

## Two sources of meaning in infant communication: preceding action contexts and act-accompanying characteristics

Ulf Liszkowski

*Phil. Trans. R. Soc. B* 2014 **369**, 20130294, published 4 August 2014

---

### References

[This article cites 50 articles, 6 of which can be accessed free](#)

<http://rstb.royalsocietypublishing.org/content/369/1651/20130294.full.html#ref-list-1>

### Subject collections

Articles on similar topics can be found in the following collections

[cognition](#) (352 articles)

### Email alerting service

Receive free email alerts when new articles cite this article - sign up in the box at the top right-hand corner of the article or click [here](#)



## Review

**Cite this article:** Liszkowski U. 2014 Two sources of meaning in infant communication: preceding action contexts and act-accompanying characteristics. *Phil. Trans. R. Soc. B* **369**: 20130294. <http://dx.doi.org/10.1098/rstb.2013.0294>

One contribution of 12 to a Theme Issue 'Language as a multimodal phenomenon: implications for language learning, processing and evolution'.

### Subject Areas:

cognition

### Keywords:

common ground, prosody, markedness, gesture, prelinguistic, social cognition

### Author for correspondence:

Ulf Liszkowski

e-mail: [ulf.liszkowski@uni-hamburg.de](mailto:ulf.liszkowski@uni-hamburg.de)

# Two sources of meaning in infant communication: preceding action contexts and act-accompanying characteristics

Ulf Liszkowski<sup>1,2</sup>

<sup>1</sup>Developmental Psychology Unit, Institute of Psychology, University of Hamburg, Hamburg, Germany

<sup>2</sup>Max Planck Research Group Communication before Language, Max Planck Institute for Psycholinguistics, Nijmegen, The Netherlands

How do infants communicate before they have acquired a language? This paper supports the hypothesis that infants possess social–cognitive skills that run deeper than language alone, enabling them to understand others and make themselves understood. I suggested that infants, like adults, use two sources of extralinguistic information to communicate meaningfully and react to and express communicative intentions appropriately. In support, a review of relevant experiments demonstrates, first, that infants use information from preceding shared activities to tailor their comprehension and production of communication. Second, a series of novel findings from our laboratory shows that in the absence of distinguishing information from preceding routines or activities, infants use accompanying characteristics (such as prosody and posture) that mark communicative intentions to extract and transmit meaning. Findings reveal that before infants begin to speak they communicate in meaningful ways by binding preceding and simultaneous multisensory information to a communicative act. These skills are not only a precursor to language, but also an outcome of social–cognitive development and social experience in the first year of life.

## 1. Introduction

Research into the nature, origins and acquisition of language assumes that linguistic communication rests on some earlier forms of non-linguistic communication. These earlier forms enable the transmission, acquisition and appropriate use of shared linguistic codes in the first place. One way to test this assumption is to ask how infants communicate before they have acquired a language. Infants gesture with their hands, their body, their face and eyes, approach and touch others, make noise and vocalize, long before they begin to speak. Like adults, who gesture along most of the times when they speak [1], infants too use multiple modalities when interacting with others. This suggests that language does not originate in the vocal modality alone [2,3]. The ontogenetic origins of adults' gesture–speech system have been traced back to the prelinguistic period during which infants systematically couple their prelinguistic visual–gestural and auditory–vocal behaviour [4,5]. However, it has remained less clear whether and how infants interact with others in any meaningful way before they have acquired a language. Engaging in meaningful interactions requires one to understand what others have in mind and react appropriately as well as to express one's own thoughts successfully to be understood. Accordingly, the ontogenetic argument is not only that infants communicate before they speak, but that they also already have some social–cognitive understanding of what others mean, what they intend, want, see, think and understand [6].

How do infants understand others before they have acquired a language? If language rests on a social–cognitive core of mutual understanding, then the process of mutual understanding in prelinguistic communication should resemble that in linguistic communication. Findings from experimental

pragmatics show that adults infer and transmit meaning from two main sources of extralinguistic information (i.e. outside syntax and semantics). One source is the preceding linguistic discourse and action context that modulate how speakers situate and express a thought, and how recipients interpret utterances [7]. For example, the utterance 'I am a scientist' might describe my daily occupation. But given the appropriate context, it could also be used to express refusal to participate in occultism. A second source of information stems from the *style* in which one expresses an utterance. Accompanying characteristics of utterances such as the prosody, facial expressions or other bodily movements modulate meaning by emphasizing what is relevant (e.g. 'I am a scientist' versus 'I am a *scientist*') or expected (e.g. compare the statement 'It's really warm' uttered with a tone of sarcasm versus uttered sincerely) [8].

Do infants use these two sources of extralinguistic information to understand what others mean and have in mind? In this paper, I will first briefly review recent evidence which shows that infants' production and comprehension of communication are vastly influenced by preceding action contexts. These studies provide a solid basis for the argument that infants understand others based on preceding and embedded shared activities. It is less well understood whether infants understand others exclusively on that basis, or whether infants also understand something about the communicative actions themselves, that is, whether infants have expectations about the form and characteristics of communicative acts independently of meaningful contexts within which they are usually embedded. In the main section of this paper, I therefore address the latter question of whether infants understand communicative acts based on characteristics alone. This source of information is especially important when information from preceding action contexts is lacking or does not sufficiently distinguish meaning, a situation that infants face quite often. A less situational understanding of communicative acts might perhaps signal a first step towards form–meaning relations, as required for word learning.

In addressing the latter question, I summarize novel findings from my laboratory which suggest that before they speak, infants infer others' social intentions from the characteristics of an act alone, and express their social and referential intentions by marking their communication with different intonations, gesture shapes and modalities.

Because this paper focuses on the cognitive question of how infant communication works, the corresponding age range falls somewhere between the onset of intentional communication at around 10–12 months of age [9] and the onset of two-word combinations towards the end of the second year, when infants begin to rely on language more so than gesture [10] and develop symbolic understanding more fully [11]. The findings also raise developmental questions about the origins of these skills. But the evidence is still scarce, and I therefore limit myself to briefly discussing at the end of each section possibilities that derive from the current approach and findings. As already alluded to, there is much more to say about developmental relations to language acquisition, and the current approach, in fact, builds on theories that treat social cognition and interaction as a necessary foundation for language acquisition, and on numerous findings that reveal developmental relations between infants' communicative behaviours and language acquisition. To name a few, infants' gestures and shared activities are longitudinally

related to their word learning [9,12,13], beginning syntax [10] and vocabulary at 5 years of age [14]; children with autism who never fully develop language also do not point or engage in non-verbal shared activities to begin with [15] and infants' interaction is longitudinally related to children's talking about others' mental states at 4 years [16]. The question that has remained, however, is how infant communication actually works, that is, how infants communicate and make meaning before they use language in earnest. It is this question I return to in the following sections.

## 2. Infants' use of preceding action contexts

Over the past decade, research has converged to show that infants in the second year of life interpret others' communicative actions flexibly, depending on the concurrent and preceding action contexts in which they occur. These findings are closely linked to a recent body of literature suggesting 'theory of mind' understanding in infancy (for a review, see [17]). Here, I summarize key experimental findings to briefly illustrate how infants use shared action contexts in their comprehension and production of communication. All these experiments are carefully controlled, usually including several control conditions, and they manipulate the shared background within which communication takes place.

### (a) Comprehension

First, imitation studies showed that 18-month-olds copy from one and the same communicative action demonstration either specific aspects of the style or the outcome depending on what the actor has previously presented as relevant or new. For example, when it was demonstrated that a mouse hopped into a house, but the outcome of the mouse in the house had been communicated previously, infants focused more on imitating the action style (hopping) than the outcome alone, suggesting sensitivity to communicative relevance [18]. Further studies tested infants' comprehension of ambiguous requests. In those studies, at the moment of test it was ambiguous to what in an array of items an adult's request referred. Different preceding shared action contexts allowed for different interpretations of the referent. Findings from a variety of methods were that 12–14-month-olds infer different referents depending on what the adult has done or seen before, i.e. whether the requester had expressed a preference for one object, had not yet seen one object or had just lost an object [19–22].

Perhaps most interesting in this respect are pointing gestures, because pointing itself only directs attention to a region in space, but leaves open the question to *what* the pointer refers (the referential intention) and *why* he refers to it (the motive or social intention) [23]. In one study [24], an experimenter pointed to one of two boxes, each containing a hidden toy, to request it from infants. Seventeen-month-olds had no problem inferring that the point to the opaque box referred to the object inside (and not to the box itself; for similar results with 12-month-olds, see [25]). However, when the objects were swapped unbeknownst to the experimenter, and she then pointed to a box, infants apparently inferred the object she had in mind, namely the one that was now in the other box, and offered that object. The reviewed findings thus reveal infants' flexible understanding of reference. However, infants also interpret flexibly why

someone points to an otherwise identifiable referent. For example, 18-month-olds may interpret a point to a puzzle piece as a directive to complete the puzzle; or as a directive to clear away the puzzle piece, depending on whether they have previously interacted with the pointer about the puzzle or a clearing activity [26].

### (b) Production

Similar to infants' flexibility in interpreting others' communicative acts, infants also initiate communication flexibly, depending on the recipients' current and past actions and perception. For example, 12-month-olds will point to an interesting event to initiate an interaction depending on the recipients' present and past attentional states [27,28], his interest in the events [29] and her preferences about specific kinds of objects [30]. Eighteen- to 24-month-olds, and in some circumstances also 12-month-olds, even intervene flexibly in anticipation of the success or failure of an actor's expected instrumental action that has not taken place yet [31–33]. In the latter studies, an experimenter acted in accordance with outdated information about reality, resulting in mistaken actions. For example, after an unseen object transposition, she would search in a wrong place; or touch something she wanted to avoid. No responses were elicited from infants. However, infants apparently anticipated these 'mini-disasters' spontaneously and intervened to correct or warn the adult by pointing out the relevant missing information before she would commit the mistake. Importantly, infants did this only in conditions when the new information was relevant to both the actor's motivational and her epistemic states.

### (c) Summary and developmental outlook

The experimental manipulations all converge to show that, from around 12 months of age, infants begin to engage in a seemingly adult version of mind-reading when communicating with others, regarding both comprehension and production. They infer *what* others communicate about, and *why*; and they flexibly situate their own actions in meaningful ways considering what others want, see or think. What infants are doing in these communicative situations is to flexibly predict the behaviour of others—the essence of a 'theory of mind', see [17]—by binding action-relevant information from preceding action contexts to the communicative act.

Still, little is known about the emergence of these skills. One thing to note is the apparent absence of experimental studies that manipulate preceding shared action contexts before 12 months of age, perhaps because infants' communicative means are more limited at that age. While one view emphasizes the change towards the end of the first year as revolutionary and an evolutionary adaptation unique to our species [6], ontogenetic findings may also suggest more gradual development over the first year of life [17], which starts out with simple action expectations about common actions (e.g. being picked up at four months [34]), testing of actions contingent to one's own actions (around three months; [35]), and expectations about others' object-directedness and line of regard [36]. In this respect, communicative means in the first year of life arise from simple action expectations within social situations. The use of shared action contexts for meaningful communication emerges through further communicative experience and action understanding. Consistent with this view, infants' skills appear to consolidate in the first half of

the second year, with some of the reviewed studies suggesting more competence in 18- compared with 12-month-olds. However, one should note that task demands vary substantially between these studies, and that several studies reveal a clear influence of shared action contexts on communication already at 12 months of age. More studies are needed to understand the role of shared action contexts before 12 months of age.

## 3. Infants' use of act-accompanying characteristics

The reviewed findings in §2 have shown that one-year-olds communicate meaningfully by relying on a background of shared action contexts. What has remained less clear is what infants actually understood about the communicative signals themselves. This is the same problem when estimating word comprehension from everyday interactions, because words are rarely uttered out of context, and so infants may sometimes appear good at comprehending verbal messages simply because the shared or recurring social situations are meaningful on their own. Looking at the reviewed studies, it is entirely possible that infants responded to the shared contextual situations alone rather than to the gesture itself. For example, in response to a searching adult, 12-month-olds provided information [22], but given enough preceding action-relevant information, they provided the information even without any solicitation [31–33]. Indeed, it would seem plausible that infants sometimes offer an object to an adult just like that, for example when it has just fallen down, or is new to the adult, or has changed locations unbeknownst to the adult. Perhaps they will do so more after an ostensive look, but certainly without always having to see the adult communicate her intention explicitly with a reach, or a palm-up beg, or a point.

The question is thus whether infants can also infer others' intentions from the communicative act alone. To test this, one needs paradigms that exclude or control for conclusive shared action contexts. If infants had some understanding of others' communication that was less situational, then this would help infants engage in a broader range of interactions given that a shared action context is often minimal or difficult to construct for infants. Social-cognitively, it would show that infants have a more abstracted understanding of the meaning of a communicative act itself, perhaps signalling a first step towards form–meaning relations, as required for word learning.

Given that communication is multimodal, encompassing gesture, vocalizations, prosody, facial expressions and so forth, infants might use multiple sources of information that accompany a communicative act to infer its meaning. A number of studies have recognized and investigated the role of multimodality in infants' word learning. In spoken languages, word learning most often requires crossing from the auditory to the visual modality to establish the link between word and referent. Several studies show that intersensory redundancies facilitate word learning [37], that caregivers structure infants' attention through visible ostensive acts, such as moving an object, touching or placing it, and naturally through distinct prosodic characteristics of the voice ([38,39] among others). All these multimodal cues help one-year-olds to associate an object with its label (usually assessed in fast mapping paradigms). Curiously, when the label itself is multimodal and consists of a spoken



word and a visual sign, and infants' mapping is later tested on the unimodal dimension of the label, 15-month-olds are better with the spoken than the visual label, suggesting that when given the choice it is easier to map a visual referent to an auditory label than to a visual label [40]. While most of these studies are specific to word learning, they do not speak to the question of whether infants use different accompanying characteristics of a non-verbal act to narrow down its referent. To date, one recent study suggests that 2–3-year-olds understand the markedness of a communicative act when inferring the intended referent [41]. It is unknown whether infants also use markedness to infer the social intentions underlying a communicative act. Further, very little is known about how infants themselves might use act-accompanying characteristics to mark their own social intentions or narrow down a referent. This would seem especially relevant considering that infants mostly communicate with deictic gestures, such as pointing, which do not carry any meaning in themselves. In support, a recent study reveals that 4-month-old infants flexibly produce the same vocalizations with different types of facial affect, and apparently in different situations, suggesting that these facial accompaniments allow for different inferences and distinguish meaning, although the intentional use has not been established at this early age [42]. In §3a–c, I present novel findings that speak to these issues, first with regard to infants' comprehension, then production.

### (a) Comprehension

Together with Nuria Esteve-Gibert and Pilar Prieto, we have recently conducted a number of experiments to investigate whether characteristics such as prosody and gesture shape help infants comprehend others' communicative intentions. In a first study [43], we asked whether parents naturally accompany their attention-directing acts for infants with distinct characteristics that convey distinct meanings. Establishing these differences in infants' input is a first step in further investigating whether infants may use this information in comprehension. Nuria visited parents at home ( $n = 9$ ) and invited them to engage their infants (mean age: 13 months) in three types of play scenarios based on the three types of motives underlying prelinguistic communication (expressive, imperative and informative intentions; see [16]). In the request game, parents were instructed to ask their infants to give them an out-of-reach toy in the course of stacking toys together. In the search game, parents were asked to inform the infant of a hidden toy under one of two cushions. In the sharing game, parents were told to share interest with their infants in new pictures that appeared on a screen. Crucially, the instructions did not mention *how* parents should achieve these goals. In about 10 repetitions of each game, we measured whether parents used attention-directing gestures, the form of the gestures, prosodic characteristics such as pitch range, syllable duration and intonation contours, and word types accompanying a gesture (noun, verb, locative and pronoun).

The main findings were that parents mostly used speech–gesture combinations (about 70%), and that their acts were statistically significantly distinct in each play scenario across the parameters we measured. Parents clearly marked their social intentions with distinct prosodic characteristics and gesture shapes, which thus added distinct information to the information from the shared game activities. For example, in



**Figure 1.** 'What's the point?' Parent and infant play with a stacking toy. From the right, a stick with an upside-down cake cup is brought into the scene. The parent has been instructed either to request it; to share interest in it or to inform about a hidden sticker under it. We measured infants' appropriate behaviour respectively as mostly offering the cup; or sharing attention to the cup; or lifting the cup in search for something else. (Online version in colour.)

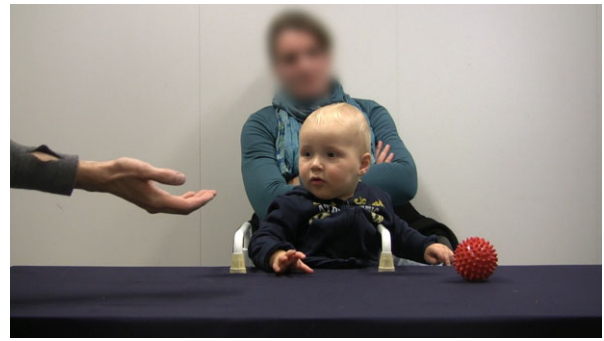
the request game, parents predominantly used a palm-up pointing gesture, whereas they mostly used the extended index finger in the other two games. Parents rarely used the palm-down pointing gesture, which infants often use in imperative situations (see also §3b). In the sharing game, the pitch range was the widest and the syllable duration the longest; in the search game, the pitch range was the smallest and in the request game, the syllable duration was the shortest. The two most frequent intonation contours (out of six analysed) in each game also patterned significantly differently from each other, and the word types coinciding with the gestures differed according to the underlying intentions, with mostly nouns in the sharing game, mostly verbs in the request game and mostly locatives in the search game. Pronouns were rare but occurred exclusively in the request game.

Infants responded mostly appropriately in these situations. However, the situations could not be controlled as carefully as in a laboratory, including imbalances in the position of referents and distractions from the home environment. Further, information from accompanying characteristics was confounded with information from the accompanying shared action scenarios. In a follow-up, we therefore took the paradigm to the laboratory to better control for the differences in the spatial layouts, the distances to referents, etc. [44]. Crucially, we wanted to know whether infants would react appropriately to parents' natural marking of intentions when the shared action context did not provide any additional clues to discern what parents meant. To this end, we used the same action context across conditions and made sure that the information from the action context alone was minimal and remained ambiguous to interpreting the communicative act. We tested eighteen 12-month-olds. Infants sat 90° to their parents at a table. Opposite the parents sat an experimenter hidden behind an occluder. At certain moments in the procedure (eight trials), she slid a stick with a plate at its edge over the table, so that it would stop on the infants' side opposite from the side where the parent sat. Infants and parents engaged in a task-irrelevant staple or bead game for most of the time and so usually did not see the plate arriving. On the plate was an upside-down cake cup of a different colour on each trial (figure 1). Parents had been assigned to different groups and had been

instructed on a general level either (i) to express their interest in the newly appeared cup; (ii) to request the cup or (iii) to inform about a hidden sticker under the cup. As in the previous study, they were not told how to realize the task. We measured whether infants would mainly attend to the cup; offer the cup; or remove the cup in order to look at the hidden sticker (or explore the stick or cup intensely). If infants understood something from the communicative act, we expected infants to offer the cup more in the requestive than the other two contexts; to attend (and point, smile or otherwise express interest) to the cup more in the expressive than the other two contexts; and to try to find the hidden sticker or other properties under/inside the cup more in the informative than in the other two contexts. A reliability coding established high agreement across our measures.

The main findings confirmed our prediction. Apart from a general tendency to attend to the cup in all conditions, infants behaved in a statistically significantly different manner across conditions following the expected pattern. They offered the cup more in the requestive than in the other two contexts; they explored the sticker more in the informative than the other two contexts; and they attended to the cup more in the expressive than in the other two contexts. This finding reveals that infants at 12 month of age comprehend an adult's social intentions on the basis of varying characteristics of the communicative act alone, irrespective of a task-specific shared activity (recall that the activity and environmental situation were the same across conditions). We replicated this finding in a second experiment in which we controlled in addition for the semantic content and substituted the parent with a trained experimenter. She copied the main characteristics of parents' acts, but she said the exact same words across the three conditions. This was of course a more stringent test on infants' understanding, because the information was further reduced by the somewhat more artificial act. However, results revealed the same expected pattern, replicating the previous experiment. These findings thus indicate that infants extract information about an adult's social intentions from the prosody and gestural features of the act alone, independently of linguistically specified information or a common background of shared activity.

In a third study, Guðmundur Thorgrímsson and I extended the previous questions and asked whether 12-month-olds would make different inferences about distinct gestures and react appropriately also when there were no shared action context, no accompanying language and no other characteristic expressions than the plain gestures in the physical layout of the scene [45]. In the experiment, infants sat at a table opposite an experimenter, and a second experimenter sat perpendicular to the infant-experimenter axis. The first experimenter simply gave infants a toy to explore for a minute, so they could get sufficiently familiar with it. After that, the experimenter retrieved it for a moment, placed it back within infants' reach either to their left or right side, and then bent down behind an occluder. The object was thus either close to or far from the second experimenter, who sat unengaged to the side. He would then act in one of three ways and extend his hand towards the object (but never touching it). His acts came sort of 'out of the blue' (figure 2) and were not embedded in a specific ongoing shared activity and not accompanied by distinct



**Figure 2.** 'Out of the blue'. The infant has been familiarized with a ball, which is then placed either to the left or right side of the infant. A previously mostly unengaged experimenter sitting either on the left or right side then extends the arm without vocal accompaniments either with a cupped hand palm up; or palm down or with an extended index finger; or does not produce any gesture. We measured infants' propensity to offer the object as a function of gesture and distance to the object. (Online version in colour.)

language or vocalizations. We were interested in three types of hand shapes: cupped palm-down hand ('reach'); cupped palm-up hand ('beg'); and extended index finger ('point').

While information-processing studies show that infants understand an extended palm-down hand as a goal-directed act [36], infants rarely experience this gesture in interaction (see above), so that we were interested in whether infants would use this understanding to react appropriately by offering an object in response. To this end, as in the processing studies, we did not add any ostensive looks or expressions of effort to the palm-down gesture. Regarding the palm-up gesture, the action schema is non-functional in retrieving an object instrumentally, and so its meaning is not simply available through hand-object associations, as in instrumental action understanding. Infants also rarely, if ever, use the gesture themselves (they request with palm-down reaching or pointing), and so understanding the palm-up gesture cannot originate from infants' own actions (as in accounts of reaching; see [46]) but rather from communicative exchanges, where infants infer the satisfying conditions of the act by complementing rather than imitating it. Finally, regarding the extended index finger, 12-month-olds know that it directs attention to relevant things in the world. But do they also represent the different reasons why adults may point, and would they search for the most appropriate one by resorting to rationality assumptions (see [47])? If so, we expected infants to apply two possible interpretations. When the object was out of reach, they might construe the point more often as a request, but when the object was close to the pointer, they should construe it more often as an invitation to attend together to the object; see also [48]. In all three conditions, we measured reliably how often infants would offer the object to the experimenter. We also administered a no-action condition to control for infants' natural tendency to offer objects to others in this specific context.

The main findings were that infants offered the object in response to both the cupped palm-down hand and cupped palm-up hand significantly more often than in the control condition. In response to the extended index finger, they offered the object more often when the object was distal, but not when it was close to the pointer. These findings suggest that 12-month-olds do not always need preceding or ongoing activity, nor additional prosodic cues, such as

signs of effort, desire or interest, to interpret and react appropriately to others' communication. Instead, by 12 months of age, infants appear to have abstracted some meaning underlying the gestural forms of attention-directing acts. In addition, in arbitrary cases such as pointing, when alternative interpretations are possible, they appear to choose flexibly between interpretations on the basis of the physical layout and rationality assumptions.

### (b) Production

Given that infants infer the meaning of gestures from the style of an act alone—that is from gestural forms and accompanying prosodic characteristics—do infants also express their intentions distinctly, for example by using different prosodic characteristics, or hand shapes, or different modalities in a supplementary way? In a first experimental study, Grünloh & Liszkowski [49] elicited with previously established laboratory procedures expressive, requestive and informative pointing (see [23]). In a within-subjects design ( $n = 14$ ), 14-month-olds pointed to puppets that appeared at a distance; to wind-up toys they wanted to obtain; or to offer items that an adult had just lost and was looking for. We measured characteristics of accompanying vocalizations, such as speech-resemblance (consonant–vowel combinations), intonation patterns (rise, fall, flat) and intensity, and the shape of the hand (open hand versus index finger). Our main findings were that infants' expressive and informative points had similar characteristics, whereas they were significantly distinct from requestive points in all other parameters we measured. Particularly, requestive points more often adopted an open hand shape, and the accompanying vocalizations a flat intonation, higher intensity and overall fewer speech-like characteristics. In a second experiment, we addressed the question of whether the request features were in fact simply signs of infants' attempts actually to reach for a toy on a table, rather than truly communicative signals. We increased the distance of the referent and matched it to that in the informative condition (about 2 m away). We reasoned that if infants indeed mark their intention to request the distal item, the open hand shape should still appear more often than in the informative condition. Further, in the requestive condition, those points with an index finger should still be accompanied by the request-typical vocal characteristics, to distinguish them from the informative points. The results confirmed our previous findings, even when the distances to referents were equated, and even when analysing accompaniments of index finger points only. Infants thus appear to mark their expressions of desire (how they want the world to be) differently from their expressions of information (how they see the world). Motivational distinctions within the latter category (e.g. help versus share interest) appear to be better determined by the interactional contexts than by the accompanying characteristics we measured. Marking an imperative motive in essence seems necessary, because the point in itself only directs attention. Infants often point to something 'out of the blue', and if they do not simply want the adult to look at it (the first interpretation of pointing) but in addition want her to give the object, they need to convey this additional part of the message. Our findings show that infants do just this—not only do they direct a person's attention in the hope that she will figure out why; in addition, they mark their intention

with distinct expressions in order to be understood. At 12 months, infants thus have expectations about how a recipient understands and reacts to their own communicative acts.

Given that infants appear to mark their social intentions when pointing, a next question is whether they also discern the referent they have in mind through distinct features of the act. One possibility is that infants use different modalities to emphasize different aspects of reference. The alternative could be that they use the modalities redundantly to augment their reference. In previous work, we had approached this question from the latter perspective. We had asked whether infants use different modalities redundantly and would substitute one with the other. For example, when ambient noise is too loud for habitual speech, adults often resort to visual gestures. When a recipient cannot see a gesture, would infants instead vocalize more? Our findings suggest the opposite [50]. We elicited pointing to puppets in 12-month-olds. Sometimes, however, the adult recipient was turned sideways and could not see infants' pointing. While pointing significantly decreased under these conditions, infants did not increase their vocalizations to substitute pointing. We found a clear increase in vocalizations only when the recipient attended to infants but did not react. In a similar laboratory study, in fulfilment of her master thesis, Patricia Manko replicated the null finding regarding the vocalizations. Twelve-month-olds were tested in the exact same design and procedure as in [50], however, instead of the adult turning to the side, she always looked straight at the infant. There was a Plexiglas barrier between her and the infant, and sometimes she would temporarily cover it with a cloth and not be visible to the infant but otherwise be available. She found again that infants significantly decreased pointing when the gesture could not be seen, and she found again that 12-month-olds did not increase their vocalizations under these conditions of visual occlusion, neither before the point to draw attention to themselves, nor during or after the point to draw attention to the event happening behind the experimenter's back. One interpretation of these findings certainly is that 12-month-olds need eye contact as a sign of engagement in order to communicate, even when the modality of communication (auditory) does not require it [50]. Another aspect is that spatial indications of referents are presumably better achieved through the visual than through the auditory modality. While the findings thus do not provide support for the idea that infants use their two modalities redundantly, they have recently led us to hypothesize that the two modalities work in a supplementary way. The point could provide reference to relevant spatial locations, and the vocalizations could add information about the referent object indicated at a spatial location. For example, slightly older infants distribute their referential expressions across modalities when they combine words and points in a supplementary way (e.g. point to cup and say mummy; [13]).

### (c) Summary and developmental outlook

The new findings on comprehension and production in this section clarify in important ways how infants understand others and make themselves understood. Extending previous research which had demonstrated that infants flexibly interpret and use communication within shared action contexts, our novel findings show that infants also



understand something about the act itself and can use this information both to comprehend others' communicative intentions and make their own intentions understood. They do so by binding concurrent multimodal information into a coherent act, and relate it to communicative expectations specific to the form of the act. These skills are necessary in developing a meaningful use of language, and the findings of a developmental primacy support the view that prelinguistic communication runs on a language-ready cognitive infrastructure.

Some caution is in place when interpreting how deep an understanding based on characteristics alone can be, and whether it should be seen as a starting point or instead as an early achievement of communication. As we have seen in §2, when the communicative act is the same infants still differentiate interpretations based on the preceding action contexts, which shows that the preceding action contexts carry more information than available from the act itself. This is precisely why a behavioural coding approach, which assumes that meaning resides in fine-tuned simple associations with a multitude of unique behavioural forms, has been rejected in language sciences in favour of inferential intention-reading models [51]. Developmentally, the specific intonation patterns infants understood from adults were not simple primary emotional displays with inherited evolutionary signal values, but instead language-specific characteristics, which thus challenges the notion of an immediately available meaning of these signals. Further, the characteristics that infants used did not match those they observed, confirming that adult characteristics are not available from the beginning but must develop somehow (for example, parents rarely requested with the palm down gesture or a flat intonation). However, in order to develop comprehension of an act on the basis of its characteristics alone, infants must first develop some expectations about the act itself. This implies a developmental primacy of information from shared action contexts within which characteristics are first introduced.

The developmental processes may be different for comprehension and production. At 12 months, infants do not fully produce the characteristics that adults use, suggesting that their production does not rely on imitation but on processes of ontogenetic ritualization whereby infants come to use individual behaviour patterns in the service of signalling their underlying intentions [6,52]. Ritualization yields a more limited range of characteristics with closer resemblance to primary emotional-affective expressions and behaviour. Our findings of flat intonation and open hand shape for requests, as well as a lack of differentiation in the characteristics accompanying expressive-declarative and informative-declarative acts, are in line with this view. Infants acquire linguistic characteristics of prosody somewhat later through imitation. The necessary requirement for this is to comprehend the meaning of prosodic characteristics in the first place, and our findings show that this is the case at 12 months of age. Findings from comprehension thus support the view of a developmental achievement, suggesting that by 12 months of age infants have developed a more abstracted understanding of communicative acts, providing a foundation for the acquisition of form-meaning relations in word learning and learning of language-specific prosody. Findings from production then reveal that infants are motivated to express their intentions already before they have acquired conventional or socially common means by using

the individual behaviours available to them in the service of communication.

#### 4. Communication before language

Infants communicate through multiple modalities long before they can speak. The question has been to what extent this communication is meaningful. Do infants understand others' communicative actions and do they act to make themselves understood? Recent eye-tracking and electroencephalography results suggest that infants comprehend spoken words already earlier than previously assumed, beginning at around six to nine months [53,54], which perhaps questions whether infants are 'pre'-linguistic at all. However, communicating in meaningful ways goes beyond these impressive associative abilities. As in linguistic communication, the task is no less trivial for infants: they have to understand—and make others understand—about *what* one communicates (including reference to parts and aspects); and *why* one does so (motive). Experimental results show that infants exhibit a remarkable flexibility in the way they comprehend and produce communication. As we have seen, they respond to and use one and the same action differently, depending on the preceding action contexts. And when the preceding action contexts are the same across situations, they differently interpret distinctly marked, but otherwise similar behaviour. And when both sources of information are the same across situations, they may still arrive at different interpretations based on the spatial layout and assumptions of communicative rationality. Further, they distinctly mark their otherwise similar pointing acts to distinguish what they intend, and use different modalities to augment their reference. Together, these empirical findings strongly signify against rigid fixed behaviour-context associations. Instead, they support the argument that infants have a social-cognitive understanding enabling meaningful communication that runs deeper than language alone. The origins of infants' communicative skills are less clear. Recent correlational, cross-cultural and training studies find both social-cognitive and social-interactive factors influencing the emergence of gestural communication, in particular pointing [55–57].

This paper shows that infants, like adults, use two main sources of extralinguistic information to communicate meaningfully. The information stems from the surrounding shared action context of an act and from its accompanying specific characteristics. Naturally, this information co-occurs. It is currently unknown what the relative contributions of each source to mutual understanding are, and whether one source is primary in development. Plausibly, expressing or inferring meaning through accompanying characteristics alone is more limited in scope than doing this on the basis of preceding shared action contexts, or both. One possibility is that the meaning of characteristics mostly derives from their use in social contexts. The finding that infants understand and create meaning from form alone perhaps indicates an early sensitivity and a forerunner to form-meaning relations as required for word learning. It is also conceivable that some characteristics such as primary emotions render themselves obvious without much need for having to be introduced through a common ground (for a conceptual discussion, see [8]). The precise mechanisms explaining how infants extract and sequentially bind preceding action-context information



to subsequent action information; how they integrate multisensory action information and how they integrate sequential and simultaneous sources of action information remain to be shown [58]. Current findings attest that infant communication is not just a precursor to linguistic communication, but a meaningful form of human communication that should be treated as an outcome of cognitive development and social–interactional experiences in the first year of life.

## References

- Kendon A. 2014 Semiotic diversity in utterance production and the concept of ‘language’. *Phil. Trans. R. Soc. B* **369**, 20130293. (doi:10.1098/rstb.2013.0293)
- Özyürek A. 2014 Hearing and seeing meaning in speech and gesture: insights from brain and behaviour. *Phil. Trans. R. Soc. B* **369**, 20130296. (doi:10.1098/rstb.2013.0296)
- Perniss P, Vigliocco G. 2014 The bridge of iconicity: from a world of experience to the experience of language. *Phil. Trans. R. Soc. B* **369**, 20130300. (doi:10.1098/rstb.2013.0300)
- Iverson JM. 2010 Multimodality in infancy: vocal–motor and speech–gesture coordinations in typical and atypical development. *Enfance* **3**, 257–274. (doi:10.4074/S0013754510003046)
- Goldin-Meadow S. 2014 Widening the lens: what the manual modality reveals about language, learning and cognition. *Phil. Trans. R. Soc. B* **369**, 20130295. (doi:10.1098/rstb.2013.0295)
- Tomasello M. 2008 *Origins of human communication*. Cambridge, MA: MIT Press.
- Clark HH, Marshall CR. 1981 Definite reference and mutual knowledge. In *Elements of discourse understanding* (eds AK Joshi, BL Webber, IA Sag), pp. 10–63. Cambridge, UK: Cambridge University Press.
- Wilson D, Wharton T. 2006 Relevance and prosody. *J. Pragmat.* **38**, 1559–1579. (doi:10.1016/j.pragma.2005.04.012)
- Carpenter M, Nagell K, Tomasello M. 1998 Social cognition, joint attention, and communicative competence from 9 to 15 months of age. *Monogr. Soc. Res. Child Dev.* **63**, 1–143. (4, serial no. 255). (doi:10.2307/1166214)
- Iverson JM, Goldin-Meadow S. 2005 Gesture paves the way for language development. *Psychol. Sci.* **16**, 367–371. (doi:10.1111/j.0956-7976.2005.01542.x)
- Namy LL. 2008 Recognition of iconicity doesn’t come for free. *Dev. Sci.* **11**, 841–846. (doi:10.1111/j.1467-7687.2008.00732.x)
- Colonnese C, Stams GJJM, Koster I, Noom MJ. 2010 The relationship between pointing gesture and language: a meta-analysis. *Dev. Rev.* **30**, 352–366. (doi:10.1016/j.dr.2010.10.001)
- Tomasello M, Farrar J. 1986 Joint attention and early language. *Child Dev.* **57**, 1454–1463. (doi:10.2307/1130423)
- Rowe ML, Goldin-Meadow S. 2009 Differences in early gesture explain SES disparities in child vocabulary size at school entry. *Science* **323**, 951–953. (doi:10.1126/science.1167025)
- Adamson LB, Bakeman R, Deckner DF, Ronski MA. 2009 Joint engagement and the emergence of language in children with autism and Down syndrome. *J. Autism Dev. Disord.* **39**, 84–96. (doi:10.1007/s10803-008-0601-7)
- Kristen S, Sodian B, Thoermer C, Perst H. 2011 Infants’ joint attention skills predict toddlers’ emerging mental state language. *Dev. Psychol.* **47**, 1207–1219. (doi:10.1037/a0024808)
- Liszkowski U. 2013 Using theory-of-mind. *Child Dev. Perspect.* **7**, 104–109. (doi:10.1111/cdep.12025)
- Southgate V, Chevallier C, Csibra G. 2009 Sensitivity to communicative relevance tells young children what to imitate. *Dev. Sci.* **12**, 1013–1019. (doi:10.1111/j.1467-7687.2009.00861.x)
- Saylor MM, Ganea P. 2007 Infants interpret ambiguous requests for absent objects. *Dev. Psychol.* **43**, 696–704. (doi:10.1037/0012-1649.43.3.696)
- Moll H, Tomasello M. 2007 How 14- and 18-month-olds know what others have experienced. *Dev. Psychol.* **43**, 309–317. (doi:10.1037/0012-1649.43.2.309)
- Moll H, Richter N, Carpenter M, Tomasello M. 2008 Fourteen-month-olds know what ‘we’ have shared in a special way. *Infancy* **13**, 90–101. (doi:10.1080/15250000701779402)
- Liszkowski U, Carpenter M, Tomasello M. 2008 Twelve-month-olds communicate helpfully and appropriately for knowledgeable and ignorant partners. *Cognition* **108**, 732–739. (doi:10.1016/j.cognition.2008.06.013)
- Tomasello M, Carpenter M, Liszkowski U. 2007 A new look at infant pointing. *Child Dev.* **78**, 705–722. (doi:10.1111/j.1467-8624.2007.01025.x)
- Southgate V, Chevallier C, Csibra G. 2010 Seventeen-month-olds appeal to false beliefs to interpret others’ referential communication. *Dev. Sci.* **16**, 907–912. (doi:10.1111/j.1467-7687.2009.00946.x)
- Behne T, Liszkowski U, Carpenter M, Tomasello M. 2012 Twelve-month-olds’ comprehension and production of pointing. *Br. J. Dev. Psychol.* **30**, 359–375. (doi:10.1111/j.2044-835X.2011.02043.x)
- Liebal K, Behne T, Carpenter M, Tomasello M. 2009 Infants use shared experience to interpret pointing gestures. *Dev. Sci.* **12**, 264–271. (doi:10.1111/j.1467-7687.2008.00758.x)
- Liszkowski U, Carpenter M, Henning A, Striano T, Tomasello M. 2004 Twelve-month-olds point to share attention and interest. *Dev. Sci.* **7**, 297–307. (doi:10.1111/j.1467-7687.2004.00349.x)
- Liszkowski U, Carpenter M, Tomasello M. 2007 Pointing out new news, old news, and absent referents at 12 months of age. *Dev. Sci.* **10**, F1–F7. (doi:10.1111/j.1467-7687.2006.00552.x)
- Liszkowski U, Carpenter M, Tomasello M. 2007 Reference and attitude in infant pointing. *J. Child Lang.* **34**, 1–20. (doi:10.1017/S0305000906007689)
- Liebal K, Carpenter M, Tomasello M. 2010 Infants’ use of shared experience in declarative pointing. *Infancy* **15**, 545–556. (doi:10.1111/j.1532-7078.2009.00028.x)
- Knudsen B, Liszkowski U. 2012 Eighteen- and 24-month-old infants correct others in anticipation of action mistakes. *Dev. Sci.* **15**, 113–122. (doi:10.1111/j.1467-7687.2011.01098.x)
- Knudsen B, Liszkowski U. 2012 18-month-olds predict specific action mistakes through attribution of false belief, not ignorance, and intervene accordingly. *Infancy* **17**, 672–691. (doi:10.1111/j.1532-7078.2011.00105.x)
- Knudsen B, Liszkowski U. 2013 One-year-olds warn others about negative action outcomes. *J. Cogn. Dev.* **14**, 424–436. (doi:10.1080/15248372.2012.689387)
- Reddy V, Markova G, Wallot S. 2013 Anticipatory adjustments to being picked up in infancy. *PLoS ONE* **8**, e65289. (doi:10.1371/journal.pone.0065289)
- Gergely G, Watson J. 1999 Early socio-emotional development: contingency perception and the social-biofeedback model. In *Early social cognition* (ed. P Rochat), pp. 101–136. Mahwah, NJ: LEA.
- Woodward AL. 1998 Infants selectively encode the goal object of an actor’s reach. *Cognition* **69**, 1–34. (doi:10.1016/S0010-0277(98)00058-4)
- Gogate LJ, Walker-Andrews AS, Bahrick LE. 2001 The intersensory origins of word comprehension: an ecological–dynamic systems view. *Dev. Sci.* **4**, 1–18. (doi:10.1111/1467-7687.00143)
- Gogate LJ, Bolzani LE, Betancourt E. 2006 Attention to maternal multimodal naming by 6- to 8-month-old infants and learning of word–object relations. *Infancy* **9**, 259–288. (doi:10.1207/s15327078in0903\_1)
- Estigarribia B, Clark EV. 2007 Getting and maintaining attention in talk to young children. *J. Child Lang.* **34**, 799–814. (doi:10.1017/S0305000907008161)

40. Puccini G, Liszkowski U. 2012 15-month-old infants fast map words but not representational gestures of multimodal labels. *Front. Psychol.* **3**, 101. (doi:10.3389/fpsyg.2012.00101)
41. Liebal K, Carpenter M, Tomasello M. 2011 Young children's understanding of markedness in nonverbal communication. *J. Child Lang.* **38**, 888–903. (doi:10.1017/S0305000910000383)
42. Oller DK, Buder EH, Ramsdell HL, Warlaumont AS, Chorna L, Bakeman R. 2013 Functional flexibility of infant vocalization and the emergence of language. *Proc. Natl Acad. Sci. USA* **110**, 6318–6323. (doi:10.1073/pnas.1300337110)
43. Esteve-Gibert N, Prieto P, Liszkowski U. In press. Prosodic and pointing gesture features distinguish pragmatic intentions in child-directed communication. In *Interdisciplinary approaches to intonational grammar in Ibero-Romance* (eds M Armstrong, N Henriksen, M del Mar Vanrell). Amsterdam, Netherlands: John Benjamins Publishing.
44. Esteve-Gibert N, Prieto P, Liszkowski U. Submitted. Twelve-month-olds use gesture shape and prosody to interpret social intentions of pointing.
45. Thorgrimsson G. 2014 Infants' understanding of communication and action as participants and observers. PhD Thesis. Radboud University Nijmegen, Nijmegen, The Netherlands, pp. 20–41.
46. Sommerville JA, Woodward AL. 2005 Pulling out the intentional structure of action: the relation between action processing and action production in infancy. *Cognition* **95**, 1–30. (doi:10.1016/j.cognition.2003.12.004)
47. Csibra G. 2003 Teleological and referential understanding of action in infancy. *Phil. Trans. R. Soc. Lond. B* **358**, 447–458. (doi:10.1098/rstb.2002.1235)
48. Grosse G, Moll H, Tomasello M. 2010 Infants appreciate the cooperative logic of requests. *J. Pragmat.* **42**, 3377–3383. (doi:10.1016/j.pragma.2010.05.005)
49. Grünloh T, Liszkowski U. In press. Prelinguistic vocalizations distinguish pointing acts. *J. Child Lang.*
50. Liszkowski U, Albrecht K, Carpenter M, Tomasello M. 2008 Infants' visual and auditory communication when a partner is or is not visually attending. *Infant Behav. Dev.* **31**, 157–167. (doi:10.1016/j.infbeh.2007.10.011)
51. Sperber D, Wilson D. 1995 *Relevance: communication and cognition*, 2nd edn. Oxford, UK: Blackwell Publishers.
52. Bruner JS. 1975 From communication to language: a psychological perspective. *Cognition* **3**, 255–287. (doi:10.1016/0010-0277(74)90012-2)
53. Bergelson E, Swingley D. 2012 At 6 to 9 months, human infants know the meanings of many common nouns. *Proc. Natl Acad. Sci. USA* **109**, 3253–3258. (doi:10.1073/pnas.1113380109)
54. Parise E, Csibra G. 2012 Electrophysiological evidence for the understanding of maternal speech by 9-month-old infants. *Psychol. Sci.* **23**, 728–733. (doi:10.1177/0956797612438734)
55. Liszkowski U, Tomasello M. 2011 Individual differences in social, cognitive, and morphological aspects of infant pointing. *Cogn. Dev.* **26**, 16–29. (doi:10.1016/j.cogdev.2010.10.001)
56. Salomo D, Liszkowski U. 2013 Sociocultural settings influence the emergence of prelinguistic deictic gestures. *Child Dev.* **84**, 1296–1307. (doi:10.1111/cdev.12026)
57. Matthews D, Behne T, Lieven E, Tomasello M. 2012 Origins of the human pointing gesture: a training study. *Dev. Sci.* **15**, 817–829. (doi:10.1111/j.1467-7687.2012.01181.x)
58. Parise E, Csibra G. 2013 Neural responses to multimodal ostensive signals in 5-month-old infants. *PLoS ONE* **8**, e72360. (doi:10.1371/journal.pone.0072360)