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NONVERBAL GENERICS: Human Infants Interpret Objects as Symbols of Object Kinds

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Abstract

Human infants are involved in communicative interactions with others well before they start to speak or understand language. It is generally thought that this communication is useful for establishing interpersonal relations and supporting joint activities, but, in the absence of symbolic functions that language provides, these early communicative contexts do not allow infants to learn about the world. However, recent studies suggest that when someone demonstrates something using an object as the medium of instruction, infants can conceive the object as an exemplar of the whole class of objects of the same kind. Thus, an object, just like a word, can play the role of a symbol that stands for something else than itself, and infants can learn generic knowledge about a kind of object from nonverbal communication about a single item of that kind. This rudimentary symbolic capacity may be one of the roots of the development of symbolic understanding in children.

Keywords

infants; symbols; reference; generics; communication

INTRODUCTION

When people think about various entities in the world, they tend to consider them not just as individuals but also as exemplars of their kinds. This applies to many domains: the animal wagging its tail in front of you is a dog, the substance you drink is wine, the object you drive is a car, the person who treats you in the hospital is a doctor, the relation that you are in with your spouse is marriage, and the institution where you work is a university. The metaphysical status of abstract concepts such as kinds is a matter of philosophical debate, but the psychological reality of such abstract concepts is unquestionable. People have no difficulties describing what a car is, and when they do so, they do not refer to a particular car but talk about the properties of an abstract type, of which particular cars are concrete tokens. These properties could include common features (has wheels), dispositional properties (can move fast), functional use (carries people), social significance (allows you to live further

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away from your work), etc. of the entities belonging to a kind, without any of them being obligatory for a particular token to be an exemplar of the type.

How do people, and especially children, acquire such abstract kind concepts? After all, experience restricts us to meeting only particular entities (a certain doctor, a certain car, a certain marriage) rather than kinds (Prasada 2000), which could only be interpreted as kind tokens if the concept of the corresponding kind has already been acquired. A potential route to kind concepts leads through inductive processes. The first step in these processes is to establish categories of particular entities. Such categories can be formed in a purely bottom-up fashion, by clustering the entities on the basis of their similarity along one or more dimensions, or by top-down (supervised) learning, where an authoritative source defines the category boundaries. Prior knowledge, innate biases, perceptual salience, and statistical principles can influence which property dimensions are included in the formation of the category. Once a category is established, the statistically frequent or otherwise relevant properties of the entities it contains (whether or not they contributed to the creation of the category) could be abstracted away and could be merged into an abstract concept, which the entities in the category are instances of. Such inductive construction of abstract kind concepts would enable the generalization of kind-linked properties to novel members of the category.

There is, however, another way to learn about kinds, at least in humans: through language. All human languages utilize kind labels. Often these words are used in expressions that refer to particular entities (“my car”), but they can also refer to the kind as a whole (“cars carry people”). When a sentence states something about the kind as a whole, it is a prime example of so-called generic expressions, in which some property is stated about the kind without explicitly referring to any instance of it (Carlson & Pelletier 1995). Of course, the property characterizing the kind in generic statements is likely to be inherited by, and to apply to, entities belonging to the kind, but exceptions exist and are often tolerated (Leslie 2007, Leslie et al. 2011). Importantly, kind-referring generic expressions are not restricted to kinds whose members have been directly experienced by the speaker or her audience. One can state and understand generic statements about unicorns, aliens, time machines, or Zarpies (Rhodes et al. 2012), and the kind concepts included in these expressions cannot be generated by inductive abstractions. Rather, when a kind concept is acquired via generic language, inferences typically go the other way around: from the kind to the individual, i.e., via deduction rather than induction (for example, premise 1: cars can carry people; premise 2: this object is a car; conclusion: this object can carry people).

Our contrast between these two types of acquisition of kind concepts is not meant to imply that they are mutually exclusive or that further processes could not contribute to learning. However, individuals without access to language cannot benefit from the second route of learning about kinds. In particular, preverbal infants and toddlers who are still in the early phase of language acquisition may be limited to acquiring conceptual knowledge by experiencing individual entities (such as objects, people, social relations) and abstracting away their commonalities. We think, however, that preverbal infants are not necessarily deprived of learning generic knowledge from others. Proposals for how this feat could be achieved constitute the theory of natural pedagogy (Csibra & Gergely 2009).

The theory of natural pedagogy is a framework theory that interprets certain aspects of human communication, and especially communication directed to children, as serving the function of transferring generic knowledge to others. Such a function of human communication is implemented in various cognitive, motivational, and social systems. From an evolutionary point of view, the theory proposes that human (linguistic as well as nonlinguistic) communication, unlike that of nonhuman animals, is not restricted to conveying information about particular events or individuals but also allows us to teach each other about kinds (Csibra & Gergely 2011). This may seem to be a counterintuitive claim since many recent attempts to model the emergence of conventionalized communication systems, such as language, start with problems (for example, collaborative foraging) that require solutions to inform others about episodic facts, such as the momentary whereabouts of objects or people (e.g., Galantucci 2005, Scott-Phillips et al. 2009; see also Tomasello 2008). From a developmental point of view, the theory of natural pedagogy proposes that children start to acquire generic knowledge before, or in parallel with, the acquisition of linguistic skills that are required to comprehend generic statements.

What cognitive mechanism enables young children to learn generic knowledge through nonverbal communication? It has been proposed that child-directed communication biases children to interpret the information conveyed about a particular object as generalizable to other objects of the same kind or to other situations (Csibra & Gergely 2006). The prototypical case of such communication is the demonstration of how an object (for example, a novel tool) works. By observing some intervention on the object, infants may learn how to use it and what effects it can produce. Such learning can indeed occur even if children are passive observers and the adult operating the tool does not make an effort to teach them. However, the theory of natural pedagogy proposes that if the tool use is communicatively demonstrated to infants, it licenses them to make the inductive inference that the demonstrated properties of the tool apply not only to that particular object but extend to other objects that belong to the same kind. This way, infants could acquire generic knowledge from a single episode of nonverbal communication, just like older children do via generic statements expressed in speech.

Such a learning mechanism would require the concerted operation of several cognitive subsystems. For example, infants would have to (*a*) recognize the occasions when they are being targeted by someone's communicative intention, (*b*) comprehend nonverbal communicative signals, such as pointing, that specify the object about which the communicator is conveying something, and (*c*) be able to make inductive generalizations across instances of a kind. Below we review evidence pertaining to these capacities in young infants. However, our main concern here is to offer an alternative explanation of how one can acquire generic knowledge from others by nonverbal communication. Briefly, we propose that step (*c*) in the above sequence (i.e., inductive generalization) is not necessary if infants take the kind, to which the communicatively highlighted object belongs, rather than the object itself, as the intended referent of the communicator. In other words, if infants take the object as an ad-hoc symbol of its own kind, they would learn about this kind through nonverbal communication similarly to how they would learn about a kind through a generic sentence. The proposal for this alternative mechanism is motivated by empirical evidence,

and it also has important theoretical implications, which we discuss below. We start by reviewing the evidence for infants' developing comprehension of referential signals, and then we explicate our proposal in detail. Finally, we discuss the implications of this proposal to the development of two related skills: the interpretation of object labels and the comprehension of symbolic objects.

REFERENTIAL EXPECTATION

The term "referential signals" is primarily used in the literature on nonhuman animal communication to denote (mainly vocal) actions, such as alarm calls, that function to inform conspecifics about something external to the communicator (Seyfarth et al. 1980). Here we extend this term to human communication in order to emphasize that, beyond words, many nonverbal human communicative acts, as well as symbolic artifacts (such as pictures), carry referential content. The philosopher Charles Sanders Peirce (1955) classified signs into three distinct types: icons, indexes, and symbols. This classification can be applied to nonverbal and object-mediated referential signals as well. Depending on the nature of the link between the signals and their referents, signals can be classified as icons (iconic gestures that mime a familiar act; pictures, maps), indexes (deictic gestures, such as pointing at something; location markers), or symbols (conventionalized gestures such as putting one's palms together to do an Indian Namaste in greeting, or a thumbs-up gesture to indicate approval; tags attached to objects to assert ownership).

The three types of sign-referent links are established through relations that are not communicative or referential (icons: similarity; indexes: physical links; symbols: regular but arbitrary association between signs and referents). How then do children identify truly referential signals? Although they may rely on various cognitive mechanisms specialized to detect such relations, these mechanisms are not sufficient to guarantee that the relations they detect are referential. After all, whether a relation between two events and/or objects is referential depends on whether the function of one of them (the sign) is to stand for the other one (the referent) in a message. Ultimately, in human communication, it is the communicator's intention that determines whether a signal is used in order to stand for something else. If so, then the relation between the signal and its referent is referential, whether it is established by association (like symbols), resemblance (like icons), or direct links (like indexes).

It has been suggested that infants go through an initial developmental phase, during which they detect referentially relevant relations between signals and referents but without a genuine understanding of the referential nature of these signals. Such accounts have been proposed for all three types of referential signals described above. For example, young children have difficulties in understanding the iconic representational nature of pictures and models (DeLoache 2004). At the same time, even young infants perceive the similarity between pictures and their referent, as evidenced by the fact that they attempt to perform actions on pictures that would be appropriate only on their referents, such as licking the picture of an ice cream (DeLoache et al. 1998). In the domain of indexical reference, studies have shown that infants follow deictic gestures, such as gaze shifts or pointing, from very early on. Even newborns shift their attention in response to observed gaze shifts (Farroni et

al. 2004), but it is only after their first birthday that infants can correctly identify what the other person is attending to (Butterworth & Jarrett 1991). This led some researchers to propose that gaze or point following is initially an automatic or reinforced response, which does not entail the understanding that these actions are meant to be referential, i.e., that they express the actor's intention to communicate about the target she is looking at or pointing to (Deák et al. 2014, Moore et al. 1997, Triesch et al. 2006). A similar developmental shift has been suggested to underlie the vocabulary spurt that infants go through in the middle of the second year. The abrupt change from a slow item-by-item acquisition to fast mapping of multiple words per day (Bloom 1973, Dapretto & Bjork 2000) is thought to be a manifestation of fundamental changes in the mechanisms employed for word learning. At this age, general-purpose associative mechanisms are supposedly replaced by language-specific principles that take into account the speaker's communicative intentions (Nazzi & Bertoncini 2003).

An alternative to these stage theories of the development of referential understanding is that the notion of reference is not an insight abstracted from children's experience with initially uninterpreted relations but rather an inherent expectation of communicative signals from the outset (Csibra & Gergely 2006, Macnamara 1982, Waxman & Gelman 2009). Such an expectation precedes and guides infants' discovering and learning of the particular relations that link referential signals to their referents. However, this learning process requires that children be able to realize that they are being communicated to.

Human communication is ostensive: It not only conveys messages but also makes explicit that the communicator's intention is to influence the addressee (Sperber & Wilson 1995). The communicative intention of a person can be identified from ostensive signals, such as eye contact, special intonation (such as the one that people use to address infants, also known as "motherese"), or calling the addressee's name, which indicate the presence of the communicative intention of the source and specify its intended recipient (Csibra 2010). Infants display a rudimentary sensitivity to some of these signals from birth. This sensitivity is then gradually tuned to the actual variants infants experience in their environment during the early months, which also enables them to learn additional ostensive signals, such as their name, as they occur together with eye contact and infant-directed speech. Our proposal assumes that beyond identifying attempts of communication, ostensive signals also predispose infants to generate certain expectations about accompanying or subsequent actions from the same source. One such expectation is that these actions could be referential in nature, i.e., they would designate something in the world as the focus of the communicative intention of the source (Csibra 2010). This expectation, in turn, will allow infants to discover regularities that link, one way or another, potential referential actions (e.g., gestures, vocal behavior) that occur with ostensive signals to particular objects in the environment.

Among the three general ways of relating signs to referents, perhaps indexical links are the easiest to detect because both symbolic and iconic signals require prior learning. A potential indexical link to which infants show early sensitivity even outside the social domain is spatial direction represented in physical motion. Referential signals that rely on such links include handling, shaking, showing, pointing to, or looking at objects during social

interactions, and are all deictic in nature. Several studies that explored the reliability of object-directed gaze as a referential signal found that dynamic head or eye motion is necessary for young infants to connect gaze direction to potential referents. Gaze cueing, i.e., priming spatial locations or directions by gaze direction, works in 4-month-olds only if they are presented with dynamic stimuli (Farroni et al. 2003). At this age, many types of motion cue work, even some that are not within the range of infants' normal experience (Farroni et al. 2000). Crucially, however, such cues shift infants' attention to the corresponding direction only if an upright face with direct gaze (i.e., eye contact, which is an ostensive signal) precedes them. Overt gaze following can also be elicited in young infants, but only if the gaze cue (e.g., head turn) is presented in an ostensive context, indicated by eye contact or infant-directed speech (Senju & Csibra 2008). In such communicative contexts, which are identified by the presence of ostensive signals, infants may follow directional signals even if no face is present: 8-month-old infants tend to follow the dynamic orientation of a contingently responding object (Deligianni et al. 2011).

The learning of other deictic referential signals, such as pointing, follows a similar developmental trajectory. In a strongly communicative context, young infants' attention is primed by a pointing hand, but only if it displays motion toward the direction of the fingers (Rohlfing et al. 2012). Later, around the first birthday, even static hands could carry potentially referential meaning for infants, but only if presented together with ostensive signals (Daum et al. 2013). Ostensive pointing, as opposed to the pointing hand shape without further communicative signals, has also been shown to inform 12- and 14-month-old infants about the location of hidden toys in hiding-finding games (Behne et al. 2005, 2012).

In sum, it takes time for infants to learn to interpret indexical referential signals, such as gazing or pointing, by extracting the regularities of object-directed actions displayed in communicative interactions. Even if there is special preparedness to pay attention to relevant body parts, such as eyes (Farroni et al. 2002) and hands (Leslie 1984), how they are used in communicative interactions may depend on many factors, including local traditions. Distal pointing, for example, takes many forms, including whole-hand pointing, lip pointing, and foot pointing, in different societies (Kita 2003). However, the fact that initially the understanding of such gestures is restricted to communicative contexts suggests that they are learned as signals (i.e., as stimuli that are meant to indicate something) rather than as cues (stimuli that happen to indicate something). The acquisition of skills to locate the object toward which these actions are directed is driven by a motivation to interpret the referential signals that are expected provide evidence about the referential intention of interacting partners. Such an account counters theories according to which infants learn to follow others' gaze because doing so provides them with an opportunity to obtain rewards in the form of "interesting sights" (Deák et al. 2014, Triesch et al. 2006).

Learning the nature of referential signals, such as words, that establish symbolic relations to entities in the world via regular association may proceed in a similar fashion. Although newborns show preference to human voice over other acoustic signals and to speech over nonspeech stimuli (Vouloumanos & Werker 2007), initially they seem to be open-minded about what kind of auditory signal could be referential. In studies where acoustic stimuli play the role of categorizing objects together (we return later to the phenomenon), 3- and 4-

month-old infants accept words but not tones in this function (Ferry et al. 2010). However, at age 3 months, lemur vocalizations are also acceptable to them (Ferry et al. 2013), and tones are also sufficient for 6-month-olds if they are pretrained in a situation where the same tones apparently serve a communicative function (Ferguson & Waxman 2014). Older infants, who have had more exposure to real-world communicative situations and hence learned what kind of acoustic stimuli serve as potential referential symbols, restrict this function to words, even when they have been subjected to the same pretraining with tones as 6-month-olds (Ferguson & Waxman 2014).

We have reviewed evidence that the learning of deictic and symbolic referential signals (such as pointing and words) is supported by the recognition of communicative contexts, which are hypothesized to elicit a referential expectation. But what evidence suggests that these signals are learned as referential signals, i.e., signs that are meant to indicate, or stand for, something in the world? Looking at the object that is highlighted by a concurrent deictic gesture (such as a head turn; Gredebäck et al. 2008) or finding the object in an array that matches the word infants hear (Bergelson & Swingley 2012) may be based on associative links between these signals and the corresponding spatial position or object features without any further understanding that the former refer to the latter. One way to assess the understanding of the referential nature of these signals is to test whether infants link these signals to absent, or at least momentarily unobservable, objects. Ganea (2005) reported that, in familiar contexts, 14-month-olds spontaneously pointed to, or searched for, an occluded object when its recently learned name was mentioned. Similarly, Moll & Tomasello (2004) found that, after an experimenter ostensively looked behind a barrier, 12- and 18-month-old infants locomoted to a spatial position from which they could check what the person had been referring to. In fact, the ability to postulate the presence of an object simply on the basis of deictic referential signals, such as looking and pointing, emerges even earlier: The expectations of 8-month-old infants were apparently violated when the occluded location, toward which an ostensively communicating person performed these actions, turned out to be empty (Csibra & Volein 2008).

An even better test of referential understanding relies on the notion of coreference: If a person concurrently produces two different referential signals, where each of them refers to an object, it is highly probable that these signals will corefer, i.e., they will pick out the same object (Gliga & Csibra 2009). This idea was tested with 12-month-olds, to whom short video clips were presented depicting a person who ostensively looked and pointed behind one of two occluders while mentioning an object label that infants at this age normally recognize (“Look, a duck!”). When the two occluders were later removed, they revealed either a duck at the indicated location and another object behind the other occluder (consistent outcome), or a duck behind the other occluder and a different, but familiar, object at the indicated location (inconsistent outcome). Infants’ looking times indicated that, compared to the consistent outcome, they found the inconsistent outcome unexpected. Had infants simply expected to find (*a*) an object at the location highlighted by the deictic gestures and (*b*) an object matching the familiar label, they would have been equally satisfied with either outcome because both would meet these expectations. Only if they expected that there was a single referential intention behind the gesture and the labeling, and

hence these two referential signals must have coreferred to the same thing, would they find the inconsistent outcome unexpected (Gliga & Csibra 2009). A similar finding in 9-month-olds suggests that even younger infants apply this coreferential expectation. Parise & Csibra (2012) had the mothers of 9-month-olds look and point toward an occluder and label an invisible object (from the small vocabulary that infants at this age are expected to possess; see Bergelson & Swingley 2012). The occluder then was removed, revealing either the labeled or a different object. The event-related potential (ERP) signal that is typically associated with the absence of semantic priming during the processing of stimuli (N400) was found only in response to the sight of the nonmatching object (Kutas & Federmeier 2011). Thus, the familiar object label had activated the semantic network associated with this word and primed the sight of the matching object. However, because studies that tested picture-word semantic priming in the absence of deictic reference at this age did not find a similar effect (Friedrich & Friederici 2005), we may conclude that 9-month-olds expect familiar words to refer to specific familiar objects when the infants are directly addressed and when the words are accompanied by further referential signals, such as pointing.

OBJECTS STANDING FOR THEIR OWN KINDS

As the short review above suggests, from the second half of the first year, infants interpret certain signals---more specifically, actions that highlight objects in the environment and words that act as object labels---as carrying potential referential content. But what do these signals refer to? Do they refer to the object that is the target of the referential act or to something more?

When they hear a familiar object label, even young infants can find the corresponding object in an array of objects (Bergelson & Swingley 2012), or they expect to find it behind an occluder if concurrent deictic gestures from the speaker suggest it as the location of the object (Gliga & Csibra 2009, Parise & Csibra 2012). This does not necessarily mean that object labels refer to individual objects for infants; it only indicates that labels allow infants to pick out specific objects from their environment as corresponding to the labels they hear. Indeed, powerful arguments support the proposal that object labels are interpreted as denoting kind concepts as soon as children start to learn words (Gelman 2004; Waxman & Gelman 2009, 2010). This does not entail that infants must have a deep conceptual understanding of what a “duck,” a “car,” or a “doctor” is, but they could nevertheless assume that things that are labeled by the same word have something in common, which is what the word denotes. We return to the relation between words and kind concepts in the next section.

What do nonverbal referential signs, such as ostensively looking at, pointing to, or holding up objects, refer to? The common-sense intuition holds that, unlike words, which may express abstract concepts, these gestures are down-to-earth signs picking out nothing else but the particular objects they spatially highlight. When infants follow gaze direction or a pointing gesture, their gaze lands on a specific object, and when these signals indicate the location of a hidden object, infants search that location in order to find the object hidden there (Behne et al. 2005, 2012). It was also suggested that deictic reference, such as pointing, could help the disambiguation of linguistic expressions as referring to the

particular (Gelman & Raman 2003). Indeed, deictic reference specifies the referent by its location, which can only be occupied by particular objects rather than by abstract kind concepts.

However, in human communication the immediate referent of an expression is not necessarily the one about which the communicator wishes to convey something. When pointing to a photo of a flower and saying, “This has a lovely scent,” one does not (normally) talk about the photograph but rather about the flower represented by it. Similarly, when someone holds up a box and declares, “This is what I take when I have a headache” (like in a TV commercial), she does not refer to either that particular box or its content but rather to the brand of medicine the content of that box is an instantiation of. In this case, the object used in the communication mediates the speaker’s reference to a kind (of object or substance). There are many examples of this latter type of object-mediated reference to kinds in everyday communication: showing how to ride a horse, demonstrating some novel functions of a smartphone or a new software application, expressing a choice by pointing to a displayed sample in a fast-food restaurant, etc. In all these cases the immediate referent to a particular entity is meant to conveniently refer to a kind (horses, a brand of smartphones, a type of food in general) without identifying the kind by its name.

Referring to a kind by deictically highlighting a particular object may be seen as a specific case of what some philosophers of language call “deferred indexicals.” When this happens, the object highlighted by the communicator’s action is not the real referent of her message but represents the referent by being a member of that kind. In this situation, the object itself serves as a sign that forwards the reference to the kind that the object belongs to. In Peirce’s classification of signs (1955), which we introduced earlier, the relation between the object as a sign and its referent as its kind is indexical: The object represents its kind by virtue of being a member of it. (It is important to appreciate that this relation is not iconic. Although objects normally display features characteristic to the kind, here it is not the similarity to a prototype but the kind-member relationship that matters.) Perhaps a better way to characterize the relation between an object and its referent in this situation is by the term that the philosopher Nelson Goodman introduced: exemplification (Goodman 1976). An object (e.g., your Ford Escort) can act as a sign in communication to indicate a kind (e.g., cars in general) because it is an example of the kind “car.” Goodman discusses exemplification primarily as a way of referring to properties that particular exemplars embody, and here we extend this idea to the membership relation. Thus, if “X is a Y,” where X is a particular object and Y is a kind, X can be used in communication to exemplify and hence refer to Y.

Returning to human infants, the question is whether they ever interpret deictic reference (e.g., pointing) to an object as exemplification, as reference to a kind. We argue that they do so, and such an inclination would explain some puzzling phenomena in infants’ responses to communication directed to them. We do not claim that exemplification is the only way children interpret reference to a particular object, as this would leave them unable to understand when someone communicates about specific objects or people. Rather, we propose that, if there are nonverbal referential acts that children interpret as referring to kinds, then such communicative acts can be utilized for expressing generic contents, which

in turn would allow infants to learn properties of kinds without resorting to inductive processes. We illustrate this point with a study that tested the effect of child-directed communication on children's tendency to generalize nonverbally demonstrated object properties.

Butler & Markman (2012) introduced a novel object, called a "blicket," to children and then demonstrated a dispositional property of the object (magnetism) in one of three different ways. For children in the pedagogical condition, the experimenter said, "Look, watch this," and he placed the object on a pile of paper clips before lifting it up with some paper clips attached. Thus, in this condition he used ostensive signals to indicate to the child that the action to be performed will be informative. In the intentional condition, he performed the same action without the preceding ostensive signals, hence without any markers to indicate to the children that the action on the object was a communicative demonstration. Thus, the same information about the object property was available to observers in this action, but it was not marked as communication directed to anyone. In the accidental condition, the experimenter appeared to accidentally drop the magnetic blicket on the pile, and when he picked it up, it also brought some paper clips with it. This action could also have informed children about the magnetic properties of the object, but not as the content of the experimenter's communication. In each condition, after revealing this interesting property of the blicket, the experimenter placed 10 blocks on the table, called them blickets, encouraged children to play with them, and left.

The question that this study aimed at answering was whether children would generalize what they had learned about a particular blicket to the other blickets and whether this generalization depended on how they acquired this knowledge. The trick that the experimenters adopted to answer this question was to let children play with 10 additional blickets, none of which had magnetic properties. By measuring children's perseverance in trying to make the inert blickets work on the paper clips, they could assess the generalization of the demonstrated property. The authors found that 4-year-olds tried longer and made more attempts with the blickets in the pedagogical than in the other two conditions. Three-year-olds' responses to the intentional condition were similar to those of the pedagogical condition, but follow-up studies showed that this was likely due to interpreting the whole situation, including the nonmarked demonstration in the intentional condition, as communication directed to them (Butler & Markman 2013). Butler & Markman (2012) concluded that, when children learn the property of an object by communication, they make stronger inferences about its generalizability to other objects of the same kind than they do with information acquired by individual learning or by mere observation of others. Thus, communicative content may uniquely support inductive generalization---a conclusion that is consistent with the original proposal of natural pedagogy (Csibra & Gergely 2009).

Here we propose an alternative interpretation of these findings, in which inductive generalization does not play a role, or rather, it plays a different role. According to this interpretation, when children learned the magnetic property of the original blicket outside communication in the intentional and accidental conditions, they attempted to inductively generalize this property to the other blickets. When they did so, they relied on the plausible hypothesis that other blickets would share this property with the original one. That is, they

learned (*a*) from the experimenter that the name of the demonstration object was blicket; (*b*) from their own observation that the demonstration object was magnetic; and (*c*) from the statement of the experimenter that the other set of objects were also blickets and then hypothesized that magnetism is the property of the object kind called blickets, hence the objects in the further set of blickets would likely exhibit magnetism (inductive generalization). This explains why children attempted to use the inert blickets on the paper clips a few times even in the accidental and intentional conditions. However, this inductively generated hypothesis was falsified by the data they collected (the blickets did not work on the paper clips), so they quickly abandoned it. In contrast, children in the pedagogical condition may not have learned anything specifically about the original blicket. If they interpreted the demonstration as expressing something about the blicket kind exemplified by the particular blicket used in the demonstration, the nonverbally demonstrated property of magnetism might have been bound directly to the kind rather than to the particular object. In other words, the demonstration might have been interpreted the same way as a linguistically conveyed generic expression ("Blickets are magnetic"), i.e., it could have been an instance of communication expressed in nonverbal generics. If this was the case, children did not have to make any inductive inference about the novel set of blickets they were exposed to during the test phase. In fact, rather than performing inductive generalization, they would have had to make a deductive inference from kind to particulars, such as (premise 1) "blickets are magnetic," (premise 2) "these are blickets," (conclusion) thus, "these are magnetic."

In this alternative explanation, the effect of the communicative demonstration, compared to the noncommunicative ones, is not incremental (a stronger urge to generalize) but is based on a qualitatively different inference. Children persevered more on the inert blickets in the pedagogical condition not because their generalization was stronger than in the other conditions but rather because they had already learned that blickets, as a kind, were magnetic. Thus, when they found a blicket that did not work on the paper clips, this counterexample did not weaken their belief in blickets being magnetic, but it informed them about the particular object in hand: they concluded that it was broken. Such a conclusion could not have been applied en masse to further blickets, which explains children's persistent perseveration in the face of negative evidence. Just like linguistic generic expressions, which are not invalidated by counterexamples (Leslie et al. 2011), nonverbally acquired kind-linked knowledge also seems to be resistant to negative evidence.

The validity of this alternative explanation hinges on the assumption that children interpreted the communicative demonstration as being about a property of the kind exemplified by the blicket used in the demonstration. Note, however, that nothing in the experimenter's actions marked the demonstration as such: It could have revealed the idiosyncratic property of the particular blicket used in the demonstration as much as it conveyed something about its kinds. This ambiguity of demonstrative deictic reference is important: Without using language, it may be difficult to explicitly indicate whether the intended referent is the particular object highlighted by the action or the kind it represents. In specific situations, contextual factors may allow the addressee to infer the likely referent. For example, in the Butler & Markman (2012) scenario, the introduction of an unfamiliar

object may have prompted children to interpret the pedagogical demonstration as revealing something about a novel kind. In contrast, when infants are engaged in a hiding-finding game, they may expect to receive referential information about the whereabouts of a particular object (Behne et al. 2005, 2012). In other situations, such as when children receive evidence on sample composition (Rhodes 2012) or a contrast between particulars is explicitly communicated (Meyer & Baldwin 2013), they can utilize this information to determine the scope of reference. But in contexts where there are no sufficient cues to expect certain types of communicative contents, the referent may remain ambiguous.

A recent study, which employed a change detection paradigm with adults, created such a context (Marno et al. 2014). In each trial, participants had to memorize an array of five novel objects presented on a computer screen. One of the objects was highlighted by the action of a person in the video: She either communicatively pointed to, or noncommunicatively reached toward, an object. The screen then went blank, and two seconds later the object array reappeared with a change. The participants' task was to identify the object that was affected by the change. Crucially, two kinds of change occurred: Either an object was replaced by another object (identity change), or an object was slightly shifted back or forth (location change). Although the presence of the actor and her actions were irrelevant for the task, they influenced the responses. In the noncommunicative context, the participants were more likely to detect location changes than identity changes of the cued objects, whereas the opposite was true in the communicative context. Thus, deictic reference (here: pointing) to a particular object made it difficult to encode its exact location. This negative effect of communication was even more striking when change detection was compared between the cued and the uncued objects. Overall, highlighting an object via an action increased the probability of detecting changes affecting the cued object compared to uncued ones. However, when the cue was communicative pointing, it did not have a facilitatory effect on the detection of location change.

This is a paradoxical phenomenon of spatial attention: If a target is selected as the potential referent of a communicative action, the location (but not the identity) of that object is less likely to be encoded in short-term memory, even though the pointing gesture specifies this target by its location. This finding, although seemingly paradoxical, is well explained by the idea that the immediate referent object of a communicative action may not be its real referent but rather only a mediator toward the actual referent. If the actual referent is the object kind exemplified by the target object, the properties of the particular object should be ignored as irrelevant. Just like the peculiarities of a photograph (e.g., its size) are irrelevant when the photo mediates the communicator's reference to the depicted content, the exact location of an object acting as an exemplar of the ultimate referent is unimportant. The findings of Marno et al. (2014) indicate that, in certain ambiguous communicative contexts, where nothing is expressed about the referent and prior information does not clarify the communicative content, addressees tend to interpret the referent of a deictic action to be the object kind represented by the immediate referent.

Preverbal infants display similar effects. When young infants observe an object, they are more likely to encode its spatio-temporal properties, such as its location or motion path, than its visual features (Xu & Carey 1996). If an object is hidden behind an occluder and then the

occluder is removed, they are more likely to show surprise in the form of increased looking time when the object disappears, or reappears at another location, than when the object has miraculously changed into another one (Mareschal & Johnson 2003, Simon et al. 1995, Wynn & Chiang 1998). However, if the object is presented in a communicative context, as the referent of a pointing gesture, the encoding priorities are swapped around (Yoon et al. 2008). In this case, 9-month-olds tend to detect the change of the object identity while failing to notice a location change. Here, just like in the study with adults (Marno et al. 2014), the objects were unfamiliar, made-up objects that could not have been assigned to known kinds. Thus, it is unlikely that communicative reference to such a novel object would have brought a certain object kind into infants' mind, though it is possible that the object induced them to open a placeholder for its kind. Either way, this finding supports the idea that communicative reference shifts infants' attention to properties (e.g., visual appearance) that may extend to other objects of the same kind, and away from properties (e.g., location) that are restricted to the particular object in the scene.

Location is not the only object property that is irrelevant if the actual referent of communication is a kind. If the immediate referent of a communicative action is a set of objects (of the same kind) and is interpreted as referring to the kind the objects represent rather than to themselves, the number of individuals in the set can also be considered incidental (cf. Gelman et al. 1998). Chen and colleagues (2011) presented 9-month-old infants two or three objects of the same kind on a stage, and the objects were then hidden behind an occluder. It is known that infants at this age can discriminate between sets of two and sets of three objects and can maintain their numerosity during occlusion (Feigenson et al. 2004). Indeed, in a noncommunicative context, in which the person who placed the objects on the stage never made eye contact with or talked to them, the infants looked longer when a different number of objects were revealed behind the occluder than when the same number of objects of a different kind emerged. This result replicates earlier findings that indicate that infants are more sensitive to changes in count than change of kind in sets of objects (e.g., Simon et al. 1995). Nevertheless, when the objects were presented by a person who communicated either visually (eye contact, waving, gaze alternation) or auditorily ("Hi baby! Look at these!") with the infants, their looking behavior indicated a different pattern of what they encoded in their short-term memory: Infants looked longer at the kind change than at the numerosity change. Eye-tracking measures indicated that this shift was not due to difference in attention between the two contexts (Chen et al. 2012).

These studies do not provide conclusive evidence that infants (and adults) interpret object-directed nonverbal communication as expressing generic knowledge (i.e., as instances of nonverbal generics). Nevertheless, they show that in communicative contexts people pay less attention to those properties of referents, such as location and numerosity, that are the most informative for specifying and keeping track of the objects in the actual context. This would be a puzzling neglect if the addressees of the communication were prepared to be informed about the particular referents present in the scene. Ignoring these properties makes sense, however, if these objects are taken as mediators of the communicator's actual referential intention, which is the object kind they exemplify. In this case, the highlighted object plays the role of an ad hoc symbol because it represents its own kind---not only in the sense that it is an exemplar of that concept, but also in the sense that it stands for that kind.

If so, the object-specific attributes of symbols can be forgotten as soon as they fulfill their role in forwarding the reference toward something else. Note that we use the term “symbol” here not in the sense as it plays in Peirce’s classification of signs, but rather in the more general sense of “something that is intended to stand for something else than itself” (DeLoache 2004). It is also important to emphasize that this symbolic function lasts no longer than the episode of communication in which the object is involved, and it does not stick to the object. Although when an object acts as a symbol of its own kind, it lacks some properties traditionally associated with symbols (arbitrariness, conventionality, fixed use; see, e.g., Namy & Waxman 2005), it may nevertheless represent one of the ontogenetically earliest ways of how objects could acquire at least temporary symbolic functions (i.e., “aboutness”) during communication. In the remainder of this article, we briefly discuss the implications of this proposal for two domains of early communicative development: the use of object labels and the understanding of symbolic artifacts.

OBJECTS AND OBJECT LABELS

When an object is interpreted as a symbol to its kind, it serves a function similar to a common noun, i.e., it refers to an object kind. However, words are much more flexible symbols than are objects because they can also identify further objects that belong to the same kind. A label can designate an object as a member of the kind that the word as a symbol refers to; an object as a symbol can designate a kind it belongs to as the referent. (This contrast is analogous to Nelson Goodman’s distinction between denotation and exemplification; see Goodman 1976.) In principle, whatever one learns about a kind via communication can be deductively extended to other objects of the same kind. When the kind that an object exemplifies is familiar to the addressee, this is a trivial task. For example, if a new way to use a cup is demonstrated to 1-year-olds, who are known to be able to identify a cup as “a cup,” they can apply this knowledge to other cups---as long as they interpret the demonstration object as a symbol of cups. If the object is unfamiliar, infants may use their conceptual knowledge to hypothesize what properties characterize the members of the kind exemplified by the object and thus identify the referent kind. For example, infants pay much attention to social interactions and are likely to have concepts of the social roles that agents play in them, such as “helper” (Hamlin & Wynn 2011, Kuhlmeier et al. 2003), “chaser” (Csibra et al. 2003, Rochat et al. 1997, Southgate & Csibra 2009), or “dominant” (Mascaro & Csibra 2012, 2014; Thomsen et al. 2011). It is possible that whatever infants learn about such an agent when it serves as the referent in communication would be extended to other novel agents when they play the same role.

Learning about novel kinds via nonverbal communication confronts the addressee with a more difficult job: She has to set up a new kind concept, about which she would know only that a particular object is an exemplar of, and that a certain attribute (a nonlinguistically expressed predicate) applies to it. In this case, one could rely on heuristics to guess what properties are shared among objects of this novel kind. One of these heuristics is the so-called shape bias, according to which objects sharing the same shape likely belong to the same kind (Diesendruck & Bloom 2003, Landau et al. 1988). However, this bias itself is the result of learning and may not be available to young infants (Smith et al. 2002, Xu et al. 2009). Children may also use the predicate expressed about an object as the defining

property of the kind it symbolizes, when this predicate is conceptually relevant, like the function of artifacts (Dewar & Xu 2009, Träuble & Pauen 2007). For example, after a pedagogical demonstration of magnetism of a blicket in a follow-up study of Butler & Markman (2012), children thought that only those further objects were blickets that could pick up paper clips, regardless of their superficial similarity, including shape and color, to the demonstration object (Butler & Markman 2014). Infants also identify artifact kinds by their demonstrated function as evidenced by the fact that they infer the number of objects on the basis of the number of demonstrated functions in an object individuation task (Futó et al. 2010).

There is, however, a predicate that does not simply allow, but also authorizes, the identification of other entities as belonging to the same kind as the exemplar: the name applied to the object (cf. Gelman 2004). Ostensive naming of a novel object therefore provides two types of information to the addressee: a property (i.e., the name) of the kind that the object exemplifies and a label by which other objects of the same kind can be identified. A corollary of the proposal that infants might treat a referent object as a symbol of its kind during communication is that an ostensively communicated name will be interpreted as a kind label rather than the name of the particular object. If this is correct, there may be no need to invoke lexical principles or constraints to explain how children can learn an object label as a name of a kind or a category, rather than as a proper name, even when it is applied to a single object (Golinkoff et al. 1994, 1995; Markman 1989; Waxman & Booth 2000). When the grammatical form or the ontological category of the referent disambiguates that a label is a proper name, children use this information appropriately (Hall 2009). However, in the absence of such cues, children may tend to interpret object labels as kind names in ostensive contexts (Markman & Jaswal 2004, Woodward et al. 1994).

Our point here is not that lexical principles or constraints do not guide word learning (they do: Golinkoff et al. 1994, 1995; Markman 1989) or that ostensive naming would be necessary for acquiring object labels (it is not: Akhtar 2005, Jaswal & Markman 2003). Rather, if, as we propose, objects can act as symbols to their kind, what is unique about object labels is not that they can refer to kinds or conceptual categories but that they can identify the extension of the concept, i.e., the set of all objects that belong to the kind. This has been demonstrated by a long series of studies by Sandra Waxman and colleagues (e.g., Waxman & Braun 2005, Waxman & Markow 1995). In short, when the same word is applied consistently to a set of objects, infants as young as 4 months tend to treat the objects as members of a single category and extract the invariant features from them. Infants do this by assuming that the visually presented objects (accompanied by ostensive signals, such as infant-directed speech) are exemplars of a kind, while the repeated label suggests to them that the objects are exemplars of the very same kind. The fact that such information induces the extraction of common features among the objects indicates that infants expect to find further shared properties that they may potentially use for identifying more members of the same kind. Note, however, that sharing visual features is not a requirement for a set of objects to belong to the same kind. A common label, even in the absence of common visual features, should, in principle, inform infants that the referenced objects exemplify the same kind (Parise & Csibra 2014).

Although using the same words to label different objects would clarify that they belong to the same kind, the opposite inference also applies: labeling two objects with different labels suggests that they might belong to different kinds. Evidence that infants do indeed draw such inferences comes from object individuation studies. When 10-month-old infants observe two different objects emerging one by one from behind an occluder, they will not necessarily conclude that at least two objects are located behind the occluder (Xu & Carey 1996). However, if they know the label for the objects (Rivera & Zawaydeh 2007), or if the objects are labeled for them with different names when they become visible (Xu 2005) or even while they are hidden (Dewar & Xu 2007), infants infer the presence of at least two objects, even if the two objects look exactly the same (Xu 2005). This effect of labeling is arguably mediated by the assumption that labels sort objects into exclusive kinds, hence two objects of different kinds are unlikely to be the same individual.

OBJECTS AS SYMBOLS

At first sight, the proposal that young infants can take objects as symbols appears to contradict a host of findings that suggests that understanding the representational nature of symbolic objects displays a protracted development in early childhood. For example, young children have serious difficulties with using a scale model in search tasks (DeLoache 1989), with understanding replicas as referential symbols to real objects (Tomasello et al. 1997, 1999), or even with recognizing the equivalence relations between actions performed with toy replicas and their real counterparts (e.g., Johnson et al. 2005). However, these difficulties may not necessarily arise from children's inability to grasp the notion of symbol per se, but rather may be due to the difficulties in grasping (*a*) that iconicity itself could be a cue of symbolic function and (*b*) the use of symbolic objects for denoting particular entities (as opposed to kinds) in the world.

Most symbolic artifacts, including pictorial representations, are iconic in nature: They represent their referent by sharing some features with it and therefore resembling it in some way. However, the resemblance relation fulfills a symbolic role only if it is intended to do so: if the object is a conventional artifact created to represent something or it is employed in communication to refer to something. Even if the child understands that one or both of these conditions are met, the iconic relation between the object and its referent is still undefined because there could be multiple ways to map features from one object to another (or to a kind). Is it the shape, the color, the texture, the material, or the internal structure that matters? The answer depends on conventions of how symbolic objects refer and on the background knowledge of the target domain that children bring into the situation. Just like infants have to acquire the shape bias during the course of word learning by abstracting away a particular type of feature that is reliably consistent across object kinds in certain domains (Smith et al. 2002, Xu et al. 2009), they also have to learn which of the many possible features of symbolic objects allow them to refer to something and how.

It is thus not surprising that children have much less difficulty in grasping the referential intention behind symbolic objects when they are used as novel indexical signals (such as markers placed on target locations) than when the objects are replicas of the referents (Tomasello et al. 1997). In this situation, the fact that the referent was a particular container

rather than a kind of object might also have helped children because indexical signs (such as pointing or marking) are more frequently employed than iconic signals (such as replicas or pictures) to indicate particular individuals in the actual context. However, the mapping between the type of signal and the type of referent is not perfect, and in ambiguous contexts, children would not necessarily interpret indexical signs as referring to particulars. Meyer & Baldwin (2013) found that parents were more likely to point to pictures when they talked to their child about specific individuals depicted in the pictures than when they made generic statements about the kind of animals or artifacts represented. This confirmed the association between indexical signals and particular referents mentioned above. However, 3- and 4-year-olds interpreted ambiguous verbal statements as generic expressions even when they were accompanied by pointing gestures, and only 4-year-olds relied on pointing to restrict the referents to particulars when they were used to contrast two subsets of individuals (in fact, even in this case 40% of them went for generic interpretation; see Meyer & Baldwin 2013). These results indicate that deictic gestures are not distinctly linked to particular referents in early development.

If children tend to interpret communicative signals, such as pointing, as referring to kinds of objects even if they are more frequently used to denote particulars, then their difficulty in understanding symbolic use of objects may also be explained by the specific test situations in which they are expected to make a mapping between symbolic objects and particular referents. Tomasello et al. (1999) tested whether children could choose a target object indicated by iconic gestures or objects. Children below 2 years succeeded in this task with gestures representing the conventional use of the target object, but they failed if the sign was an object differing only in color from the target object. In the now classic scale model task, in which children are expected to find a hidden object in a room on the basis of location information received about a model room matching the spatial arrangement of the target room, children below 3 years of age are clueless (for a review, see DeLoache 2002). Their failure is not due to inability to see the similarity between the model and the target room, given that they succeed when the perceived relation between the model and the target is not symbolic but causal (DeLoache et al. 1997). However, to solve this task, children have to understand that the model (with all its iconic features) represents not just a room, but the particular one in which they have to find the hidden object.

In contrast, when pictorial representation is used for referring to an object, not as a particular one but as a representative of its kind, even younger children tend to succeed. This is evident in tasks where 18-month-old infants learn a word for an object in a picture, and later they successfully select the referent of this word as the object represented rather than the picture of the object (Geraghty et al. 2014, Preissler & Carey 2004). The fact that young children do not readily extend a name to other objects of the same shape but different color (Ganea et al. 2009) indicates that word learning may not provide them with information about the properties that are kind relevant and that the shape bias is not yet strong enough to overcome their conservatism. However, note that the successful mapping between the symbolic object (i.e., the picture) and the real one is achieved in this task by identifying the kind that the object in the picture exemplifies and the word assigned to the picture denotes. In contrast to infants' success in this task, even 4-year-olds fail when they have to interpret photographs as referring to particular objects in particular states (e.g., Donnelly et al. 2013). Conventions

and manipulability also contribute to how people use objects in communication. Parents and children are more likely to use generic phrases for pictures than for replica objects. However, when the objects cannot be touched, the difference between replicas and pictures in how much generic language is elicited becomes smaller and even reversed if the depicted entity is an artifact (Gelman et al. 2005).

The developmental trend that seems to emerge from these studies is that understanding the symbolic function of an object is easier and comes earlier when it refers to an object kind than when it refers to a particular. This characterization of development is analogous to the analysis of Rakoczy and colleagues (2005), who observed a delay between grasping “nondenoting” (i.e., kind-referring) and “denoting” (particular-referring) symbolic acts and symbolic use of objects. Whereas Rakoczy and colleagues emphasize what infants and young children are (yet) unable to understand when confronted with symbols (i.e., that symbols can be referential in the narrow sense of denoting specific states of affairs in the world), we focus on what they can understand: that objects can stand for abstract concepts, such as kinds. If this is the starting point, then the development of symbolic understanding of objects involves (at least) three steps. The first one is the learning of when an object, highlighted by communicative acts, does and does not exemplify its kind. Young infants do indeed seem to commit the mistake of failing to encode the location of deictically referred objects even when it is the most relevant property in a situation, such as in a hiding-finding game (Topál et al. 2008). Second, infants have to be able to understand that an object can act as a symbol for not only its own but also for another kind. This is what they do when they learn words for objects represented in pictures (Preissler & Carey 2004) and when they are engaged in substitution pretense (cf. Rakoczy et al. 2005). The object used in substitution pretense (e.g., a banana) is stipulated to be a member of another kind (e.g., a telephone)---any member, not a particular one (not a specific phone). As a third step, children have to learn the conventionalized ways of decoding (usually iconic) symbolic relations. When they have done so, symbolic artifacts may carry representational content for them even outside communicative interactions.

A final note about the representational nature of symbols. In order to properly appreciate objects as symbols, one has to represent them both as representations of something else and as physical objects themselves at the same time (DeLoache 2004). Plenty of evidence shows that achieving this dual representation is a difficult task for young children: They are prone to confusing the two representations or to ignoring one by favoring the other. These findings, however, do not contradict the proposal that infants may, in certain circumstances, interpret objects as ad hoc symbols standing for their kind. Indeed, the fact that infants (and, unwittingly, adults) tend to ignore the location of these objects only in communicative contexts confirms that as soon as a potential symbolic function is attributed to an object, this object is no longer tracked the same way as ordinary physical objects. In other words, when an object acts as a representation, it is no longer interpreted as an object itself, making parallel tracking of its dual nature unnecessary. Mastering dual representation of a single object may be a precondition to treat symbolic objects as representations (of kinds or individuals) even when they are not directly involved in ostensive communication.

CONCLUSIONS

We can only interact with specific objects, though most of our interactions with objects require us to recall information about properties belonging to their kinds rather than to the specific ones. It is then not surprising that children show an inclination to learn about kinds over specific individuals (Cimpian & Park 2013). In language, generic statements that employ kind labels are the usual medium through which kind-relevant information is conveyed, and both adults and children use generic language when they intend to transfer their knowledge to others (Gelman et al. 2014).

Susan Gelman (2004) proposed that language plays two roles in influencing children's knowledge of kinds that cannot be accomplished by other means: (*a*) naming uniquely allows the identification of individuals belonging to a kind, and (*b*) generic expressions teach children category-wide generalizations. Although we agree that the first function may be specific to language, the proposal we put forward in this article assumes that the second function may not require linguistic communication. As long as there is a nonlinguistic symbol for a kind, anything expressed about it will be bound to the kind rather than to the symbol itself. Thus, if an object can act as an ad hoc symbol of its kind in communication, a demonstration on this object amounts to a nonverbal generic statement about its kind. If this is correct, what may not be easy to express nonverbally is that a property is restricted to a particular object. Ironically, it is language that can help here: One function that various grammatical devices, such as determiners and other quantifiers, serve is the disambiguation of the referential scope of otherwise ambiguous expressions using kind terms.

Thus, infants do not have to learn that, in communication, objects can stand for something else than themselves---what they have to learn is that they can stand for something else than what they naturally exemplify: their own kind. Beyond allowing infants to learn kind-generic knowledge without sophisticated linguistic abilities and without inductive generalization, interpreting objects as symbols of their kind may also be one of the roots of all symbolic capabilities that a child goes on to acquire.

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Glossary

Addressee	the person (or persons) who are targeted by a specific communicative act
Deductive inference	inferring the properties of an individual item from the knowledge about the kind or type it belongs to
Deictic gestures	gestures, such as pointing, that specify their referent, such as an object, directly within a context shared by the communicator and the addressee

Generic expressions	statements that express generalization along a specific dimension. The most frequent generic sentence type asserts something about a kind of entity (“cats have four legs”), which can be contrasted with assertions about a specific individual (“my cat has four legs”) or about a group of individuals (“those cats have four legs”)
Generic knowledge	knowledge about kinds as opposed to specific individuals or specific situations. Such knowledge enables one to deductively infer properties of individual items belonging to the kind
Iconic gestures	gestures that mimic some properties of the referent, such as an action (e.g., pretending to drink), a property (e.g., a circular shape), or manner (e.g., speed)
Inductive generalization	extending something that is learned about a single item or small set of items to a whole class, such as when the bitter taste of a novel vegetable is expected to characterize the kind of vegetable
Ostensive communication	communicative acts that advertise themselves as communicative by making it explicit that they are intended to inform or influence someone else (the addressee). One way to make a communicative act ostensive is to accompany it by ostensive signals
Ostensive signals	communicative signals, such as eye contact, calling someone by name, or using special intonation, that allow people to identify communicative actions as deliberately targeting them. Even young infants show sensitivity to some of these signals
Referential signals	communicative signals that indicate something external to the communicator. Referential signals can be nonverbal (deictic, iconic, or symbolic) gestures, vocalizations (such as alarm signals of various monkey species), or verbal utterances, such as words
Symbolic gestures	gestures that have been associated to a particular meaning in a society, such as “thumbs up” or a “V” for victory
Exemplification	a referential relation introduced by Nelson Goodman, in which a sample stands for some property the sample possesses or for an object kind the sample belongs to

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SUMMARY POINTS

1. Infants expect to receive referential signals in communicative contexts, which are established by ostensive signals. This expectation allows them to learn how various referential signals, including deictic gestures and object labels, pick out objects in their environment.
2. Objects ostensively acted upon can be treated as deferred indexicals: They can be signs that further refer to the kind they exemplify. Evidence shows that, in the absence of contextual information indicating otherwise, infants, children, and adults tend to take an object as a symbol for its kind.
3. The interpretation that an object represents its kind allows for nonlinguistically expressed predicates about the object to be taken as kind-generic knowledge. Children benefit from such nonverbal expressions, which enable them to learn properties of kinds without inductive generalization.
4. Object labels are referential signals to kind concepts, but they have the additional virtue of allowing the identification of the extension of the concept.
5. Children may have difficulties in understanding the symbolic uses of objects because they tend to take them as referring to kinds and not to particulars.