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Communication about absent entities in great apes and human infants

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ABSTRACT

There is currently debate about the extent to which non-linguistic beings such as human infants and great apes are capable of absent reference. In a series of experiments we investigated the flexibility and specificity of great apes' ($N = 36$) and 12 month-old infants' ($N = 40$) requests for absent entities. Subjects had the choice between requesting visible objects directly and using the former location of a depleted option to request more of these now-absent entities. Importantly, we systematically varied the quality of the present and absent options. We found that great apes as well as human infants flexibly adjusted their requests for absent entities to these contextual variations and only requested absent entities when the visible option was of lower quality than the absent option. These results suggest that the most basic cognitive capacities for absent reference do not depend on language and are shared by humans and their closest living relatives.

1. Introduction

The use of conventional symbolic systems allows humans to extend their communicative interactions beyond the here and now. Words, for example, denote things in the world and induce thoughts about these things even when the things themselves are perceptually absent to the speaker and the listener. They enable us to be precise about what it is that our interlocutor should envision and thereby allow us to make reference to specific absent entities.

Theories on the evolutionary origins of language listed reference to absent entities or displacement as one of the "design features" of human language (Hockett, 1960). To trace back the evolutionary history of this ability, the question is whether we can also find it in other animals or whether it is something specific to language and therefore uniquely human. The answer is yes, and no. On the one hand, animals like the western honeybee (*Apis mellifera*) manage to communicate to each other the precise location of a food source when the food source is perceptually absent. On the other hand, this form of communication lacks the flexibility and intentionality of human communication (Gould & Gould, 1988).

Human children start to show signs of comprehending the referential nature of words for absent entities at around 12 month of age. For example, they look and gesture more towards a display that matches the colour and location of a previously mentioned absent object suggesting that the word elicited a representation of that object (Saylor, 2004). Slightly older children also take into account a person's experience with an object when responding to an ambiguous referential request of an absent object (Saylor & Ganea, 2007). However, early comprehension of absent reference is rather fragile and influenced by the familiarity as well as the spatial location of the object that is referred to (Osina, Saylor, & Ganea, 2013; Saylor & Ganea, 2007). In terms of production, children only start to use words to refer to absent entities from around 18 month onwards (Veneziano & Sinclair, 1995).

Non-human great apes (hereafter apes) can use symbolic systems of communication to refer to absent referents after a process of enculturation and/or intensive training regime (Gardner, Gardner, & Van Cantfort, 1989; Lyn, Greenfield, Sayage-Rumbaugh, Gillespie-Lynch, & Hopkins, 2011; Savage-Rumbaugh, 1986). However, some authors have questioned whether symbol use in apes, especially the early studies, can be interpreted as evidence of absent reference (Savage-Rumbaugh, Rumbaugh, & Boysen, 1980; Terrace, 1985). For instance, Savage-Rumbaugh et al. (1980) argued that symbol use could merely reflect an association between producing the symbol and receiving its referent within a highly structured context. Nevertheless, even if language trained apes did use symbols to communicate about absent entities, this still does not answer the question of whether reference to absent entities is possible without symbols. The same is true for infants' production and comprehension of verbal reference to

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absent entities. To answer this question, one should study individuals who are non-linguistic but nevertheless exhibit signs for intentional communication such as non-enculturated apes and pre-linguistic human infants at around 12 months of age. Infants as well as apes in the laboratory use pointing gestures in an intentional and flexible way to request objects they desire (Leavens, Hopkins, & Thomas, 2004; Tomasello, Carpenter, & Liszkowski, 2007).

In theory, given enough shared experience or common ground, reference to absent entities should also be possible using pointing instead of a conventional symbolic system (Tomasello, 2008). For example, a child could point for her father to the empty cookie jar, thereby asking for more cookies, because both father and child have it in their common ground that this is the place where the cookies usually are. In fact, to pick out the specific referent of a word, the listener has to interpret the speaker's expression in light of their common ground as well (Clark, 1996). However, compared to a pointing gesture, words are more specific when used to refer to absent entities. By uttering "Cookie!" the child would be pretty specific about her intention while a point to the empty jar could refer to many things besides its absent content including the jar's colour, size or shape (Wittgenstein, 1953). The child could also point to the jar without any specific referent in mind, simply because she has been rewarded with a cookie for doing so in the past. The point itself would have no specific referent in this case. Thus, even though the study of pointing seems to be a valuable way to investigate displacement in a variety of species, inference about the intentional state of the pointer requires a precise methodology. This is especially important when investigating the cognitive processes underlying reference to absent entities. In the case of an unspecific request, there is no need to mentally represent the object of desire because there is no specific object of desire. Strictly speaking this is not even a case of reference since there is no object that is designated by the signal (Frege, 1892). On the other hand, requesting specific entities requires a representation of the desired object and a way to communicate this desire given the current physical and social context. Requesting specific *absent* entities requires the individual to represent the desired object independent of its perceptual availability along with a means of communication that elicits a representation of the desired object in another individual. In the absence of evolved or conventional signals that serve this function, individuals have to rely on objects, locations or movements that bear a referential relation to the absent object for both interlocutors. In the case of pointing, this would be representing a location as the location in which both interlocutors saw a certain object before. Representing this kind of relation between object and location might be seen as a precursor to symbolic representation proper.

While earlier studies investigated infants' use of declarative pointing to refer to absent entities (Liszkowski, Carpenter, & Tomasello, 2007), the study of imperative pointing seems to be more suitable to directly compare apes and infants using a similar setup (Bullinger, Zimmermann, Kaminski, & Tomasello, 2011). Two recent studies used an imperative pointing paradigm to investigate reference to absent entities (Liszkowski, Schäfer, Carpenter, & Tomasello, 2009; Lyn et al., 2014). Liszkowski et al. (2009) compared 12 month-old human infants and chimpanzees (*Pan troglodytes*) in their ability to use the former location of an object to request more objects after observing the interaction between two demonstrators (see supplementary material for details). Their results suggested that infants used this strategy to request more desirable objects whereas apes did not. The authors concluded that even though displacement seems not to be tied to language, the necessary cognitive abilities to engage in it only evolved in the human lineage.

Lyn et al. (2014) criticised this study by arguing that the apes' failure to refer to the absent objects was due to a methodological flaw instead of a lack of ability. They proposed that chimpanzees pointed to the hiding place of additional items within the test room rather then to the previous location of the desired object. According to Lyn et al. (2014), the study by Liszkowski and colleagues therefore only tested reference to occluded entities, not reference to absent entities. To test "true" reference to absent entities, Lyn et al. (2014) tested bonobos (*Pan paniscus*) and chimpanzees in a setup in which subjects were familiarised with food being stored in two locations while additional food items that could be requested were located outside the testing area (see supplementary material for details). The results showed that most apes pointed at least once to the former location of the food during test trials, thereby meeting Lyn et al.'s (2014) criterion for reference to absent entities.

The two studies discussed above yield contradicting conclusions. More importantly, however, neither of them tested for *reference to absent entities*. Namely, it is unclear whether subjects, apes as well as human infants, in any of the two studies intended their requests to yield a specific object (e.g. "Give me a *grape*") or whether their pointing reflected a more general and unspecific request ("Give me something" or "Do something over there"). In addition to the methodological problems discussed by Lyn et al. (2014), Liszkowski et al. (2009) offered only undesirable objects as an alternative which were most likely ignored by the subjects. There was no need to flexibly adjust the request due to contextual variations. From a functional perspective the request served to obtain a desired object but from a referential perspective it is unclear whether subjects intended this (see also Bates, Camaioni, and Volterra (1975) for this distinction). Equally damaging to the interpretation of Lyn et al.'s (2014) results is the fact that both available locations were deliberately paired with the food items and the procedure rewarded points to both locations. It is conceivable that subjects had simply learned to instrumentally point to those locations to obtain food without them intending to communicate with the experimenter about the intended referent and indeed, data showed that subjects did not differentially point to the two locations.

This means that, as far as we know, whether apes or human infants request *specific* absent entities remains untested. Building on the work of these two previous studies, we introduced the following methodological improvements. First, instead of offering a single desirable option to request, we varied the quality of the alternative option available. Crucially, we made sure that the alternative option, when presented on its own, was still desirable to the subject. The subject should only request the absent option if it is of higher value than the visible option. Second, in contrast to earlier studies we decided to use a procedure in which subjects gained direct instead of observational experience about the relevant aspects of the study.

We presented apes and 12 month-old human infants with two plates on which we placed either objects of different or the same quality. Subjects were then allowed to request these still visible objects one by one from the experimenter (E) by pointing to the respective plate. Once an option was depleted, E refilled this option with objects of the same kind multiple times. Importantly, these additional objects were stored outside the test room and were never visible to the subject. In the critical test trials, instead of refilling the depleted option, E remained seated and waited for the subject to make another request. If subjects were specific in their requests, they should only point to an empty plate when this plate previously contained objects of a higher quality than the still visible alternative. By varying the combinations of options available we ruled out alternative explanations such as associative learning or the use of simple heuristics. Furthermore, we used a