly more often in the selfish for-me condition (57%) than in the helpful for-you condition (19%): $t(7) = 3.309$, $p = .013$. Thus, in the selfish for-me condition they always used the tool once they got it, whereas in the helpful for-you condition, on 10% of the trials they did not. In the helpful for-you condition, more subjects pointed for the tool than used it summed across the 12 trials (trials as subjects): $t(11) = 4.022$; $p = .002$).

Figure 2 illustrates the mean percentage of subjects gesturing for the correct tool and using it across trials and conditions. What can be clearly seen is that as soon as the helpful for-you trials started the chimpanzees began pointing less often, and by the end of this condition they were pointing hardly at all – and as soon as the selfish for-me trials returned they began pointing much more often again. Also, near the end of the helpful for-you trials they sometimes requested the correct tool but then did not use it to actually get the food for E. This

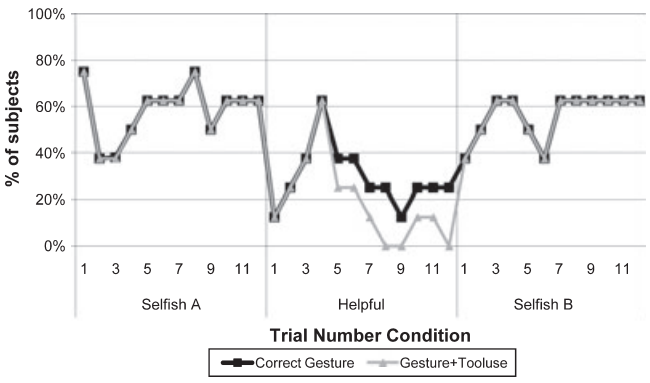

Figure 2 *Study 1a: Percentage of subjects gesturing and using the tool across trials and conditions.*

pattern of less pointing and tool use over time – which did not occur in the selfish for-me condition in either block – suggests that the apes might have taken some time to adjust to the changed contingencies of this helpful for-you condition. They may have thought initially that there was still some chance that they might get the food, as in the just-previous selfish for-me condition. Their behavior was not so much helpful as hopeful. This hypothesis is plausible given that the warm-up for this middle block of helpful for-you trials – which is what gave them the opportunity to learn the changed contingencies – was quite brief compared to the experience apes gained on the for-me condition from the training and the warm-up for the first block of selfish for-me trials. It is thus possible that E continuing to give the tool to the ape even in the condition where E would get food might have somehow misled the apes to think that they might continue to use the tool to get food after all.

Study 1b: Chimpanzees

In Study 1a the chimpanzees pointed infrequently, but still sometimes, in the helpful for-you condition, at least initially. To make the contrast between conditions a bit stronger, therefore, in Study 1b we replicated Study 1a with one main modification: the apes no longer used the tool, but rather E did. The idea was that with this change the chimpanzees would discern the changed contingencies in the helpful for-you condition more quickly, and so point even less for the human's benefit.

Another modification we could have made, but did not, was to make the warm-up to the helpful for-you condition longer (i.e. giving them the correct tool straightaway, but then if they used it the human always got the food). But we chose not to do this because this procedure would very likely have led to an overall lack of further participation for many subjects.

Method

The same eight chimpanzees who had participated in Study 1a also served as subjects for this study. The apparatus was also the same, with the difference that the tool could no longer be inserted into the food box from the apes' side but only from E's side. The order of conditions and number of trials remained the same except that there were only four warm-up trials and only of phase 1 – since the apes were already experienced from the first study and they would not need to use the tools themselves. Even though the tool always remained on E's side and was used only by E, the two experimental conditions were still the same as in Study 1a: in the selfish for-me condition the food box was on the ape's side, whereas in the helpful for-you condition the food box was on E's side.

The data were analyzed and coded exactly as in Study 1a (without analysis of tool use as the chimpanzees did not use the tool). To assess interobserver reliability, a second coder, unaware of the hypotheses and the procedure of the study, coded 25% of the videotapes. Agreement on whether a gesture occurred was high at 97.2% (Cohen's K = 0.931). Given that the two observers agreed that a gesture occurred, further reliability estimates were determined on accuracy of pointing. Excellent agreement was achieved: Cohen's K = 1.0.

Results and discussion

There was no significant difference in pointing accuracy between conditions; chimpanzees pointed significantly more often to the correct tool (92% of trials) than to the distractor (8% of trials) in both conditions. All further analyses are based on correct gesture trials.

The chimpanzees pointed significantly more often in the selfish for-me condition (72%) than in the helpful for-you condition (14%): $t(7) = 3.857$, $p = .006$. Figure 3 presents data for individual differences. Whereas two individuals did not participate, all others showed the same pattern of increased gesturing behavior in the selfish for-me condition as compared to the helpful for-you condition.

As can be seen in the trial-by-trial analysis of Figure 4, as soon as the helpful for-you trials started the chimpanzees began pointing much less often, and by the end of this condition they were pointing hardly at all (none in the last two trials). Then they immediately began pointing much more often again when the selfish for-me trials returned. These results thus replicate those of Study 1a – even more strongly – that chimpanzees point mainly when they themselves will benefit and very little when another will benefit. The simplest hypothesis is that in this study the chimpanzees are adjusting their communicative attempts in accordance with the probability of receiving food themselves.

Study 2: Children

Although we know from previous research that young human children will in some situations point informa-

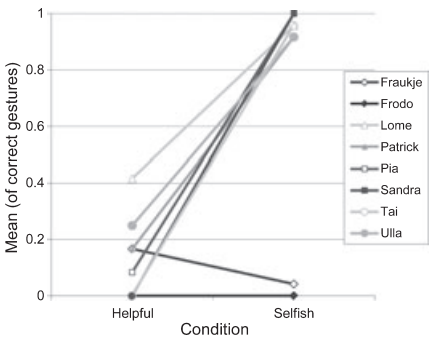

Figure 3 *Study 1b: Individual differences in subjects gesturing to the correct tool across conditions.*

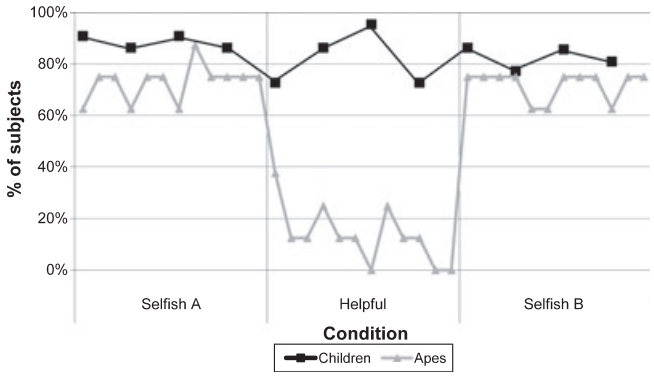

Figure 4 *Study comparison (1b–2): Percentage of subjects gesturing across trials and conditions.*

tively for others (Liszkowski *et al*., 2006; Liszkowski *et al*., 2008), we do not know if that motive is as strong as their selfish communicative motive to obtain things for themselves. In Study 2, therefore, we replicated as closely as possible the methods of Study 1b with human children at around their second birthday.

Method

Participants

Twenty-five-month-old infants coming from mixed socioeconomic backgrounds were recruited from a database of parents from Leipzig, Germany who had volunteered for studies of child development. The final sample included 22 infants (10 girls, 12 boys: mean age = 24.28; range = 24.4 to 25.26). Seventeen additional infants were excluded because they either did not point at all during the experimental session (13), lost interest in the game (3) or because they failed the pretest criterion (1). Infants received a small gift for participating.

Materials and design

The infant was seated on the mother's lap at a table placed in the middle of the room. E sat opposite the child, and the assistant sat in the corner of the room with her back turned, pretending to be distracted and only interacting with the child when E was absent. The experimental setup comprised one opaque dice box (15 × 50 × 20 cm) which was placed at the middle of the table between the child and E and which could be baited from the top. A rectangular tool had to be used on the box by E to make the dice drop out – at which point they could be taken and thrown into a box making fun sounds, which the infants took great joy in doing. Additionally, a piece of foam rubber served as a non-functional distractor. Further behind E at a distance of 240 cm and approximately 15 degrees left and right from the infant were two shelves on which the tools were placed during experimental trials at a height of 90 cm (all measurements following Liszkowski *et al*., 2006). During the preparation of the experimental trials, E hid behind the shelves. All trials were recorded by two cameras from frontal and side views (see Figure 5).

As in Study 1b, the study comprised two experimental conditions: a selfish for-me condition and a helpful for-you condition. In the selfish for-me condition the dice box was placed with the opening towards the infant so that the dice was easily accessible for the child, whereas in the helpful for-you condition it was placed with the opening towards E so that the dice was still accessible for the child but more easily for E (see Figure 5). The music box was placed accordingly either next to the infant or behind E between the two shelves. These conditions were again arranged in an ABA design: an initial selfish for-me block, a middle helpful for-you block and a final selfish for-me block (four trials of each). During each of the ABA blocks subjects also had two filler trials (in which E simply used the correct tool) mixed in semi-randomly as in the ape studies (for a total of six trials per block). All conditions were run within one day. Prior to each block we conducted a warm-up of two trials to introduce the subjects to the respective condition. Before any testing there was a pretest to make sure that the subjects could differentiate between the functional and non-functional tool.

In each trial two tools were presented: the effective tool and the distractor. These were either put on top of the table in full sight of everyone (warm-up and filler trials) or hidden inside the shelves (experimental trials). For each subject the distribution of the tools left and right was randomized across trials, such that the effective tool was never placed in the same location for more than two consecutive trials.

Procedure

The session began with a brief play period in which the music box was introduced so children could become familiar with it and also with the experimenters. Parents were told not to influence or help their children in any way.

Pretest. The assistant baited the dice box and put the tools on top of the table while the infant and E were sitting at the table. In two consecutive trials E tried to get the dice out with the distractor at first and after not succeeding switched to the effective tool. In the following trials, E held one tool in the left and the other tool in the right hand (according to the randomization) and asked the child '[Name], can you show me, which of the two tools I need to get the dice?' Whenever the infant pointed to one tool, E used it and the infant got the reward in cases of a correct point. Subjects passed the test if they pointed to the correct tool in five out of six trials. E conducted a maximum number of 12 trials. The one child who did not pass the pretest did not proceed with the study.

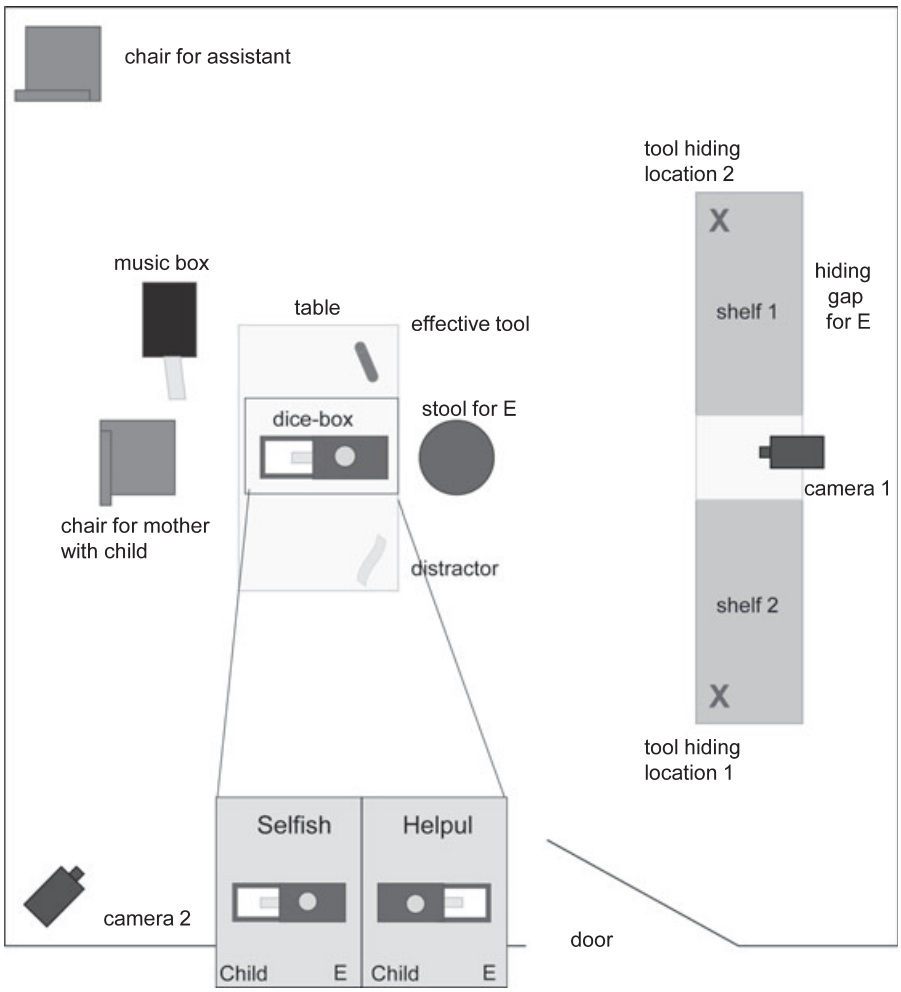

Figure 5 *Experimental setup of Study 2.*

Warm-up. The assistant baited the dice box and put the tools on top of the table with the infant and E both present and watching. E used the effective tool and either the infant (in the selfish for-me condition) or E (in the helpful for-you condition) received the reward.

Experimental sessions. After the warm-up conducted before each block, subjects began the corresponding experimental trials – administered, as noted, in an ABA design: selfish (four trials), helpful (four trials), selfish (four trials). The two filler trials within each block were identical with the warm-up trials: E simply used the correct tool.

In the experimental trials subjects watched the assistant bait the dice box and hide the tools inside the shelves, with E out of sight behind the shelves. As E returned, she could not find the tools in their usual location on top of the table and displayed surprise in an escalating manner of three phases over time (following Liszkowski *et al.*, 2006): (1) E looked at the location where the tools previously had been, raised her arms, palms up, frowned, looked around and said: 'Hmm?... strange…' (2) After about 10 seconds, E further said: 'Where are the tools? Where have the tools gone?' (these two stages were the same as those used for the chimpanzees). (3) After about 10 more seconds, E addressed the subject directly and said: '[Name], do you know where the tool is?' If the subject pointed, E followed the gesture and upon finding a tool, took it and used it. When the infant pointed to the correct tool, either the infant (in the selfish for-me condition) or E (in the helpful for-you condition) received the reward. In the helpful for-you condition, E took the dice with a little delay after it emerged – giving the child the possibility to grab it – and threw the dice into the music box with her back oriented towards the child and the music box not visible to the child.

Coding. Since E was blind to the location of the effective tool, she had to rely totally on the child's behavior for choosing a location. Whole-hand points were accepted as well as index-finger points (see Franco & Butterworth, 1996, on the equivalence of these two forms). E did not react in cases of ambiguous gestures. E's response to clear indications was to take the tool from the designated location deliberately and use it on the dice box.

For data analyses the number of trials interpreted as points, the phase in which the point occurred and trials with a point to the effective tool were coded live. Data used in the analyses of grabbing behavior for the dropped-out dice and emotional reaction to the dice appearance and its whereabouts came from a subsequent coding of the videotapes by E. Coding started as soon as E entered the study area and ended as soon as (a) either the child or E received the reward (successful trial) or at the latest when (b) either E left the table to hide again behind the shelves or the assistant approached (unsuccessful trial). To assess interobserver reliability, a second coder, unaware of the hypotheses and the procedure of the study, coded 22.7% of the videotapes. Excellent agreement was achieved on whether a gesture occurred, the phase in which it occurred and whether it was directed at the effective tool: Cohen's K = 1.0. Agreement on whether the infant grabbed for the dropped-out dice was high at 95.8% (Cohen's K = 0.895) and agreement on whether the infant reacted positively or neutral/negatively towards the appearance and whereabouts of the dice was also high at 91.4% (Cohen's K = 0.819).

Results and discussion

Again there were no significant differences in pointing accuracy between conditions; children pointed significantly more often to the correct tool (89% of trials) than to the distractor (11% of trials) in both conditions. Overall, children pointed within the first two phases of E displaying surprise in 86% of all points, suggesting that the third phase of the verbal escalation had little influence on eliciting communication. All further analyses are based on the correct gesture trials.

The children pointed equally often in the selfish for-me and in the helpful for-you conditions: $t(21) = 0.924$, $p = ns$. As can be seen in the trial-by-trial analysis of Figure 4, the helpful for-you trials had basically no effect on the pointing of the young children; they pointed to the effective tool about 84% of the time in both conditions.

Given that children pointed at the same high rate in both conditions, it was important to establish that they indeed differentiated between the two conditions, that is, that they indeed knew that in the selfish for-me condition they would get the dice for themselves whereas in the helpful for-you condition the experimenter would get the dice. That they did distinguish the condition is apparent in their behavior towards the dice when it emerged. Children grabbed for the dice on almost every trial (98% of the time) in the selfish for-me condition, whereas they grabbed for the dice much less often (20%) in the helpful for-you condition (Wilcoxon: $T^+ = 210$; $N = 20$ (2 ties); $p < .001$). These results suggest that the children could clearly differentiate between conditions. Furthermore, children clearly valued the two conditions differently. Their emotional reaction to the dice appearance and its use in the selfish for-me condition was positive whereas in the helpful for-you condition it was neutral/negative. Children reacted positively on almost every trial (94%) in the selfish for-me condition, whereas they almost never did so (11%) in the helpful for-you condition ($t(21) = 16.95$; $p < .001$). These results suggest that the children were not rewarded in the helpful for-you condition by watching the experimenter throw the dice in the music box, whereas they were rewarded when they did it themselves in the for-me selfish condition.

Because the methods of Study 1b with chimpanzees and the current study with children were so similar, it is possible to compare the performance of two species across studies. Figure 6 shows the percentage of correct gestures across the two conditions for each species. There was a main effect of species ($F_{1, 28} = 27.494$; $p < .001$; $\eta^2 = 0.495$) and of condition ($F_{1, 28} = 30.031$; $p < .001$; $\eta^2 = 0.517$). But these must be interpreted in the context of the interaction between condition and species ($F_{1, 28} = 22.908$; $p < .001$; $\eta^2 = 0.450$). Specifically, the two species behaved roughly the same in the selfish for-me condition ($t(7.91) = 0.84$, $p = ns$), but their behavior was very different in the helpful for-you condition ($t(28) = 8.54$; $p < .001$), with children gesturing about six times more often than the chimpanzees when the experimenter would be receiving the reward. This difference can be seen most dramatically in the trial-by-trial analysis of Figure 4, in which the children's level of performance contrasts sharply with the apes' pronounced U-shaped performance across trials.

These results clearly show that young children do engage in informative pointing as often as they engage in selfish pointing in very similar conditions. Comparison to the apes' behavior in Study 1b shows no difference in selfish for-me pointing, but only in helpful for-you pointing, which children produced more often by several orders of magnitude.

General discussion

In the current study we observed a stark difference in the communicative behavior of human children and their

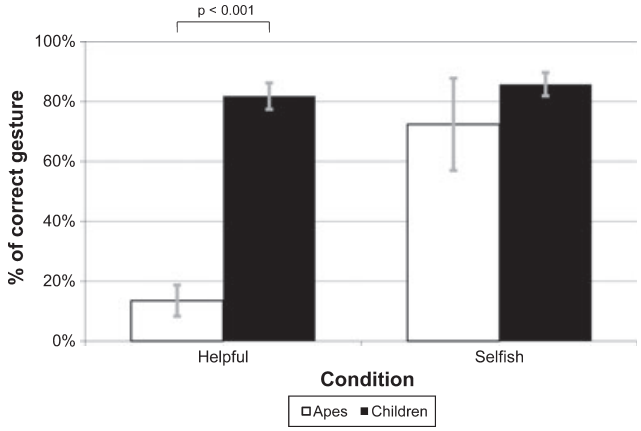

Figure 6 *Study comparison: Percentage of correct gesture of both species as a function of condition. Error bars represent standard error of the mean.*

nearest primate relatives, chimpanzees. The two species pointed equally often to tools for selfish motives, that is, in order to prompt an experimenter to get the tool and use it for their benefit. But when it became clear that the experimenter intended to use the tool for her own benefit, the children kept pointing happily at the same high rate whereas the chimpanzees fairly quickly quit pointing altogether. It is possible that on some occasions the chimpanzees pointed informatively, and then quit, but the most likely explanation is that their few pointing gestures during the helpful for-you trials were simply carry-overs from the previous selfish for-me trials, reflecting their continued hope that they might still get some food.

From a cognitive point of view there is no difference in selfish for-me pointing and helpful for-you pointing, and so the explanation for this species difference would not seem to be cognitive in any straightforward sense. Both types of pointing assume an understanding of the recipient as a goal-directed, perceiving agent (Gómez, 2007; Gómez, Sarriá & Tamarit, 1994). From a motivational point of view it is not that they do not have any altruistic motives. At least two different studies have found that chimpanzees will under some circumstances provide physical assistance to others needing help by, for example, fetching out-of-reach objects or opening doors for them (Warneken *et al.*, 2007; Warneken & Tomasello, 2006); and so the difference is not just a complete absence in apes of any altruistic motive. Rather, the difference we observed would seem to be quite specifically about different communicative motives: only humans point to inform others of things helpfully. It is important to point out that this difference is not confined to apes' communication with humans. Nonhuman primate vocalizations and gestures in the wild are also almost always attempts to get others to do things for the communicator's benefit – not to inform others of things helpfully.[2] Moreover, chimpanzees and other nonhuman primates have trouble comprehending helpful and even imperative/directive communicative motives (Kirchhofer, Zimmermann, Kaminski & Tomasello, 2008). Thus, when a human tries to helpfully inform a chimpanzee where hidden food is located, by pointing to its location, for example, they mostly do not comprehend – perhaps because it does not make sense to them that someone would inform them of the location of food they could easily monopolize themselves (see Call & Tomasello, 2005, for a review).

Humans, in contrast, have evolved especially cooperative communicative motives. They share their interests and attitudes with one another declaratively (e.g. 'What a beautiful sunset'), and they inform one another of things that they think the other will find useful or interesting (e.g. 'You dropped your wallet'). Indeed, the informative motive has become so prominent in human communication that human directives/requests are often expressed as informatives. Thus, in one form of so-called indirect requests – the predominant way that humans request things of one another – one person simply informs another of her needs or desires, 'I want some water'. This form of expression presupposes a mutual understanding that the recipient will be eager to help if she knows the other's desire. Humans also comprehend the helpful, informative communicative acts of others as a matter of course. If an experimenter points to inform young children where a hidden toy is located by pointing to its location, they comprehend immediately – presumably because this helpful communicative motive seems quite natural for them (Behne, Carpenter & Tomasello, 2005). Tomasello (2008) speculates that informative communication evolved in the context of special kinds of human collaborative activities (involving shared goals, which other primates do not have) in which helping the partner simultaneously helps the self in the pursuit of their joint goal.

Developmentally, Tomasello, Carpenter and Liszkowski (2007) proposed that each of the three basic motives of human communication has unique ontogenetic roots in distinct forms of social interaction. First, infants in some sense direct the behavior of others from birth as they cry, and then later ritualize crying into more intentional whining and fussing. This is the origin of the imperative-directive-requestive motive, and infants' directive communicative acts quite often are accompanied by a whining intonation. Second, infants also share with others in back-and-forth social interactions (so-called proto-conversations), typically with positive emoting and vocalizing, from soon after birth as well. This is the origin of the sharing-declarative motive aimed at sharing emotions and other psychological states with others (typically accompanied by various kinds of positive intonations) – perhaps as a way of establishing and cementing social bonds. And third, infants begin helping others altruistically from around their first birthday, and this is the origin of the informative motive in which infants altruistically provide others with information that those others want or need (typically with no marked vocalizations or intonations at all). Based on the results of the current study, along with those of related studies (e.g. Tomasello & Carpenter, 2005), even humans' closest primate relatives do not have the sharing-declarative or the helping-informative motives in their species-typical communicative repertoires. Phylogenetically, these especially cooperative motives are first expressed in infants in intentionally structured communicative acts at around their first birthday, as they first begin to engage in collaborative activities underlain by joint intentions and attention.

[2] The proximate goal of such natural communicative acts as alarm calls and food calls is not to inform others of the location of predators and food (though those others are in fact informed by these acts) as they are also given when everyone is already present and informed (Cheney & Seyfarth, 1990; Clark & Wrangham, 1994). Seyfarth and Cheney (2003, p. 168) say: 'Listeners acquire information from signalers who do not, in the human sense, intend to provide it'.

The current study has thus identified a basic difference in the social motives underlying the gestural communication of chimpanzees and human children: only human children gesture for others informatively. The informative motive is fundamentally an altruistic motive in which the communicator informs others of things she believes that they, not she, will find interesting and important (Sperber & Wilson, 1986). This informative motive thus was and is of crucial importance in both the phylogeny and ontogeny of uniquely human cooperative communication, including of course linguistic communication.

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