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Research Article

Prelinguistic Infants, but Not Chimpanzees, Communicate About Absent Entities

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ABSTRACT—*One of the defining features of human language is* displacement*, the ability to make reference to absent entities. Here we show that prelinguistic, 12-month-old infants already can use a nonverbal pointing gesture to make reference to absent entities. We also show that chimpanzees—who can point for things they want humans to give them—do not point to refer to absent entities in the same way. These results demonstrate that the ability to communicate about absent but mutually known entities depends not on language, but rather on deeper social-cognitive skills that make acts of linguistic reference possible in the first place. These nonlinguistic skills for displaced reference emerged apparently only after humans' divergence from great apes some 6 million years ago.*

Much of humans' everyday communication is about absent entities displaced in time and space from the here and now. Talking about absent entities brings them into existence on a mental level, and may be unique to humans. Although some nonhuman primate species may hear the vocalizations of other individuals and infer the presence of a predator they cannot see (Seyfarth & Cheney, 2003), the vocalizers themselves can always see or hear the predator, and so their call is a direct reaction to the predator's presence—there is no intention to inform others about a perceptually absent referent. Further, some species of bees perform "dances" that direct other bees to food sources outside the hive (Gould & Gould, 1995), but the dancer's behavior is basically a canonical transformation of its own previous foraging route, not an attempt to direct others' attention to a perceptually absent referent. Thus, animal communication does not seem to involve reference to absent entities in the way human communication does.

According to almost all theoretical accounts, displaced reference is possible only in human spoken language (e.g., Hockett, 1960). Language enables displaced reference because both speaker and hearer have learned the same conventional means for making reference to specific entities—so that when the speaker says "elephant," the hearer automatically imagines an elephant on the basis of his or her past communicative experiences with people using this word. But it is also possible to make reference to absent entities without a shared language, if one has enough shared experience or common ground with the recipient. For example, at a Chinese buffet, when a customer wants cashew chicken but sees that the location which normally holds cashew chicken is empty, he or she simply needs to get the server's attention and point to the usual location of that dish in order to request more. Drawing the server's attention to the usual location of the absent cashew chicken works to communicate a desire for the missing dish because both customer and server know that what is relevant in this context is not the location itself, but the currently absent referent that usually is in that location. It is the common conceptual ground of both communicator and recipient that grounds reference (Clark, 1996; Clark & Marshall, 1981), and so enables reference even to entities displaced from the here and now.[1]

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[1]A problem of deictic reference as presented in philosophy and linguistics is that a point to an object can refer to pretty much anything, such as its size, color, or shape (Wittgenstein, 1953). Moreover, the thing pointed at (the demonstratum) can even be different from the referent (Bühler, 1934; Nunberg, 2004; Quine, 1971). Deictic reference works because it is embedded in common ground within Gricean communication, in which a referent-isolating thought is invoked by recognizing the intention of invoking that referent-isolating thought (Levinson, 2004).

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One could easily imagine that adult human beings are able to use the pointing gesture in this way only because they have previously learned linguistic means for making reference to absent entities. However, one could also imagine that human beings have the ability to make reference to absent entities even prior to language, and that indeed this ability is a precondition for using linguistic conventions in a displaced manner in the first place. The key test would involve prelinguistic infants, who typically use the pointing gesture quite flexibly for some months before acquiring any conventional language (Carpenter, Nagell, & Tomasello, 1998; Liszkowski, 2006) and who also show evidence of the prerequisite ability to keep track of the common ground they share with other individuals (Moll, Richter, Carpenter, & Tomasello, 2008; Saylor & Ganea, 2007). If infants were able to use the pointing gesture to make reference to absent entities in the same basic way as adults (Liszkowski, Carpenter, & Tomasello, 2007; but see Gómez, 2007), this would overturn the established view that displaced reference depends on language. Moreover, if it could be shown that humans' closest primate relatives, great apes (who point and reach for things they want humans to give them; Call & Tomasello, 1994), do not make reference to absent entities in this same way, this would suggest that full-fledged reference is a unique skill of human social cognition that runs much deeper than language alone, and indeed may be one of the cognitive prerequisites in the evolution and acquisition of language (Tomasello, 2008).

In the current study, we confronted 12-month-old prelinguistic human infants and adult chimpanzees with two new situations in which they wanted something they could not see. In both situations, participants first repeatedly saw a human adult place several desired objects of the same kind on top of one platform, while also placing undesired objects of another kind on another, similar platform. Then, for the test, the desired objects were removed. In the *occluded-referent* condition, participants then saw the adult take another object of the desired kind and place it *under* its platform, out of sight. In this case, even though participants could not see the desired object, they knew it was there under the platform, and so they could potentially request it by pointing to its location. In the *absent-referent* condition, in contrast, after the adult removed the desired objects from the platform, she did not add any more, so that the usual location of the desired kind of objects was empty. In this case, if participants pointed to the now-empty platform, it would mean that they expected the adult would be able to infer that what they wanted was one of the missing kind of objects, that is, one of the kind both the adult and the participants knew was usually on that platform.

METHOD

Participants

Infants were recruited using a database of parents who had volunteered to participate in infancy research. Only infants whose parents reported that they pointed were invited. Eight infants had to be excluded because of fussiness ($n = 6$) or experimenter error ($n = 2$). The final sample included thirty-two 12-month-olds. Infants were randomly assigned to one of two conditions. In the absent-referent condition, there were 8 girls and 8 boys with a mean age of 12 months 14 days (range = 12 months 2 days to 12 months 30 days), and in the occluded-referent condition, there were 8 girls and 8 boys with a mean age of 12 months 12 days (range = 12 months 4 days to 12 months 28 days).

The chimpanzee participants were socially housed in a zoo and primate research center. Sixteen chimpanzees (12 females, 4 males) with a mean age of 19 years (range = 6–31 years) were tested in a within-subjects design, with half the sample receiving the absent-referent condition first and the other half receiving the occluded-referent condition first; the order of conditions was counterbalanced for age and gender.

General Procedure

Figure 1 shows a schematic drawing of the setup. In each condition, participants received two trials with different sets of materials; trials were separated by a short play session during which the apparatuses were changed. Each trial began with a demonstration in which participants watched an interaction between a *giver* and a *requester*. The aim of the demonstration phase was to convey to the participant that (a) the giver had two different kinds of materials that she put habitually in two corresponding locations and (b) she would comply with specific requests for one or the other kind of material by offering it to the requester (but only if she understood the referent correctly). To emphasize the need for a referential request (i.e., a request for one specific kind of object, not the other), we offered a choice of two different kinds of materials, one highly desirable (toys for infants and food for chimpanzees) and one undesirable (paper towels for infants and bedding material for chimpanzees). In addition, to increase the infants' motivation to request one of the desired toys (balls in one trial, blocks in another), we made available a chute or slide, in which infants could put the toys. The chimpanzees were naturally highly motivated to obtain food.

In the demonstration, participants watched from a side perspective as the giver first took out the two types of materials (e.g., two balls and two small piles of paper towels) from an unspecified location under a table and placed each type on top of one of two distinct locations (two different platforms) that were equidistant to the requester. The requester then acted out the first of a total of four request sequences with manual and facial gestures accompanied by words (because a silent adult interaction would be unnatural), but pointing or other referential gestures were never used in these sequences. A request sequence consisted of an unspecific and a specific request. Unspecific requests consisted of the requester looking around, frowning, raising her hands palm up, and saying, "Give me something." These requests resulted in hesitation in the giver and an indecisive

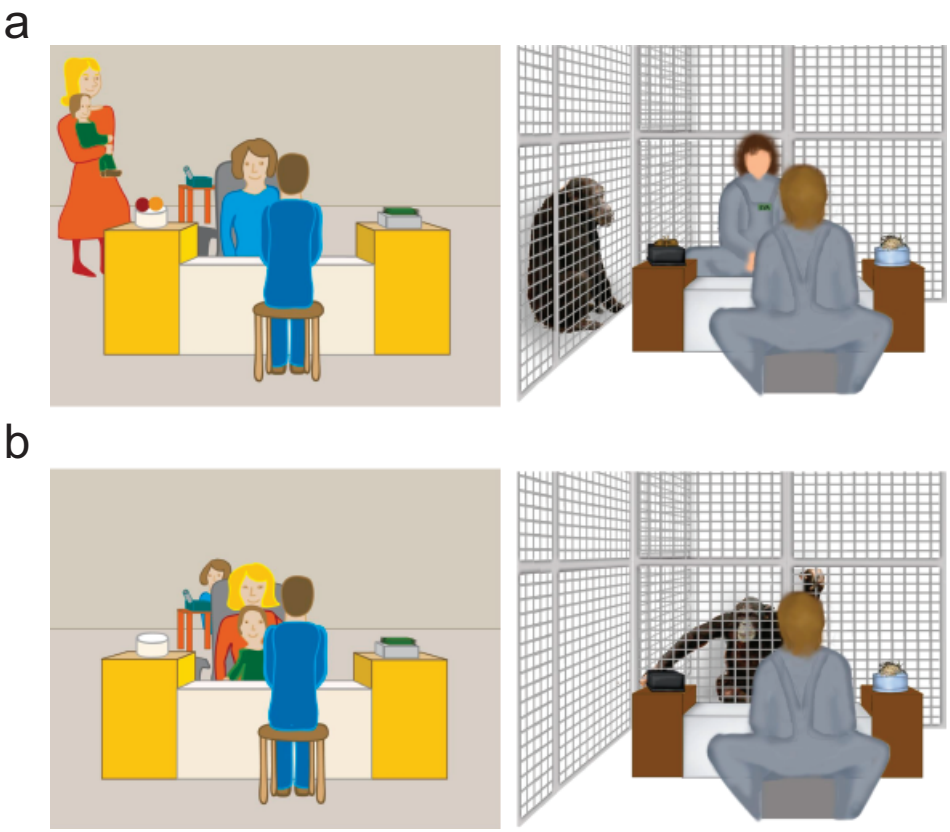

Fig. 1. Illustration of the experimental setup for infants (left) and chimpanzees (right), viewed from behind the giver. In the demonstration (a), participants watched an interaction between the giver and requester. Two desirable objects of the same kind (for infants: balls or blocks that could be used with a chute or slide toy, depicted in the back; for chimpanzees: packages of food) were repeatedly placed by the giver on the left or right location (counterbalanced) and successively requested by the requester. Undesirable objects (paper towels or bedding material) were placed on the alternative location. In the test (b), participants were in the requester's position and faced the giver to interact with her directly. The location that had held the desirable kind of objects was empty (absent-referent condition) or contained a desirable object inside (occluded-referent condition).

offer of a small pile of the undesired objects from its location (i.e., the giver alternated looks between locations, shrugged her shoulders, and said, "What? These?"). Specific requests consisted of the requester looking at the giver, nodding, clapping her hands together, and saying, for example, "I want a ball." These requests elicited understanding in the giver and a prompt offer of a desired object from the other location (i.e., the giver raised her eyebrows and said, "Ah, this"). The requester then (a) threw the desired toy down the play chute (or slide, in the case of the blocks) behind her or (b) unwrapped the food item, pretended to consume some, and offered the rest to the chimpanzee. This kept participants attentive and motivated.

After two request sequences, the platforms were empty. Before the third request sequence, in the occluded-referent condition, participants watched as the giver first placed the materials under the platforms, out of sight. In the absent-referent condition, the platforms remained empty. In response to the requester's unspecific request, the giver retrieved the undesired material (either from under the platform or from the unspecified location under the table), placed it on the platform where this kind of material had been before (hereafter, the *alternative location*), offered some to the requester, and then placed two of the desired objects on top of the platform where the desired objects had been before (hereafter, the *target location*). In response to the requester's specific request, the giver then gave one of the desired objects to the requester. For the fourth request sequence, participants were positioned next to the requester, so that they shared her perspective, and the procedure continued as before. At the end of the fourth request sequence, the requester gave the desired object to the participant, thus making it clear that the participant could now obtain the desired objects for him- or herself. It is crucial to note that neither the requester nor the giver ever pointed (or produced any other referential hand gestures) at any time during the demonstration.

Before the test, in the occluded-referent condition, participants watched as the giver placed another desired object under the platform. In the absent-referent condition, the giver started to place a desired object on top of the platform, but then

distractedly forgot. In both conditions, there was thus nothing on the platform on which the desired objects had previously been placed. Some undesired objects remained present on top of the other platform after the fourth request sequence. Thus, in the two conditions, participants had had equal visual exposure to the desired and undesired objects. The final thing participants saw before the test was the giver highlighting the two platforms simultaneously by moving them with her hands.

For the test, participants sat in the requester's place and for the first time could request the desired objects from the giver themselves. In a natural but predetermined, stepwise sequence, the giver first waited for participants to make a request. If they did not do so immediately, the giver looked expectantly to the participants, then occasionally touched both locations simultaneously, and eventually gave a reminder that other objects were available and that the locations could be refilled. The test terminated either when participants pointed to the target platform or when this predetermined sequence ended. If infants did not point, a motivation control trial was administered; for chimpanzees, a motivation control trial was administered after every trial. In these control trials, a desired object was placed visibly on top of the platform. All sessions were videotaped. A detailed description of the materials, the scripted interaction, and the counterbalancing is provided in the Supporting Information available on-line (see p. 660).

Coding and Reliability

For both the infants and the chimpanzees, the same main coder coded the video recordings of the sessions. A point was coded during a test trial if the participant's arm was either fully or half extended with the index finger out or with an open hand either palm down or palm up; for the chimpanzees, a point was also coded if they pointed with their lips, although this occurred on very few (three) occasions. Points were coded as *target points* if they were directed to the platform where the desired object was or had been, as *points to the alternative location* if they were directed to the platform that held the undesired objects, and as *unspecific points* if they were directed to unspecified locations in the middle, somewhere between the two platforms (e.g., the table or giver). Main analyses were carried out on the points before any motivation control trial, that is, before participants had the possibility to point to a desired visible object.

The same reliability coder coded the two test trials for 25% of the infants in each condition and for 25% of the chimpanzees. This coder was naive to the hypotheses of the study. There was 100% agreement between the main and reliability coders on the number of infants' and chimpanzees' points to the target location, chimpanzees' points to the alternative location, and infants' points to middle locations. There was a significant correlation between the reliability coding and the main coding for the number of infants' points to the alternative location, Spearman's $\rho = .733$, $p = .001$ (both Ms $= .375$), and for the number of chimpanzees' points to middle locations, Spearman's $\rho = .912$, $p = .001$ (Ms $= .56$ vs. $.75$, respectively; Mann-Whitney exact test, n.s.).

RESULTS

Results are presented in Figure 2. In the occluded-referent condition, 10 of 16 infants pointed to the platform that a desired object was under (15 points); in the absent-referent condition, 9 of 16 infants pointed to the empty platform where the desired kind of objects had been placed previously (12 points). These values are not statistically different (Fisher's exact test, $p = 1$; Mann-Whitney exact test, $p = .636$). Thus, infants were able to refer equally well to absent and to occluded referents.

In contrast, chimpanzees were not able to refer equally well to absent and to occluded referents. In the occluded-referent condition, 9 of the 16 chimpanzees pointed to the platform a desired object was under (13 points). However, in the absent-referent condition, only 3 of the 16 chimpanzees pointed to the empty platform, each pointing to that platform just once. These values are statistically different (McNemar exact test, $p = .031$; Wilcoxon exact test, $p = .008$). Note that 2 of the chimpanzees who pointed to the empty platform in the absent-referent condition had already participated in the occluded-referent condition, so it is possible that they were generalizing from their previous test experience. Moreover, a series of further analyses revealed that the chimpanzees' three points to the empty platform arguably were not acts of displaced reference, but rather simply frustrated attempts to try anything to get the food.

First, the timing of the points was informative. For infants, the majority of points (85%) in both conditions were initiated early in the trial, before any reminders about the objects or the adult's ability to refill the platforms were given. This was true in both the absent-referent condition (75% of points; mean latency = 29.5 s) and the occluded-referent condition (93% of points; mean latency = 35.9 s), $t(17) = 0.467$, $p = .646$. Results for chimpanzees were similar in the occluded-referent condition, with 69% of the points being initiated before the reminders (mean latency = 38.1 s). In contrast, the chimpanzees' three points to the empty platform in the absent-referent condition were initiated only after these reminders, and much later in the trial (mean latency = 64.6 s).

Second, another measure of how directly participants pointed to the target location was whether they made an unspecific request (i.e., pointed to the middle) before pointing to the target location. Figure 2 shows that among the infants who pointed to the target location, all but 1 (who was in the absent-referent condition) pointed to that location at least once without any preceding unspecific requests. Two infants in the absent-referent condition and 2 infants in the occluded-referent condition pointed to the visible, undesirable, alternative referent before pointing to the target location, presumably because of their interest in the paper towels. But overall, the majority of infants

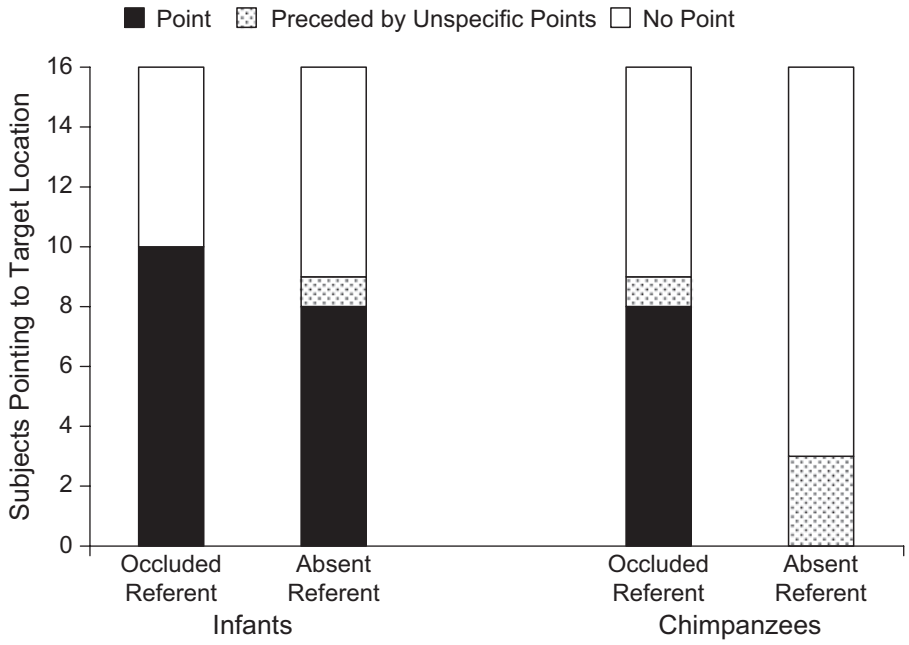

Fig. 2. Number of participants who pointed at least once to the target location (i.e., the location of the occluded or absent entity). The graph differentiates target points that were and were not preceded by points to unspecified locations somewhere between the target and alternative locations (i.e., unspecific points). In addition, the number of participants who did not point to the target location is indicated. In the occluded-referent condition, a desired object was under (inside) the platform. In the absent-referent condition, the desired kind of objects was absent from its usual location.

who pointed to the target location in the absent-referent (78%) and occluded-referent (80%) conditions pointed at least once directly to the target location, without a previous point to any other location, and the percentage of target points not preceded by another point did not differ significantly between the two conditions (58% vs. 60%; Mann-Whitney exact test, $p > .800$). In contrast, all three of the chimpanzees' target points in the absent-referent condition were preceded by several points (range: 2–7 points) to other unspecified locations in the middle (1, 3, and 7 points) and the alternative referent (1 point). These results for the absent-referent condition are also in contrast to chimpanzees' own performance when they were in the occluded-referent condition, in which all but one of their points were directly to the target location without any other preceding points.

Finally, the morphology of participants' points told a similar story. From early in their first year of life, infants reach out for things with an outstretched arm and open hand, and chimpanzees have a ritualized begging gesture to acquire food from other individuals. These gestures, however, are different in function and morphology from pointing with the extended index finger (Franco & Butterworth, 1996). The morphological form of index-finger points is nonfunctional in grasping and obtaining objects; it is functional only in directing other individuals' attention. Therefore, it is conceivable that points to the location that previously held the absent desired objects (or points to occluded referents) would take on the form of index-finger points (because one does not grasp for a location or, in this context, for the occluder) more than would requests for visible items, as in the motivation control trials (which might also elicit "reach out to grasp" movements).

For infants, the majority of points to the target location (60%) were index-finger points; the number of index-finger points did not differ significantly between the absent-referent (66%) and the occluded-referent (53%) conditions (Mann-Whitney U *exact*, $p = .435$). The majority of infants who pointed to the target location did so with the index finger (78% and 60% in the absent-referent and occluded-referent conditions, respectively; these values did not differ significantly, Fisher's exact test, $p = .63$). In the motivation control trials, in contrast, only 10 of 29 points (34%) to the visible referent were index-finger points, and the rest (the majority) were whole-hand points. In contrast, the vast majority of chimpanzees' points (88%) to the target location were whole-hand points, and this was true in both the absent-referent (66%) and the occluded-referent (92%) conditions—as well as when chimpanzees were requesting the visible referent in the motivation control trials (70% of chimpanzees' points). The only two index-finger points that were observed among the chimpanzees in the absent- and occluded-referent conditions were points with the finger resting on the mesh of the cage.

All infants and all chimpanzees who did not point during the test trials pointed in the motivation control trials.

DISCUSSION

Prelinguistic, 12-month-old infants were able to request a desired but absent object from an experimenter by pointing to the location where other exemplars of that type of object had been previously. They performed as well in this situation as in one in which a desired object was in a known but occluded location. In the majority of cases in both conditions, infants pointed early in the trial, before any reminders from the adult, and usually used a full index-finger point. Also in the majority of cases in both conditions, infants' pointing to the target location was the first communicative act of the trial; that is, there were no other preceding communicative attempts.

In contrast, chimpanzees did not point in this way to refer to absent entities. Only 3 chimpanzees pointed to the target location in this situation, and each of these points was produced late in the trial, after the experimenter reminded the chimpanzees of the objects, and after a series of unsuccessful points to other, unspecified locations. These results suggest that the chimpanzees were basically trying anything to obtain more food. In contrast, when a desired object was present but occluded from sight, the chimpanzees pointed directly to it, early in the trial, before any reminders, and only 1 of the 13 points was preceded by a point to another location. The vast majority of chimpanzees' points in both conditions were produced with an open hand, as in chimpanzees' natural begging gesture. All these results demonstrate that, unlike infants, chimpanzees do not point to refer to absent objects.

One could argue that chimpanzees did not point in this situation because they were not motivated, or because they were required to point for a human instead of a conspecific, or because they did not understand the previous demonstration. However, results from the occluded-referent condition and motivation control trials provide strong evidence against any of these alternative explanations. For example, all participants (both chimpanzees and infants) who did not point in the test pointed to the desirable visible objects in the motivation control trials. This result shows that participants had the motivation and ability to point to request objects they wanted if those objects were visible. Thus, chimpanzees' difficulty in the absent-referent condition was not a result of lack of interest in the desired objects, inability to point for humans, or other such explanations. Further, in the occluded-referent condition, more than half of the participants of both species pointed to the location where they knew a desired object was hidden. This required something more than pointing to visible entities (e.g., a conception of object permanence; see Gómez, 2007), but this something more was possessed equally by the two species.

It is also important to point out that the method was designed so as to limit the scope of possible alternative interpretations in the absent-referent condition. First, the platform itself was relevant only by virtue of its common use as a place for a specific kind of object (Clark, 2003); no other physical properties or affordances were associated with it. Second, participants never saw the experimenters modeling pointing, and participants had never been rewarded for pointing to the location before, so they could not have benefited from observational learning or vicarious or direct rewarding—they requested for the first time at test. Third, the design required specifying the referent of the request: Unspecific vocalizing or pointing was not enough because there was a choice of two types of objects. Finally, and perhaps most important, exactly what the infants were requesting when they pointed to the target location was clear from the context (which set up the strong motivation to get one of the desirable toys to put in the chute or slide), from the requestive behaviors accompanying infants' points (e.g., whining, leaning forward), and especially from infants' responses in the motivation control trials, when they pointed to obtain such a toy. Thus, infants were not pointing simply to inform the adult about a perceptual change in the target location (its emptiness), or to request that the adult simply act on the target location, without invoking the absent desired kind of object; if they were, they should have been satisfied with the toy simply being present and on the platform in the motivation control trials.

Overall, our main finding is that when a desired object was missing from the location in which other exemplars of that type of object had previously been placed, only the infants—and not the chimpanzees—pointed to the currently empty location as a way of making the adult human understand their request for that type of absent object. Our results thus demonstrate that (a) human infants are capable of communicating about absent entities before language has emerged ontogenetically, and (b) this ability is not seen in humans' closest primate relatives, chimpanzees. Converging evidence comes from research on a deaf-born child of hearing parents. Without exposure to conventional language, this child developed a communication system that also included acts of displaced reference (Butcher, Mylander, & Goldin-Meadow, 1991). In human evolution, referential acts were presumably used initially for indicating perceptible objects and events, so going beyond this required further representational skills and the ability to track relevant common ground in social interaction. The ontogenetic primacy of the ability to communicate about absent entities demonstrates that it is not dependent on, but rather foundational to, language. The current findings with chimpanzees suggest, in addition, that displaced reference emerged in human evolution only after the divergence from great apes some 6 million years ago. It is a reasonable speculation that displaced reference may even have preceded conventional language in the evolution of human communication.

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