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Infants Communicate in Order to Be Understood

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Infants intentionally communicate with others from before their 1st birthday. But there is some question about how they understand the communicative process. Do they understand that for their request to work the recipient must both understand the request and be cooperatively disposed to fulfill it? On the basis of the study by Shwe and Markman (1997), we developed a new paradigm that tested whether and how 18-, 24-, and 30-month-old children repair a failed request. Children at all ages repaired their requests in the case of a misunderstanding even if they had obtained the requested object already. They also repaired differently depending on the precise reason for the communicative failure (e.g., misunderstanding the referent versus the communicative intent) and did not repair in the case of correct understanding, even if they did not get the requested object. Thus, from very early in their communicative careers, young children operate with a basic understanding of the mental and cooperative nature of human communication.

Keywords: early communication, communicative intention, imperatives, requests, cooperativeness

Infants intentionally communicate with others from before their first birthday. But there is a long-standing debate about how they understand the communicative process. The specific question is whether they already understand communication as a cooperative endeavor to influence mental states. A number of researchers doubt that infants could have such an adultlike understanding of another individual's mental states, let alone the intention to influence mental states to achieve communication. The classic statement of this skeptical view was presented by Shatz (1983), but recently a number of other researchers from different theoretical frameworks have espoused something similar as well (e.g., Carpendale & Lewis, 2004; Csibra & Gergely, 2006; Gómez, Sarriá, & Tamarit, 1993; Moore & Corkum, 1994; Moore & D'Entremont, 2001). For example, Moore and colleagues (1994, 2001) claimed that early communication can be explained by standard learning mechanisms in which, for example, pointing is

reinforced by (positive) adult attention toward the infant. Gómez et al. (1993) suggested that when infants point, they seek to affect the recipient's behavioral, not mental, relation to a referent. And Csibra and Gergely (2006) proposed that infants' early social cognition and communication might not be based on an understanding of others' mental states but only on the detection of certain observable properties of goal-directed action and social contact.

Other researchers have espoused a richer view of infant communication. For example, Golinkoff (1986, 1993), in response to Shatz (1983) and Shatz and O'Reilly (1990), argued that infants from early on communicate in order to achieve a "meeting of minds," that is, to share their experiences, emotions, and desires with other people, and that children want to get their point across independently of achieving material or behavioral outcomes. More recently, starting from a usage-based, social-pragmatic theory of early communication and language (Tomasello, 2003), Tomasello, Carpenter, and Liszkowski (2007) argued and presented evidence that even prelinguistic infants have a basic understanding of the communicative process as a cooperative effort to influence the mental states of others. As one example, Liszkowski, Schäfer, Carpenter, and Tomasello (2009) found that 12-month-old infants who desire an object that is no longer perceptually present will point to the location where it is usually found in order to remind the adult of that absent object on a mental level (see also Saylor, 2004). And Liszkowski, Carpenter, and Tomasello (2008) found that when confronted with a searching adult, 12-month-olds will systematically point to the object whose location the adult does not know rather than to a similar object whose location the adult does know. On the basis of these and similar studies, Tomasello et al. (2007) argued that infants are not just responding to behavioral cues or attempting to influence behavior in their prelinguistic communication, but rather they are really understanding and at-

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tempting to influence the attention and knowledge of others—their mental states.

Tomasello et al. (2007) also argued that infants often communicate for cooperative, not just instrumentally self-serving, motives. Thus, a number of studies suggest that 12-month-olds' pointing is underlaid by such cooperative, prosocial motives as (a) the desire to share attention and interest to external entities with others (expressive declaratives) and (b) the desire to offer needed information to others helpfully (informative declaratives; Liszkowski, Carpenter, Henning, Striano, & Tomasello, 2004; Liszkowski, Carpenter, Striano, & Tomasello, 2006). Moreover, 14-month-old infants assume cooperativeness in the pointing of others, for example, by assuming that an adult's point to a bucket is an attempt to inform them helpfully about the location of a sought-for object (Behne, Carpenter, & Tomasello, 2005)—an assumption seemingly not made by nonhuman primates (Tomasello, 2006, 2008). Nevertheless, Southgate, von Maanen, and Csibra (2007) argued that both forms of infants' declarative pointing can be explained by a more selfish and utilitarian motive, namely, the motive to acquire new information from adults.

An especially important test case for evaluating young children's understanding of, and motivations for, communication is imperatives. Even in adults, at first glance, imperatives would seem to be more concerned with the behavior than the mental states of others, and would seem to be motivated by the selfish desire that the recipient do something that benefits the self. Accordingly, in terms of ontogeny, a number of theorists have opined that even if infants' declarative communication is both cooperative and aimed at influencing others' mental states, their early imperative communication is more focused on behavior than on mental states and is less cooperatively structured than is their declarative communication (Brinck, 2003; Camaioni, 1993; Camaioni, Perucchini, Bellagamba, & Colonnaesi, 2004; Gómez et al., 1993). Camaioni (1993), for example, proposed that with imperatives infants use adults as a kind of social tool to produce a desired outcome based on an understanding of them as causal agents who make things happen, whereas with declaratives they treat the other as a mental (contemplative) agent who understands and has attitudes about things (see also Brinck, 2003). Evidence for this proposal is that (a) imperative pointing emerges ontogenetically before declarative pointing and (b) children with autism (and some apes) point imperatively but not declaratively, suggesting that imperatives are somehow cognitively and/or motivationally less demanding (e.g., Camaioni, Perucchini, Muratori, & Milone, 1997; Camaioni, Perucchini, Muratori, Parrini, & Cesari, 2003; Gómez et al., 1993; Mundy, Sigman, Ungerer, & Sherman, 1986; Tomasello & Camaioni, 1997).

But a number of studies have not found that imperatives precede declaratives in early development (e.g., Carpenter, Nagell, & Tomasello, 1998; Franco & Butterworth, 1996). Moreover, children with autism appear to use different request strategies than typically developing children (Phillips, Gómez, Baron-Cohen, Laá, & Rivière, 1995), and apes' imperatives are arguably used in a different way as well (Tomasello, 2006). Thus, there may be two types of imperative communication based on different understandings of the communicative process (or maybe there is a continuum; Tomasello, 2008). One type is more individualistic imperatives aimed at concrete behavioral results with little or no understanding of how the results are achieved (demands or commands), whereas

the other type is more cooperative requests aimed at getting others to do things by having them understand what is desired, with the assumption that others are naturally cooperative and so will want to fulfill the desire (various kinds of indirect requests). In cooperative imperatives, then, the communicative process of successful requests can be broken down into (a) the recipient's understanding of what is desired and (b) the recipient's cooperative attitude in deciding to fulfill it.

Do young children understand requests in this way? One way to approach this question is by studying children's reactions to communication failures and other forms of miscommunication. In repairing their own failed communicative attempts (e.g., by repetition, reformulation, or clarification), children can show what they think went wrong—thus revealing, in some cases, their understanding of the effective components of the process. Many studies have documented infants' mostly appropriate reactions to miscommunications and young children's ability to repair failed communications appropriately in different contexts and for different listeners (see, e.g., Anselmi, Tomasello, & Acunzo, 1986; Golinkoff, 1986, 1993; Marcos & Bernicot, 1994, 1997; Shatz, 1983; Shatz & O'Reilly, 1990; Tomasello, Farrar, & Dines, 1984; Wilcox & Webster, 1980).

However, there is only one study that has directly addressed the question of children's comprehension of the process of imperative communication: Shwe and Markman (1997) systematically manipulated an experimenter's reaction to children's requests by either understanding or misunderstanding them and then handing over either the requested object or a different object. In the crucial comparison, that is, in the two conditions in which children obtained the requested object (they got what they wanted), children repaired more often (by repeating the object label or rejecting the unwanted object) when they had been misunderstood than when they had been understood. Because children repaired the communicative act even when they had obtained the requested object, the authors concluded that this was evidence for the view that children's goal was to obtain the object via the other person's understanding of their communication.

It turns out, however, that the procedure used by Shwe and Markman (1997) has some methodological and interpretative difficulties. In each of the conditions in their study, children were presented with a pair of objects, one very exciting (a toy) and one very boring (e.g., a sock or shirt). Then children were prompted to request one of the objects from the experimenter. After the child clearly requested an object by pointing, reaching, or labeling, the experimenter placed one of the objects in a bucket on the far corner of the table, leaving only one object in front of the child. Then the adult expressed understanding or misunderstanding of the child's request (according to condition) and either refused or complied with the child's request (e.g., "You asked for the X. I think you want the X. I'm going to give you the Y. Here's the Y."). Only after these utterances did the adult hand over one of the objects. Thus, even in the conditions in which the child got what he or she wanted, the child did not get it immediately but only after a significant delay. Nevertheless, the child's reactions were coded from the moment the experimenter placed one of the objects in the bucket on the far corner of the table, that is, considerably before the child actually had access to the toy.

In a pilot study with 24-month-old children, we replicated these procedures and results, but the problem was that most children

attempted to repair right away, while the adult was still making the utterances that defined the condition. This means that in the crucial condition in which children (eventually) got the requested object but were misunderstood, they may simply have been repeating their request while the adult babbled on with the object still inaccessible. Furthermore, in this crucial condition, children saw the adult holding up the correct object while talking about the distracter object (e.g., holding up the duck and saying, “You want the shirt”). It is thus also possible that children simply were trying to correct the adult’s mislabeling of the toy, not trying to repair their own failed request in a listener-sensitive manner.

A final problem with Shwe and Markman’s (1997) study is their exclusive focus on verbal behavior. At the age of 2.5 years—and even more importantly at younger ages—children’s communication is still based to a large degree on nonverbal actions (Church & Goldin-Meadow, 1986; Marcos & Bernicot, 1994; Özçalışkan & Goldin-Meadow, 2005). Thus, Shwe and Markman might have missed important information by not coding children’s nonverbal communicative behavior. And, of course, because they tested only children of 2.5 years of age, their study cannot answer the question of whether younger children communicate imperatively with an aim to achieve understanding, or rather start off using adults as social tools and then gradually learn about the mental impact of their communication by experience through linguistic or other social interactions.

For all these reasons, we designed a new experimental paradigm improving on the Shwe and Markman procedure and then used it with 18-, 24-, and 30-month-old children. Crucially, in this new procedure children had immediate access to the object (to make sure their reactions were only to the communication), and we examined both their verbal and their nonverbal reactions. We motivated children to request an object from an adult, and the adult then reacted to this request in one of five ways. In the “correct” condition, the adult showed correct understanding of the request and handed over the requested object. In the “happy accident” condition, the adult misunderstood the request but handed over the requested object anyway, accidentally. This is, of course, the crucial condition that enabled us to differentiate between the mere material goal of obtaining the object (which was fulfilled) and the communicative intention to achieve understanding (which was not fulfilled and could potentially be repaired). In the “waiting” condition, the adult showed correct understanding of the request but did not hand over the requested object immediately (children got the distracter object by accident instead). In contrast to Shwe and Markman (1997), however, we did not refuse to give the requested object but instead told children that they would get the requested object in a moment. This condition thus tests whether understanding is enough, at least temporarily, as long as it is clear that the adult intends to be cooperative. In the other two conditions, the adult misunderstood the child’s request and handed over the distracter object, but she did so in different ways, to investigate whether children would repair differently in each case. In the “wrong referent” condition, the adult mistakenly took children to be referring to the distracter object instead of the requested object, whereas in the “wrong intent” condition, the adult correctly focused on the requested object but then reacted as if children had wanted to share attention to this object instead of obtaining it.

We also administered a language development inventory to investigate whether children’s language skills were related to their

pragmatic abilities in our study. According to the social-pragmatic account of language acquisition (Bates, Camaioni, & Volterra, 1975; Bruner, 1983; Tomasello, 2003), young children develop crucial pragmatic abilities before they acquire sophisticated linguistic skills. Thus, their appropriate reaction to the conditions in our study should not be dependent upon a certain level of language acquisition. Social factors, in contrast, could be expected to play a role in children’s capacity to deal with the different communicative situations. Given existing evidence on the influence of day care quality on language development (McCartney, 1984) and the advantageous influence of siblings on theory of mind development (e.g., McAlister & Peterson, 2007), we also collected information about each child’s siblings and time spent in child care to investigate the influence of these factors as well.

Method

Participants

Participants were 60 infants, 20 in each of three age groups: 18 months ($M = 17.29$; range: 17.0–19.0), 24 months ($M = 24.6$; range: 23.0–25.0), and 30 months ($M = 30.5$; range: 29.0–31.0). Half were boys, and half were girls. Participants came from a middle-sized German city and were recruited from a database of parents who had volunteered to participate in studies of child development. For reasons of sensitivity about collecting demographic data in Germany, we did not collect data on ethnicity, race, or socioeconomic status from our participants. The official statistics indicate that the population from which participants were drawn consists of 93.5% native Germans and is predominantly middle class (Statistical Office of the Free State of Saxony, 2009). Two of the children in our sample (3.33%) came from bilingual homes; the other children were from monolingual German homes.

An additional 17 children participated but had to be excluded from the final sample because they had two or more invalid trials ($n = 10$; a trial was invalid if children did not produce a clear request for the object pertaining to the game, or if children simply accepted the wrong object) or because of experimenter error ($n = 6$) or equipment failure ($n = 1$).

Design and Materials

There were five experimental conditions: In two conditions children had access to the requested object immediately, either because they were understood correctly and the experimenter (E1) handed the object over intentionally (correct condition) or because they were misunderstood but obtained the requested object by accident (happy accident condition). In three other conditions, in contrast, children had immediate access only to the distracter object, for different reasons: In one condition they were understood correctly but told that they would get the requested object in a moment (waiting condition), and in two conditions they were misunderstood in one way or another: either by misunderstanding the referent of the request (wrong referent condition) or by misunderstanding the intention of the request as declarative instead of imperative (wrong intent condition). Each child received all five conditions, with one trial per condition in counterbalanced order.

We used five games. The order of games was counterbalanced in such a way that each condition appeared with each game in the

same number of trials. Each game needed four similar objects: Four teddies went into their beds to sleep (for the 18-month-olds they went into a box through a slide), an elephant put on his four shoes to go for a walk, four balls had to go into a box with four holes, a crocodile wanted to eat four bananas, and four cars drove into their garage spaces. In each case, the last of the four objects was the target object of the request interaction. Thus, children were highly motivated to request, and it was always clear which object they wanted. These target objects were chosen to be easy to label for young children, and a post hoc check of the language checklists filled out by the parents confirmed this assumption: Only 15 out of 54 children (twelve 18-month-olds and three 24-month-olds) were reported not to produce all five labels. Each target object was paired with a distracter object that was selected to be very uninteresting to children. The resulting object pairs were thus teddy and dark brown plastic lid; shoe and piece of cloth; ball and piece of crumpled paper; banana and piece of cardboard; and car and small crumpled plastic bag.

Parents were asked to fill out the FRAKIS (Szagun, 2004), a standardized language checklist very similar to the MacArthur Communicative Development Inventory: Words and Sentences. It yields measures of productive vocabulary, inflection and morphology, sentence complexity, and mean length of utterance.

Procedure

After a warm-up play period with both experimenters, children were taken to the testing room. The assistant (E2, male), the

parents, and the children sat on one side of a large table, and the experimenter (E1, female) sat on the other side facing the children, who were seated on their parent's lap (see Figure 1). Parents were asked to sit still and refrain from communicating or intervening during the study. A small spot on the table marked the location where the object would be placed during the test (table target location). This location was well within reach for children and for E1's right hand. The other target location was on a shelf behind E1's left shoulder so that she could reach with her left hand to the shelf and with her right hand to the table target location at the same time. To familiarize children with the target location on the shelf and get them used to requesting objects from E1, five toy animals were placed on the shelf. Children were encouraged by E2 to request the toy animals. For the last two animals, E1 first excused herself from the game, saying that she had to work, and turned around. E2 and the children thus had to call E1 in order to request, just as they would have to do later in the study.

After this short familiarization period, E2 and children turned their backs to the table and played briefly with a small toy that E2 retrieved from his pocket. In the meantime E1 positioned the objects for the first game and condition. Then she turned away and pretended to be busy. E2 and children turned back to the table, and the first trial began. E2 presented the first game, for example, a box with four holes into which would fit four colored balls. He played enthusiastically with children, presenting one ball after the other, each time mentioning the label of the target object (the ball). The play script was designed to be interactive in order to engage and

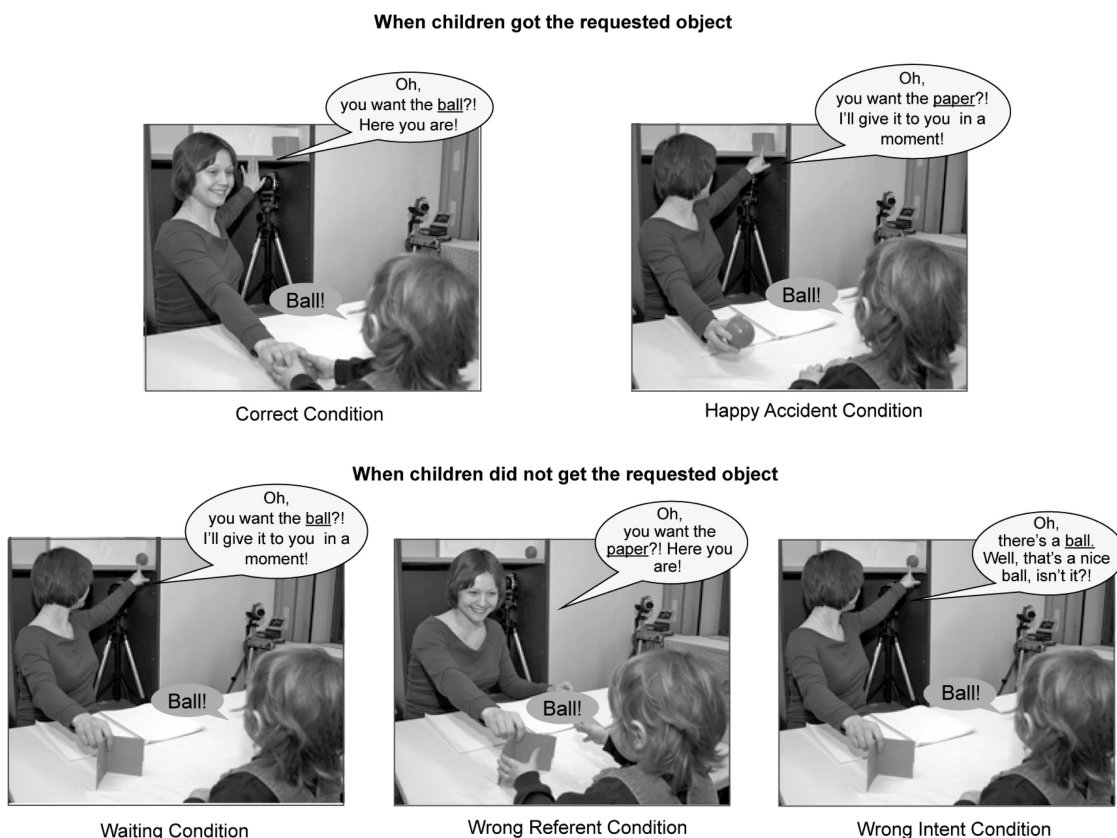


Figure 1. The experimenter's reaction to children's requests in each condition.

motivate children, for example, by asking them such questions as “Which hole should it go in?” and encouraging them to handle the objects. In each game the last of the four objects was missing. E2 started searching for it by announcing, “Oh, the last ball is missing! Where is the last ball?” and rummaging through his box. Meanwhile E1 casually turned around, holding a writing pad in front of her face, pretending to be reading. In her right hand (in front of the writing pad) she had the object that children would get immediately, either the target or the distracter object, depending on the condition. At this point, E2 directed children’s attention to the target object (either in E1’s hand or on the shelf, depending on the condition) and said, “Look! There is the ball!” pointing to it until children clearly saw where the target object was. E2 then encouraged children to call E1 in order to ask her for the target object, saying, “Come on! Let’s call [E1], so she can give us the ball!” As soon as either children or, if needed, E2 called her, E1 lowered the pad, holding the object in her right hand a bit to the side as if not aware of it. She looked directly at children and asked in a surprised and naive fashion what they wanted: “Yes? What is it, [child’s name]?” If children did not request the target object immediately, E1 asked again: “[Child’s name], what do you want?” If children did not request the object after three prompts from E1, E2 repeated his prompt by saying, “[Child’s name], we need the ball! Ask [E1] for the ball!” and E1 immediately followed in by asking, “[Child’s name], what do you want?” This second prompt by E2 was necessary only for 10 out of 288 valid trials. If children still did not request the target object in this second round of prompts, the trial was aborted and, if possible, repeated at the end of the session. As soon as children produced a clear request for the target object (see Coding

section for details), E1 reacted according to one of the five conditions (see Figure 1).

Conditions in which children received the requested object.

In two conditions, children received the object they had requested immediately and were either understood or misunderstood.

Correct condition. E1 held the requested object in her hand; the distracter object was on the shelf. In response to children’s request, she looked at children, held up the requested object, and at the same time announced, “Oh, you want the [ball]!” Immediately, she placed the requested object in the target position on the table (well within reach of children) and marked this action by saying, “Here,” smiling and nodding. After this initial reaction, E1 remained attentive to children, looking at them frequently and smiling, but refrained from reacting to any behavior directed at her. To avoid staring at the children for too long, she pretended to be adjusting her sleeves. Approximately 10 s after placing the object on the table (timed and indicated by E2 using an inconspicuous coughing cue), E1 gave an additional verbal cue, saying, “Hmm. Well. So.” (Some verbal action was necessary to avoid a long, unnatural silence during the response phase. See Table 1 for an overview of the verbal reactions in the different conditions.) She then waited another 7 s and resolved the situation by muttering, “Ah, well. That’s nice,” and turning away from the table, pretending to be busy again. The total length of the response phase was determined through piloting.

Happy accident condition. E1 held the requested object in her hand; the distracter object was on the shelf. In response to children’s request, E1 turned toward the distracter object on the shelf and pointed to it, saying, “Oh, you want the [paper]!” At the same

Table 1
Experimenter Script for Verbal Responses, Actions, and the Timing of Components of the Response Phases (in Seconds) in Each Condition

| Verbal response | Action | Response phase |
|---|-----------------------------------|----------------|
| Correct | | |
| “Oh, you want the [ball]!” | Places requested object on table | |
| “Here.” | Smiles and nods | ~10 |
| “Hmm. Well. So.” | | ~7 |
| “Ah, well. That’s nice.” | | |
| Happy accident | | |
| “Oh, you want the [paper]!” | Places requested object on table | |
| “Yes, I’ll give it to you in a moment.” | Smiles and nods | ~10 |
| “Yeah, just a minute, okay?” | | ~7 |
| “Ah, you wanted the [ball].” | | |
| Waiting | | |
| “Oh, you want the [ball]!” | Places distracter object on table | |
| “Yes, I’ll give it to you in a moment.” | Smiles and nods | ~10 |
| “Yeah, just a minute, okay?” | | ~7 |
| “Here.” | Places requested object on table | |
| Wrong referent | | |
| “Oh, you want the [paper]!” | Places distracter object on table | |
| “Here.” | Smiles and nods | ~10 |
| “Hmm, what’s up?” | | ~7 |
| “Ah, you wanted the [ball].” | Places requested object on table | |
| Wrong intent | | |
| “Oh, there’s a [ball]!” | Places distracter object on table | |
| “That’s a nice [ball]!” | Smiles and nods | ~10 |
| “Hmm, what’s up?” | | ~7 |
| “Ah, you wanted to have it.” | Places requested object on table | |

time, she distractedly placed the requested object (e.g., the ball) in the target position on the table. Then she turned back toward children and said, "Yes, I'll give it to you in a moment," smiling and nodding. After this initial reaction, E1 adjusted her sleeves as in the other condition. Approximately 10 s after placing the object on the table, E1 gave an additional verbal cue, saying, "Yeah, just a minute, okay?" She then waited another 7 s and resolved the situation by saying, "Ah, you wanted the [ball]." This resolution of the misunderstanding indicated to children that their repair efforts (if there were any) were not in vain.

Conditions in which children did not receive the requested object. In the remaining three conditions, children did not receive the object they had requested immediately. They received a distracter object instead, and they received the requested object only after the response phase.

Waiting condition. E1 held the distracter object in her hand; the requested object was on the shelf. In response to children's request, E1 turned toward the target object on the shelf and pointed to it, saying, "Oh, you want the [ball]!" At the same time, she distractedly placed the distracter object (e.g., the paper) in the target position on the table. Then she turned back toward children and said, "Yes, I'll give it to you in a moment," smiling and nodding. After this initial reaction, E1 adjusted her sleeves as in the other conditions. Approximately 10 s after placing the object on the table, E1 gave an additional verbal cue, saying, "Yeah, just a minute, okay?" She then waited another 7 s and resolved the situation by handing over the requested object.

Wrong referent condition. E1 held the distracter object in her hand; the requested object was on the shelf. In response to children's request, she looked at children, held up the distracter object, and, at the same time, announced, "Oh, you want the [paper]!" Then she placed the distracter object in the target position on the table and marked this action by saying, "Here," smiling and nodding. After this initial reaction, E1 adjusted her sleeves as in the other conditions. Approximately 10 s after placing the object on the table, E1 gave an additional verbal cue, saying, "Hmm, what's up?" She then waited another 7 s and resolved the situation by saying, "Ah, you wanted the [ball]," and handing over the requested object.

Wrong intent condition. E1 held the distracter object in her hand; the requested object was on the shelf. In response to children's request, E1 turned toward the target object on the shelf and pointed to it, saying, "Oh, there's a [ball]!" At the same time, she distractedly placed the distracter object (e.g., the paper) in the target position on the table. Then she turned back toward children and said, "That's a nice [ball]!" smiling and nodding. After this initial reaction, E1 adjusted her sleeves as in the other conditions. Approximately 10 s after placing the object on the table, E1 gave an additional verbal cue, saying, "Hmm, what's up?" She then waited another 7 s and resolved the situation by saying, "Ah, you wanted to have it," and handing over the requested object.

Resolution and Follow-Up

In each condition, during the whole response phase (from placing the object on the table until E1 had resolved the situation), E2 was looking away from children. He reacted only to very insistent acts of reengagement in a minimal way.

After resolving the situation, E1 turned away from the table, pretending to be busy again. E2 reacted in a neutral way, saying, "There, you got a [ball]!" and finished the game. Then E2 and children again turned their backs to the table and played with a small toy, so that E1 could surreptitiously place the objects for the next trial. Then E2 and children turned back to the table and started the next game.

After the test, parents were given the language development inventory and asked to complete the questionnaire at home and mail it back within the next 3 days.

Coding

Twelve children had one invalid trial that had to be excluded from analysis. (If a child had more than one invalid trial, that child was excluded as a subject and replaced.) The distribution of these 12 invalid trials with respect to the age groups and conditions in which they occurred was as follows: four 18-month-olds (two happy accident, one wrong intent, one wrong referent), two 24-month-olds (one wrong referent, one happy accident), and six 30-month-olds (three happy accident, one waiting, one wrong referent, one wrong intent). The trials were scored as invalid because children did not produce a clear request, that is, as indicated by pointing to the object, reaching for it, or labeling the object ($n = 1$); because children simply accepted the distracter object ($n = 8$); because they were distracted by the game after producing a request ($n = 2$); or because of experimenter error ($n = 1$).

We started coding when E1 placed the object on the table and stopped coding when she resolved the situation. In the conditions in which children received the requested object first (happy accident and correct conditions), we stopped coding when children had finished the game with E2 because it was very likely that they would request another object at that point.

Main measures. The main measure in this study was whether children repaired the communication. As *repair* we coded all verbal utterances, vocalizations, points, reaches, and showing gestures that were directed at E1 and were not clearly affirmative in nature (as indicated by nodding and/or smiling) or clearly commenting on children's own action (i.e., unrelated to the request interaction; e.g., saying, "Is going to slide," while making the teddy slide; see Table 2 for representative examples of repair behaviors in all conditions and age groups). The communication had to be directed toward E1, as evidenced by looking at E1 while communicating or by contingency with regard to what E1 had just said. Manipulation of the distracter object was coded as a repair only if it was clearly performed in a rejecting manner (e.g., accompanied by "no" or throwing it toward E1) but not if children merely gave the distracter object back to E1.

If children repaired, we further coded whether it was a *single repair* or whether there was more than one repair, in which case it would be coded as *multiple repair*. A single repair instance could consist of verbal and nonverbal communication at the same time. We coded separate instances of repairs only if there was a clear pause or a change of referent (e.g., pointing to one referent but labeling another). This coding yielded an ordinal scale of *repair number* with three levels: no repair, single repair, and multiple repair. We coded repairs in this way, instead of counting total numbers of repair instances in the verbal and gestural mode

Table 2
Representative (Abridged) Examples of Children’s Repair Behaviors for Each Age Group

| Condition | 18 Months | 24 Months | 30 Months |
|----------------|---|---|--|
| Correct | No repairs | C takes toy, looks to E and says, “A toy.”* | No repairs |
| Happy accident | C waits, then takes toy and says, “Toy! Toy!” while looking at E. | C takes toy and waits. After E’s prompt, C is still waiting, looks to E and says, “I have this already!” while showing the toy. | C says, “This one!” and points to the toy. Later: “The toy!” |
| Waiting | C looks around for a while. After E’s prompt, C says, “Toy.” Some seconds later: “Want it!” | C sits and waits, then raises hand slightly to point to shelf, and waits until given toy. | C gestures to game and says, “In there!” then waits until given toy. |
| Wrong referent | C reaches for toy on shelf and vocalizes, throws distracter object away, vocalizes, reaches for toy on shelf and vocalizes. | C says, “Toy!” takes distracter object, puts it aside. C then says, “Toy, too. Toy!” and gestures to game. | C says, “No!” puts distracter object aside, points to shelf, and says, “That. That. Toy! Of elephant,” then points to the game. |
| Wrong intent | C gestures to crocodile’s mouth, saying, “Want it! Want it! Eat!” | C reaches for shelf and says, “Want it!” | C points to toy and says, “There, there, one is missing—a toy!” After E’s prompt, C says, “Can you put it, put it in here?” pointing to toy. |

Note. For easier comparison, we substituted the requested object label (i.e., either teddy, ball, car, banana, or shoe) with “toy” in all examples. C = child; E = experimenter.

separately, because of the general functional approach that we took. Given the nature of the data, counting exact numbers of repairs would have been rather difficult, whereas it was straightforward to decide between no, single, and multiple repairs. Note that this measure is more conservative in terms of differences because all numbers greater than 2 are simply reduced to 2.

Specific measures for matched groups of conditions. For the conditions in which children received the requested object immediately (correct and happy accident), we also measured the latency to turn away from E1 (beginning at the moment E1 placed the requested object on the table), expecting that children would hesitate longer in the happy accident condition even if they did not repair in any explicit way. For the conditions in which children did not receive the requested object immediately (waiting, wrong referent, wrong intent), we measured the latency to repair (beginning at the moment E1 placed the distracter object on the table), expecting that children who repaired in the waiting condition would do so only after some time, while repairing immediately in the two misunderstanding conditions.

Finally, to determine whether children would repair differently when confronted with different kinds of misunderstanding, for the two wrong conditions (wrong referent, wrong intent) we coded the *focus* of the first repair that children produced. We used only the first repair because E1 could not react immediately to children’s repair efforts, and this might cause children to change their strategy. We distinguished two types of repairs. First, we coded repairs that focused directly on the identity of the requested object (*object identity repair*), when children labeled the object, pointed to it, or used demonstrative pronouns such as *that*. Second, we coded repairs that did not focus on the identity of the requested object but rather on some other aspect of the interaction (*interaction repair*), for example, what the requested object was needed for, or what should happen with it. This type of repair was coded when children pointed to the game; said something like “It should go here,” “The crocodile needs it,” or “I want it”; used relevant baby signs (e.g., “clapping hands,” which is often used in

German families as a gesture for “please”); or said their own name. Rejections of the wrong object were not included as repairs in this analysis because they are too unspecific. Instead, the next more specific repair was coded. If verbal and nonverbal behaviors conflicted in terms of focus (e.g., pointing to the requested object but naming the game or pointing to the game but labeling the requested object), we prioritized the verbal information when deciding which category to code (15 out of 120 trials).

All sessions were videotaped and coded by E1 from video clips in which condition cues had been cut out. From the same clips, a random sample of 10 infants (50%) in each age group, 150 trials in all, was coded by an independent second rater who was blind to condition and the hypotheses of the study. Interrater reliability was excellent: for repair, Cohen’s $\kappa = .968$; for focus, $\kappa = .968$; for latency to turn away from E1, there was a strong correlation between the values of the two raters (Spearman’s $\rho = .91, p = .01$), as was the case for latency to repair (Spearman’s $\rho = .81, p < .001$).

Results

For the sake of clarity, we present analyses separately for the conditions in which the children got the requested object immediately (correct and happy accident) and the conditions in which children first got the wrong object but for different reasons (waiting, wrong referent, wrong intent). Comparisons across those two groups are theoretically less interesting, as they would show only whether in a given situation children care whether they got what they wanted.

However, first we tested for potential effects of the different games and gender on the main measure (i.e., whether children repaired) using a generalized linear mixed model with binomial error structure, including game, gender, condition, age, and repair number as fixed factors and subject as random-effects factor. We found no effects of either game, $\chi^2(5, N = 60) = 1.80, p = .88$,

$\Delta AIC = -10$, or gender, $\chi^2(1, N = 60) = 0.07, p = .80, \Delta AIC = -2$.¹

We also checked for potential order and carryover effects of condition. Order effects were tested by calculating correlations for each child between trial number and repair number (i.e., no, single, or multiple repair; this was done for all conditions) and between trial number and reaction time (for the conditions in which children did not receive the requested object only). The mean of the correlation coefficients was not different from zero for either of the measures—repair number: $t(59) = 0.44, p = .66, r = .06$; reaction time: $t(36) = -0.69, p = .49, r = .11$ —indicating that children did not repair more or less as an effect of having gone through more conditions, nor were they getting slower or faster in producing a repair. We also checked for carryover effects (for repair number as the main measure only) by comparing the repair numbers for trials that had a certain condition in the previous trial with those not having this condition in the previous trial. In no age group did any condition have a significant effect on how much children repaired in the following trial (Wilcoxon signed-ranks test; for wrong referent at 30 months: $T^+ = 63.0, N = 12, p = .06, r = .38$; for all other results: $43.5 < T^+ < 100.5, 12 < N < 18, .10 < p < .96, .01 < r < .30$).

When Children Received the Requested Object: Correct and Happy Accident Conditions

Repairs. In the crucial comparison for the question about children's intention to be understood, we found that significantly more children in all age groups repaired at least once in the misunderstanding condition (happy accident) than in the understanding condition (correct), even though in both conditions they obtained the requested object (see Figure 2; for Wilcoxon signed-ranks tests for each age group separately, see Table 3). Children thus clearly showed (a) recognition of the misunderstanding and, importantly, (b) the motivation to repair the misunderstanding independently of achieving their material goal.

We also wanted to see whether this effect differed in strength for the different age groups. To be able to perform a multifactorial analysis on ordinal data, we recoded children's repair responses into a new binary variable by assigning a 0 or 1 value for each repair category; that is, if the child had produced a single repair,

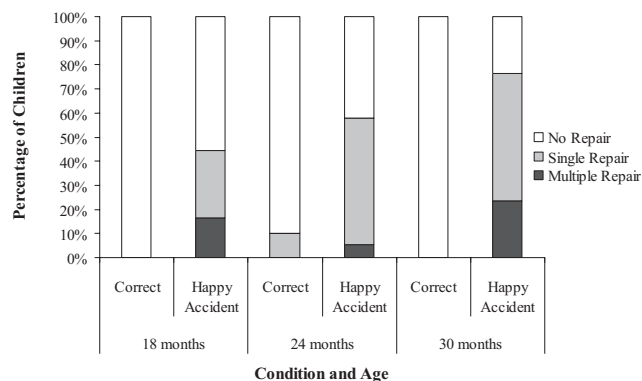


Figure 2. Percentage of children who repaired in each of the conditions in which they received the requested object (correct and happy accident).

the recoded variable would yield three entries: none = 0, single = 1, multiple = 0. Repair was thus entered into the analysis as a pseudofactor. There were no effects of age: Differences between the conditions were of similar magnitude and in the same direction in all age groups (binary logistic regression on the recoded binary response variable with subject, age, condition, and repair as factors; there was no Age \times Condition interaction: $Wald = 0, df = 2, p = 1.00, \Delta AIC = -0.45$).

Latency to turn away from E1. Although children at all ages repaired more often in the happy accident than in the correct condition, there were still many cases in which children did not repair in the happy accident condition, especially in the youngest age group (see Figure 2). We thus conducted an additional analysis to see whether children, specifically those in the youngest age group, who did not repair in the happy accident condition did not care about the misunderstanding or maybe simply did not have the communicative means to respond appropriately. We measured the latency to turn away from E1 for all nonrepairers. With age, children got faster in returning to the game in both conditions; however, children in each age group showed a much longer delay in the happy accident condition than in the correct condition (see Figure 3; repeated measures analysis of variance on logarithmized data because of unequal error variances): Condition: $F(1, 19) = 14.45, p = .001, r = .56$; Age: $F(2, 19) = 5.01, p = .018, r = .44$; Condition \times Age: $F(2, 19) = 1.44, p = .26, r = .06$. This suggests that there was a strong effect of the understanding–misunderstanding manipulation, although on a more indirect measure, even for nonrepairers.

When Children Did Not Receive the Requested Object: Waiting, Wrong Referent, and Wrong Intent Conditions

Repairs. Although in all three conditions they did not get the requested object, significantly more children in each age group repaired in each of the misunderstanding conditions (wrong referent and wrong intent) than in the understanding condition (waiting; see Figure 4; for Wilcoxon signed-ranks tests for each age group separately, see Table 3).

This result indicates that also for very young children, communicative interaction is based on an assumption of cooperativeness: Although they did not achieve their material goal directly, they were satisfied because they received understanding and consent to their request and thus trusted that the adult would ultimately grant their wish. Differences in number of repairs between the two misunderstanding conditions (wrong referent and wrong intent) were not significant (for Wilcoxon signed-ranks test for each age group separately, see Table 3).

¹ Because for mixed models no generally accepted and easily available effect size measures exist, we used difference in Akaike's information criterion (AIC) as a proxy for effect size. The AIC is a measure of how good the model explains the data. The better the model accounts for the data, the smaller the AIC; that is, the model including the factor should have a smaller AIC than the model without the factor. The ΔAIC values we report for an individual variable were calculated as the AIC over reduced model without that factor minus the AIC of a model with that factor. If the ΔAIC is positive and larger than 2, this suggests that the variable has a clear effect (Burnham & Anderson, 2002).

Table 3
Results of Wilcoxon Signed-Ranks Tests for Each Pair of Conditions in Each Age Group

| Condition pair | T^+ | N | | p | r |
|---------------------------------|-------|-------|--------------|------|------|
| | | Total | Without ties | | |
| 18 months | | | | | |
| Correct vs. happy accident | 36.0 | 18 | 8 | .01 | -.43 |
| Waiting vs. wrong referent | 109.0 | 19 | 15 | <.01 | -.47 |
| Waiting vs. wrong intent | 91.0 | 19 | 13 | <.01 | -.53 |
| Wrong referent vs. wrong intent | 6.0 | 18 | 4 | 1.00 | -.06 |
| 24 months | | | | | |
| Correct vs. happy accident | 60.5 | 19 | 11 | .01 | -.43 |
| Waiting vs. wrong referent | 136.0 | 19 | 16 | <.01 | -.59 |
| Waiting vs. wrong intent | 145.0 | 20 | 17 | <.01 | -.53 |
| Wrong referent vs. wrong intent | 185.0 | 19 | 6 | .16 | -.28 |
| 30 months | | | | | |
| Correct vs. happy accident | 91.0 | 17 | 13 | <.01 | -.57 |
| Waiting vs. wrong referent | 105.0 | 18 | 14 | <.01 | -.61 |
| Waiting vs. wrong intent | 120.0 | 18 | 15 | <.01 | -.60 |
| Wrong referent vs. wrong intent | 4.0 | 18 | 3 | 1.00 | -.10 |

To test for age effects, we used the same procedure as described in the previous section. Again, the differences between conditions were of similar magnitude and in the same direction in all age groups (no Age \times Condition interaction; $Wald = 2.8$, $df = 4$, $p = .60$, $\Delta AIC = -1.19$).

Latency to repair. Children generally repaired much less in the waiting condition than in the two wrong conditions. Nevertheless a number of children also repaired in the waiting condition. We hypothesized that this was due to insecurity about the outcome when the time lag became less reasonable—remember that the response phase was approximately 17 s long. Thus, we conducted an analysis of how quickly children repaired—if they repaired—in each of the three conditions. It turned out that indeed in the waiting condition children repaired significantly later than in both wrong conditions, whereas there was no age effect and no significant difference between the latencies to repair in the two wrong conditions (see Figure 5; repeated measures analysis of variance on logarithmized data because of skewed distribution): Condition: $F(2, 28) = 8.78$, $p = .001$, $r = .38$; Age: $F(2, 14) = 1.71$, $p = .22$, $r = .20$; Condition \times Age: $F(4, 14) = 0.75$, $p = .57$, $r = .01$ (post

hoc pairwise comparisons for the effect of Condition: waiting and wrong referent, $p = .005$; waiting and wrong intent, $p = .01$; wrong referent and wrong intent, $p = .06$). Thus, the children who repaired in the waiting condition apparently did so not because they mistook the situation as one of misunderstanding but rather because after a while they became impatient or less sure whether the communication had really worked.

Focus of repair. In the analysis of focus of repair, we explored whether children repaired the different kinds of misunderstanding in the wrong referent and wrong intent conditions in different ways. We compared what children focused on in their first repair, specifically, whether the focus was on the requested object (object identity repair) or something else, for example, the game or the interaction (interaction repair).

Children produced significantly more object identity repairs in the wrong referent condition, where this was the aspect of the communication that had failed. In the wrong intent condition, in contrast, they realized that pointing out the referent again would not solve the problem and instead used interaction repairs to solve the communicative problem (see Figure 6; McNemar test; 18-month-olds: $N_{\text{change}} = 7$, $p = .02$; 24-month-olds: $N_{\text{change}} = 10$, $p = .002$; 30-month-olds: $N_{\text{change}} = 13$, $p < .001$; no child changed in the opposite direction, each Cohen's $g = -0.5$; Cohen, 1988).

Children were thus clearly sensitive to the type of misunderstanding and tailored their repairs accordingly. Differences between age groups were not significant (Fisher's exact test on a combined response variable: $p = .14$, Cramér's $V = .25$).

Influence of Language Abilities, Child Care, and Older Siblings

Next we explored to what extent the pragmatic abilities assessed in our study were dependent upon children's language abilities, number of months spent in child care, and the presence of older siblings. We calculated a pragmatic score out of the responses in the different conditions by assigning one point for each condition in which children showed the correct behavior (i.e., repaired or

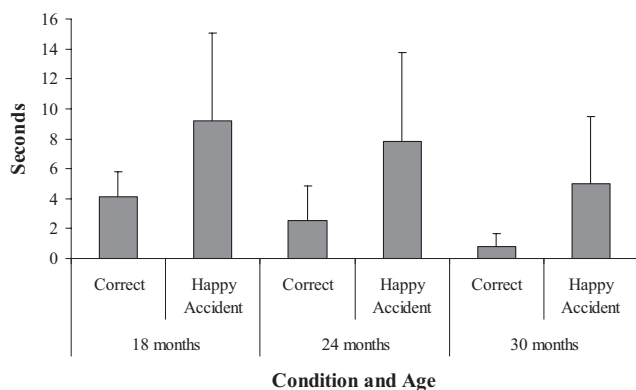


Figure 3. For nonrepairers, mean latency to turn away from the experimenter in seconds (and standard deviations) in the conditions in which children received the requested object (correct and happy accident).

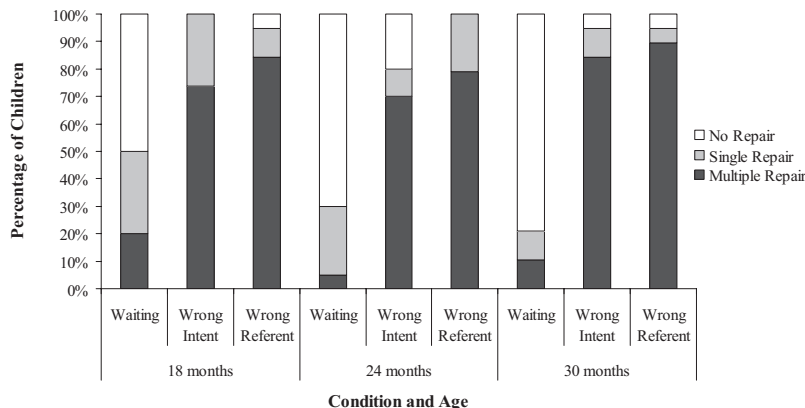


Figure 4. Percentage of children who repaired in the conditions in which they did not receive the requested object (waiting, wrong referent, and wrong intent).

not), plus one point each if they showed the expected pattern of focus in their repair in the latter two misunderstanding conditions (wrong referent and wrong intent). Thus, children could score on a scale from 0 to 7 points.

Data from the child language inventory FRAKIS (Szagun, 2004) were subjected to a principal component analysis that showed that all subscales could be reduced to one powerful principal component, a compound language measure, which we used in the analysis. The three measures (language, child care, and siblings) were analyzed separately for their predictive potential on the pragmatic performance in our study.

Language abilities. We did an analysis of covariance (ANCOVA) along with a partial correlation across all ages because the ANCOVA also allowed us to test for the interaction between the two factors Age and Language to potentially reveal that the relation between language capability and pragmatic score differs between ages. Children’s language abilities were not predictive of their pragmatic performance in our study (ANCOVA with age as factor and language as covariate): Language: $F(1, 48) = 0.24, p = .63, r = .01$; Age: $F(2, 48) = 0.40, p = .68, r = .02$, Language \times Age: $F(2, 46) = 0.94, p = .40, r = .04$. A partial correlation controlling for age also yielded no significant correla-

tion between language abilities and pragmatic performance in our study (partial $r = .06, p = .70, n = 52$).

Duration of child care. The duration of child care did have an impact on children’s pragmatic performance in our study. The effect differed significantly across age groups (see Figure 7; ANCOVA with age as factor and child care as covariate): Child Care: $F(1, 47) = 0.37, p = .55, r = .01$; Age: $F(2, 47) = 0.47, p = .63, r = .02$; Child Care \times Age: $F(2, 47) = 3.89, p = .03, r = .14$.

For the youngest children we found a negative correlation between months spent in child care and pragmatic performance, whereas for the two older age groups there was either no correlation or a tendency for a positive correlation (18-month-olds: Pearson $r = -.48, p = .039, n = 19$; 24-month-olds: Pearson $r = .36, p = .141, n = 18$, 30-month-olds: Pearson $r = .45, p = .078, n = 16$). We discuss this finding below.

Siblings. Finally, we compared the pragmatic performance of children with older siblings and children without older siblings. Younger siblings were not taken into account, as children in our youngest age group were only 18 months old themselves, and younger siblings in this case would probably not be of great help in developing pragmatic competence. For all age groups, older siblings exerted a positive influence on the pragmatic performance in our study (two-way analysis of variance): Siblings: $F(1, 49) =$

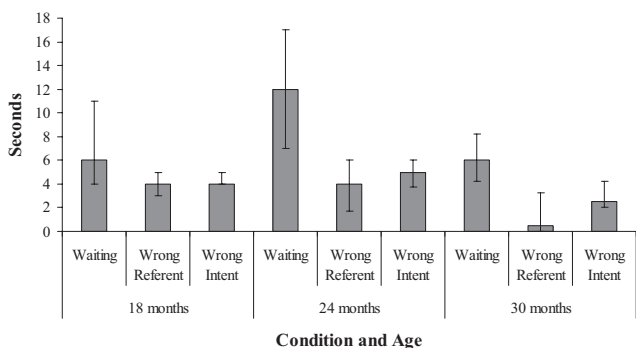


Figure 5. Medians and quartiles for latency to repair in the conditions in which children did not receive the requested object (waiting, wrong referent, and wrong intent). Error bars indicate first and third quartiles.

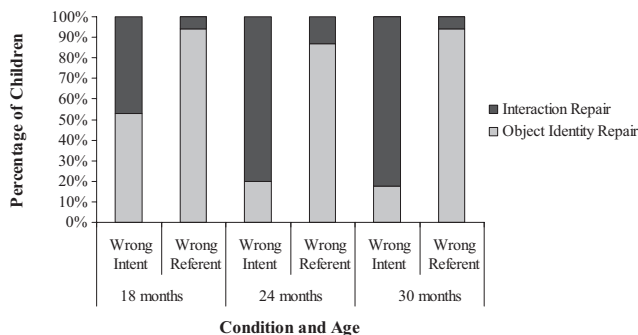


Figure 6. Percentage of children whose repairs focused on object identity versus interaction in the wrong intent and wrong referent conditions.

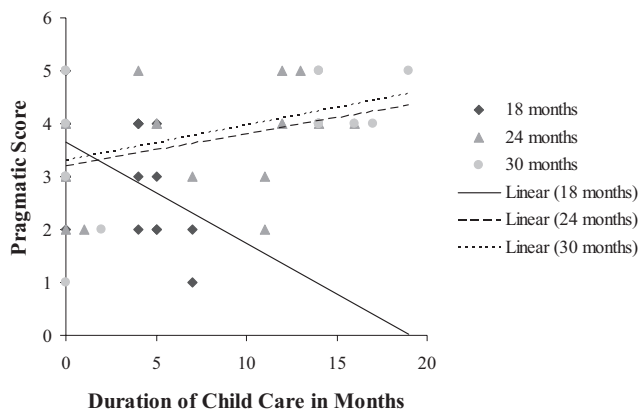


Figure 7. Relation between pragmatic score in our study and months spent in child care for each age group.

6.93, $p = .011$, $r = .12$; Age: $F(2, 49) = 0.24$, $p = .79$, $r = .01$; Siblings \times Age: $F(2, 49) = 1.04$, $p = .36$, $r = .04$.

Discussion

In this study 18-, 24-, and 30-month-old children reacted differently in a request interaction depending on whether they had been understood correctly— independently of whether they obtained the requested object. In one pair of conditions, children obtained the requested object immediately but were either understood correctly or misunderstood. Children still repaired the misunderstanding even though they had achieved their material goal of obtaining the requested object. In three other conditions, children were given a boring distracter object first and were understood or misunderstood in different ways. Here they repaired much less when the experimenter understood them correctly and agreed to give them the object (even though they had not yet achieved their material goal) than in the two misunderstanding conditions.

This pattern of results clearly indicates that young children act with the understanding that communication is a manipulation of others' mental states that works by making the recipient know what one wants. They thus do not regard a request as successful solely on the basis of the material outcome: They still try to achieve understanding even if they have already obtained the requested object. They also refrain from repairing even if they have not received the requested object, as long as understanding and agreement have been expressed.

The fact that even the 18-month-old infants showed this pattern of results for all measures, and that their results were as strong as those of the older children, supports the view that young children have sophisticated social-pragmatic skills even before language development has really gotten moving (Bates et al., 1975; Bruner, 1983; Tomasello, 2003). The finding that children's language abilities were not correlated with their pragmatic performance in our study strongly suggests as well that young children can solve communicative problems quite well without sophisticated linguistic abilities. This finding is also in line with previous findings that pragmatic and linguistic abilities develop separately (Blank, Gessner, & Esposito, 1979; Dale, 1980; Snyder, 1978).

In contrast, social factors such as months spent in child care and presence of older siblings did affect children's pragmatic abilities. Child care, specifically, seems to be negatively related to the pragmatic development of very young children. Presumably this is because the input and interaction children can get in typical German child care centers (with up to 10 infants per caregiver) is less structured and scaffolded than what they get from direct one-on-one interaction with a parent. For older children, however, there is no or even a slight positive relation to duration of child care, probably because older children have reached a stage in their communicative development where they need less scaffolding and thus can interact meaningfully with other children. Interacting with peers or older siblings could be beneficial because children have to work harder to make themselves understood with other children than with adults. This hypothesis is further supported by our finding of a positive influence of older siblings on children's pragmatic performance. Given the advantageous influence of siblings on theory of mind development (McAlister & Peterson, 2007; Perner, Ruffman, & Leekam, 1994; Woolfe, Want, & Siegal, 2003), this may also reflect the importance of understanding others' minds for appropriate communication (see also Bates, 1976; Ninio & Snow, 1996; O'Neill, 2005).

Whereas in the original study by Shwe and Markman (1997), on which our study was based, alternative interpretations of the repair behavior in the crucial happy accident condition were quite plausible, these could be ruled out in our study. That is, in the study by Shwe and Markman, children had physical access to the requested object only after the experimenter had expressed her understanding. As our pilot study showed, most children reacted even before the object had been placed on the table. Thus, it could be that children were repeating their request because they did not have the requested object yet and wanted to make sure they would get it. In our main study, however, the object was placed simultaneously to the expression of understanding. Children obtained the requested object right at the beginning of the response phase, which renders this alternative interpretation implausible.

Another problem in Shwe and Markman's (1997) study was the artificial nature of the procedure, especially when the experimenter held up one object but labeled the other object while looking at children. Because Shwe and Markman coded only label repetitions, these might even be interpreted as repairs of the experimenter's mislabeling of the toy. In our study, in contrast, there was always alignment of attention and label to one of the objects, which should have prevented children from interpreting the misunderstanding as an accidental mislabeling. It becomes most clear in the verbal reactions of the 30-month-old children—who are naturally most advanced in their verbal repertoire—that they were not repairing the label, but instead the object they wanted, when they said, for example, "I have it!" or "This one," while showing the requested object to the adult. The current study thus is the first to show unambiguously that infants from 18 months of age communicate in order to achieve understanding.

In the two wrong conditions in our study, children demonstrated that they were well able to analyze in detail the feedback they got and react accordingly: If the misunderstanding was based on reference to the wrong object, they mainly tried to repair the referent of their request, whereas if the misunderstanding was about their communicative intent, children mainly repaired this instead. This result complements previous findings on children's

reformulations of their requests (Anselmi et al., 1986; Marcos & Bernicot, 1994; Wilcox & Webster, 1980) by showing that children this young are able to differentiate appropriately between a miscomprehension of the intent only and a miscomprehension of the referent only, with no clarification request needed to discover the nature of the misunderstanding.

From a theoretical perspective, our results support the cooperative communication model (Tomasello, 2008), which posits that humans, even in imperative communication, rely on cooperativeness in order to achieve their instrumental goal. Along with wanting to have the object, children want to be understood in their communicative attempt. In the waiting condition, children did not receive the requested object but did not repair, because the experimenter expressed understanding of and willingness to fulfill their request. This strongly suggests that the fulfillment of the material goal is normally sought via achieving understanding. But it is only reasonable to choose this way of pursuing a material goal if one can rely on the cooperativeness of the communicative partner, that is, assuming that the other will be willing to fulfill one's desire when he or she knows what it is. Thus, in the waiting condition, because the adult understood their request and agreed to it, they should now trust that the adult will fulfill their request—there is nothing left to repair. Additionally, the fact that children do repair in cases in which they did obtain the requested object but have been misunderstood clearly indicates that they already have a separate intention to be understood.

These findings argue against the idea that children's early imperatives are cognitively leaner and motivationally more egocentric than their early declaratives, as has been proposed by various researchers (Brinck, 2003; Camaioni, 1993; Camaioni et al., 2004; Gómez, et al., 1993). Such approaches, like the social tool account (Camaioni, 1993), allow only for communication that is a direct and causal manipulation of another's behavior, not one's mental states—so, under these accounts, repairing a misunderstanding when the outcome has already been achieved should simply never happen. On a behavioral level, both outcome-oriented individual imperatives and cooperative imperatives aimed at understanding might seem quite similar. It is thus conceivable that the similar-looking imperative pointing gestures in great apes (Gómez, 2005; Leavens & Hopkins, 1998) and in special human populations such as children with autism (Camaioni et al., 2003) might be based on a different set of intentions and motivations. After all, there is a considerable amount of empirical evidence that typically developing infants communicate with a rich understanding both in declarative (see Tomasello et al., 2007, for a summary) and, as we have seen here, in imperative speech acts (see also Liszkowski et al., 2009), whereas apes and children with autism typically do not point declaratively, and apes, at least, also do not comprehend similar types of cooperative communication (see, e.g., Tomasello, 2006). Therefore, it remains to be investigated whether their imperative communication has the same underlying "intention to be understood" based on an assumption of cooperativeness as does the imperative communication of young children.

In summary, this study is the first to present evidence that children from 18 months of age have the separate intention to achieve understanding over and above achieving their material goal. Their communication is thus aimed at manipulating others' mental states based on an underlying assumption of partner cooperativeness.

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