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Early Referential Understanding: Infants' Ability to Recognize Referential Acts for What They Are

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Previous research has documented infants' ability to follow adults' line-of-regard and pointing gestures by 9-12 months of age, but it has not been clear whether infants appreciate that such cues are a privileged source of information about word reference. Study 1 demonstrated that this is understood by at least 19-20 months: Infants used referential cues to guide a new word-object mapping even though this required that they ignore competition from temporal contiguity. In Study 2, the effects observed in Study 1 were not obtained with actions that served to enhance the salience of an object nonreferentially (e.g., manipulating without looking), suggesting that infants appreciate that actions that accompany labeling are not necessarily referential. Taken together, these findings indicate that language learning is grounded in a relatively rich understanding of cues to reference, at least from late infancy on.

Among students of language, there is nearly universal agreement that referential understanding is a pivotal element of linguistic competence. That is, a bona fide language user appreciates, at least tacitly, that words and phrases convey information by virtue of shared knowledge about their relation to things external. This understanding provides the foundation for putting language to communicative use.

Given the centrality of referential understanding, surprisingly little is known about its ontogeny, although there is reason to believe that infants do not greet the world in possession of the full spectrum of adult knowledge about reference. For example, adultlike knowledge of reference includes the notion that acts of reference are potentially ambiguous and may be difficult for an addressee to interpret accurately. There is now considerable evidence that young children typically fail to appreciate properly the interpretive difficulties facing an addressee (e.g., Ackerman, 1981; Beal & Belgrad, 1990; Robinson & Whittaker, 1985). An understanding of the necessity for designing utterances to ease the listener's interpretive burden seems to develop over an extended period. Perhaps, however, other components of referential understanding are acquired on a relatively condensed developmental schedule.

What infants and children do and do not understand about reference will be an important determining force for language learning (Bruner, 1983; Macnamara, 1982). If referential understanding is entirely absent, for example, word learning can occur only by mechanisms of association such as temporal contiguity. That is, without referential understanding of any kind, children would experience no impetus to search for a possible referent[1] when hearing others speak, and word-to-world relations would be established only because associative principles come into play; a word would come to be related to a certain external thing only because, over a number of occasions, infants happened to hear a certain sound pattern when they were focused on the correct thing. If early word learning indeed reduces to associative processes, then the path to learning will necessarily be slow and fraught with error (Baldwin, 1991, in press; Macnamara, 1982). On the other hand, if infants possess some basic elements of referential understanding, the path to learning will be expedited. To illustrate, imagine that infants understand both that (a) words are likely to bear some relation to things external—people use words to talk *about* things and (b) speakers typically offer cues concerning the target of their referential intent—cues that clarify the relevant external thing. When a new word is heard, infants could then initiate a search for a potential referent of the utterance to link with that word, and they could consult cues from the speaker to guide that search. Because parents typically supply a rich and redundant set of cues in speech to young children, just one exposure to a new word might well be enough for well-equipped infants to register considerable information about the reference and meaning of the new term. Word-world relations could be established both rapidly and with a modicum of error.

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[1] Following Lyons (1977), a convention will be observed throughout the article regarding the use of the term *referent*. Lyons writes, "it is the speaker who refers (by using some appropriate expression): he invests the expression with reference by the act of referring. It is terminologically convenient, however, to be able to say that an expression refers to its referent (when the expression is used on some particular occasion and satisfies the relevant conditions)" (p. 177). It is in this sense, for example, that it can be said that a given object is the referent of a particular utterance.

Some recent evidence indicates that the former component of referential understanding—the expectation of aboutness—may already be a part of infants' repertoire from the very early phases of language learning. In a review of empirical evidence about developments in social cognition, Wellman (1993) argued that infants appreciate the "aboutness" of social action, including language, from as young as 9–12 months. And in the language domain specifically, Baldwin and Markman (1989) found that infants as young as 10–14 months attended longer to novel objects when language accompanied the presentation of those objects than when objects were presented without accompanying speech. Moreover, infants showed no increase in attention to the speaker (the source of the sounds), only to the object indicated. These findings suggest that infants expected the speech they were hearing to bear some relation to the objects they were viewing.

What infants understand about the latter component—that speakers provide cues to clarify their referential intent—is still very much in question. Although there is now evidence from research concerning children's developing "theory of mind" that preschool-age children appreciate certain aspects of intentionality (e.g., Moses, 1993; Shultz, 1980; Shultz & Wells, 1985), there is little relevant evidence from the infancy period, and none that clarifies whether referential intent, in particular, is understood. The present research was designed to provide three crucial pieces of information regarding referential understanding during infancy. First, if infants are found to actively seek and use referential cues that speakers provide, then it becomes plausible that they appreciate the speaker's underlying intent to refer. However, infants' reliance on referential cues might reduce to the operation of low-level mechanisms such as associative principles or salience. Thus, a second goal was to rule out such reductionist factors as the sole source of infants' referential abilities. The third purpose was to test whether infants can distinguish referential from nonreferential acts; such an ability would provide additional evidence for their ability to appreciate and recognize another's referential intent. What is required is to show that infants interpret actions that accompany speech as cues to reference only when the speaker shows clear-cut signs of referential intent. Techniques for obtaining evidence on each of these points are discussed in turn.

Regarding the first issue, in Baldwin (1991, in press), infants showed an ability to actively consult cues that speakers provide regarding the reference of their utterances. A *discrepant labeling* situation was designed in which infants would establish an incorrect word–object mapping if they failed to appreciate the relevance and significance of cues such as line-of-regard for determining the speaker's reference. Infants were shown two novel objects and were given one to play with while the experimenter retained the other. When the infants' attention was focused on the toy in their own possession, the experimenter looked at and labeled her own toy, the result being a discrepancy between the infants' focus and that of the speaker at the time the label was uttered. Without an ability to consult the speaker for cues to reference, infants should fall prey to a mapping error—principles of association would lead them to link the new label with the toy of their own focus. On the other hand, if infants appreciated the relevance of the speaker's nonverbal cues (e.g., line-of-regard and body orientation directed toward her own toy), they could consult these cues and thereby establish the correct word-to-object link. In two separate studies, infants readily glanced up at the experimenter when discrepant labeling occurred and followed her gaze to the object of her focus. Furthermore, subsequent comprehension questions revealed no appreciable incidence of mapping errors during discrepant labeling. Infants throughout the 16- to 19-month range showed no tendency to link the new label with the toy they were actually focused on when they heard the new label. Infants of 16 to 17 months failed to link the new label with either of the novel objects when discrepant labeling occurred, whereas 18- to 19-month-olds established a stable mapping between the label and the object of the *speaker's* focus. These findings suggest that infants appreciate that speakers provide cues that are relevant to interpreting new words and spontaneously consult these cues when faced with discrepant labeling.

However, several questions arise regarding the referential abilities infants displayed in these studies, questions which bear on (a) whether these findings indeed provide evidence for early referential understanding and (b) even if so, the extent to which this ability could actually influence the course of early word learning. As described, the discrepant labeling situation was designed such that infants were focused on an incorrect object at the time a novel label was heard. Temporal contiguity should push infants toward linking the new label with the incorrect object, yet infants avoided this error, instead linking the label with the object specified by the speaker's referential cues. However, one could argue that temporal contiguity was only weakly instantiated as a competing force to referential cues in this methodology. Although infants were indeed focused on an incorrect object at the time the label was uttered, their tendency to check for cues led them to immediately look away from this object to glance at the speaker and then down to the correct object. The lag between hearing the novel label and locating the correct object was very short, only 1–2 s in many cases. Thus temporal contiguity had little opportunity to operate in favor of a mapping error. Perhaps infants would show little ability to block mapping errors if temporal contiguity were a more robust competitor. One purpose of the present research was to examine infants' reliance on referential cues in the face of much more powerful opposition from temporal contiguity. Study 1 provides a test of this issue.

Also in question is the mechanism underlying infants' use of referential cues to guide word–object mappings, the second criterial issue raised earlier. On a rich interpretation, infants consult cues such as line-of-regard because they appreciate that these cues are a source of information regarding the speaker's referential intent. However, a simpler mechanism might be responsible for the abilities infants have displayed. It has been clear for some time that infants as young as 9 months are sensitive to cues such as pointing and changes in line-of-regard and readily follow another's gaze (e.g., Butterworth, 1991; Butterworth & Cochran, 1980; Leung & Rheingold, 1981; Murphy & Messer, 1977). What has remained unclear is why infants follow these cues; their level of understanding about the significance of such referential cues has remained unclear. The earlier findings (Baldwin, 1991, in press) indicate that infants of 16–19 months make use of cues when interpreting the reference of another's utterance, but this may or may not be due to an under-

standing that these cues index the other's focus of attention and, hence, are informative about the likely target of their referential intent. Perhaps referential cues merely increase the salience of a particular object for infants, and cues are used to direct new word mappings because infants are simply linking a new label with the object that is concurrently of greatest salience. The plausibility of such a salience mechanism was put to the test in Study 2.

Finally, the existing findings do not clarify whether infants are able to distinguish between acts that are indeed referential (from the adult point of view) and those that are not. An act of reference typically involves a variety of cues specifying the correct referent. For example, in the earlier work, line-of-regard, body and face orientation, and voice direction were among the cues available to infants regarding the correct referent of the speaker's utterance. Redundancy and clustering of cues seems to be typical in parents' speech to young children (e.g., Kaye, 1977; Masur, 1982; Messer, 1978, 1983). It is important to recognize, however, that the presence of such cues does not, in every instance, guarantee that the speaker is indeed referring to the object associated with those cues (e.g., Macnamara, 1982). That is, actions such as changes in line-of-regard, body and face orientation, touching, or holding an object can also accompany language when the object involved is not the referent of the utterance. For present purposes, I call such cases *nonreferential acts*—cases in which actions toward objects are not linked to any immediate referential intent on the part of a speaker. For example, a parent happens to reach out and pick up a toy dinosaur in the process of cleaning up while saying, "Yes, it's time for bed." In this instance, the action of selecting a toy does not supply information regarding the term *bed.* The general point here is that an utterance may coincide with one or some combination of actions, yet in some cases it would be a mistake to use those cues to interpret the reference of that utterance. What then might serve to distinguish referential from nonreferential acts? Certain cues are sometimes available in the speech stream itself; for example, when I say, "The object of my regard is a *dax*" or "Hey, there's a *dax* in here," I am supplying lexical and syntactic information that the utterance refers to the object at issue. Infants' ability to take advantage of such lexical and syntactic cues to an act of reference would of course be limited initially, but some ability to do so may be emerging by the end of infancy given the lexical and syntactic knowledge documented for this age group (e.g., Gleitman, 1990; Hirsh-Pasek & Golinkoff, 1991; Naigles, 1990; Naigles, Gleitman, & Gleitman, in press). On the action plane, line-of-regard seems somewhat privileged as an index of referential intent. Actions such as offering, touching, or manipulating may often be viewed as nonreferential if they are unaccompanied by gaze toward the object concerned. Having said this, however, I should note that probably no single cue is taken as either necessary or sufficient as an index of referential intent, at least by adults. It seems likely that adults' inferences about another's referential intent are based on a complex weighting of the cues available in conjunction with background knowledge concerning the conversational context as well as the capabilities and propensities of the speaker. In question is whether infants, like adults, appreciate that utterances need not be taken to refer to an object in view, that is, whether infants can discriminate referential from nonreferential acts in at least some cases. This question is also addressed by the second study.

Study 1

As discussed, an initial question is whether infants indeed possess a real and robust understanding that speakers provide cues to reference that are informative about word–object relations. Although earlier work (Baldwin, 1991, in press) suggests that they do by at least 18 months, in the discrepant labeling scenario that infants experienced in that research, temporal contiguity did not conflict in a powerful way with referential cues: Infants could immediately look away from the object of their own focus on hearing the novel label, and within a second or two, they could fixate the correct referent. Thus there was only a very short delay between presentation of the label and infants' sighting of the correct object.

A survey of the literature regarding associative learning indicates that, generally speaking, conditioning depends crucially on nearly simultaneous presentation of the unconditioned and conditioned stimulus in classical conditioning, or the operant and reinforcement in instrumental conditioning (Holland, Holyoak, Nisbett, & Thagard, 1986). Typically, conditioning will not occur if delays are greater than several seconds in length. Because infants tended to look away from the incorrect object and toward the correct object within this crucial span of several seconds in the earlier studies, it may not be accurate to characterize this as a situation in which temporal contiguity encouraged infants to link the new label with the incorrect object, while referential cues alone specified the correct object. Instead, it may be that temporal contiguity was partially responsible for infants' success at linking the new label with the correct object, because infants tended to fixate that object within a few seconds of hearing the new label. The primary purpose of the first study was to present infants with a novel label in a situation in which temporal contiguity and referential cues were in strong conflict, each uniquely specifying a different object. This was achieved in a *conflict* condition, in which infants were prevented from viewing the referent specified by the speaker's referential cues until at least 10 s after the label was uttered, a delay well beyond the 2–3-s limit recognized as typically necessary for effective conditioning. During the 10-s period before display of the correct object, infants had the opportunity to examine a different object, one toward which referential cues were not directed at the time of labeling. In question, then, was whether infants would (a) avoid linking the new label with the toy that was present during the 10-s period immediately after the label was heard (called the *first toy*) and (b) succeed at mapping the new label to the object specified by referential cues (called the *second toy*), despite the more than 10-s gap between hearing the label and viewing this object.

To provide a basis against which to compare infants' success at word learning in the conflict condition, half of the infants in the study were introduced to new labels in a *coincide* condition. Here, infants heard a new label in exactly the same scenario as in the conflict condition and were thereafter immediately presented with the correct object to examine. After a 10-s delay, they were given a second novel object toward which no referential cues had been directed at the time of labeling. Thus tem-

poral contiguity and referential cues coincided in specifying the first toy as the appropriate object to which the novel label should be linked in the coincide condition; infants experienced no conflict between these two alternative sources of information about word–object mappings. Infants should have little difficulty linking the new label with the correct object in this case. Infants' success in the coincide condition thus provided a measure against which to compare the extent to which they resisted linking the novel label with the first toy in the conflict condition, because the first toy was the incorrect referent in that case.

Infants' responses to comprehension questions (e.g., "Where is the *modi*?") were used as the measure of their word learning success. If infants use referential cues to guide mappings, they should systematically select the first toy in response to comprehension questions in the coincide condition, and they should systematically select the second toy in the conflict condition. In contrast, infants should select the first toy in both the coincide and conflict conditions if temporal contiguity is the guiding force behind their mappings.

A control was included to determine whether infants' comprehension performance indeed reflected word learning. Half of the infants in the study were asked preference questions (e.g., "Where is your favorite one?") instead of comprehension questions after their introduction to the new labels. Such preference questions allow infants to select whichever toy they prefer (no guidance is provided by hearing the label), and hence provide information about whether infants are biased to prefer one of the toys over the other. Because toys in a pair were selected to be roughly balanced in salience, random performance in response to such preference questions should be expected, at least across a group of infants. If, in contrast, infants' responses to comprehension questions were *systematic,* it would be clear that the comprehension results did not reduce to mere preferential responding.

Finally, all infants were asked comprehension questions regarding familiar labels during the test phase as well as questions regarding the novel toys. Their success at responding systematically to familiar label comprehension questions provided a baseline estimate of their ability to cope with the comprehension format used in the present study.

Method

Subjects

Forty infants between 19 and 20 months of age participated in the study. The data from 8 of the infants were omitted (5 because of fussiness, 2 for reasons of experimenter error, and 1 because of toy breakage), leaving 32 infants (*M* age = 19 months, 24 days). Half were girls and half were boys. All infants were full term at birth, were developing normally, and came from monolingual, native English-speaking families.

Parental responses to the Macarthur Communicative Development Inventory (MCDI) indicated that, as a group, infants in the study already possessed sizable receptive and productive vocabularies. According to parents, infants comprehended an average of 269 words (*SD* = 86; range = 111–386) and produced 129 words (*SD* = 112; range = 6–372), and 59% of the words they comprehended were object labels on average (*SD* = 5.2; range = 54%–75%), whereas 57% of the words they produced were object labels on average (*SD* = 10.7; range = 33%–75%). None of these measures of vocabulary size was significantly correlated with infants' comprehension performance in the experimental situation.

Materials

Stimuli. Each infant saw five pairs of toys, three familiar and two novel. Before infants' participation in the study, parents were interviewed by phone to select the familiar toys. All infants saw the same two pairs of novel toys. One pair included a hollow, black, plastic accordion-shaped cone with orange trim and a miniature set of red, plastic folding binoculars with black trim, and the other pair included a toy composed of three multicolored, coiled, elastic shoelaces stitched together to form a starlike cluster and a red plastic toy with two white swinging plastic arms that clacked on contact. Criteria for selection of the novel toys were that the toys be novel, attractive, visually distinct from one another, balanced in salience within a pair, and manipulable for infants of 19 to 20 months.

Novel labels. Two novel labels were used in the study: *modi* and *dawnoo.* These word forms were selected according to (a) novelty for infants, (b) distinctiveness from each other and from the familiar labels used in the study, and (c) ease of pronunciation for infants. Novel labels (which obey the rules of English phonology) were used instead of standard English labels to allow counterbalanced assignment of the labels to the four different novel toys.

Equipment. A video camera equipped with a stopwatch function and a videocassette recorder equipped with frame-by-frame viewing capability were used to record the infants' and experimenter's behavior during the experimental session. The time-stamped video record provided continuous information about the temporal flow of events.

Phone questionnaire concerning familiar labels. Before the laboratory visit, parents were interviewed about infants' familiarity with 18 object labels: *airplane, rabbit, bird, cat, doll, ball, sock, duck, car, shoe, spoon, flower, bottle, dog, banana, boat, cup,* and *keys.* Only labels that parents were certain children understood were used in the experimental session.

Design

The study included two conditions: coincide and conflict. The two conditions each included two phases: (a) a training phase, in which a new label was introduced to infants under controlled conditions, and (b) a test phase, in which infants were either asked comprehension questions regarding the newly trained novel label (e.g., "Where is the *modi?*") or preference-control questions regarding the novel toys involved in the preceding training (e.g., "Where is your favorite one?"), and all infants were asked comprehension questions concerning a familiar label (e.g., "Where is the *shoe?*").

Each infant participated in two trials of either the coincide condition or the conflict condition. Half of the infants who participated in each condition answered comprehension questions about the novel toys, whereas the other half answered preference-control questions. Assignment of toy pairs, target toy (i.e., the labeled toy), and labels was counterbalanced with respect to condition (coincide vs. conflict), question type (comprehension vs. preference-control), and trial order (first trial vs. second trial). During the test questions for any given infant, the target toys appeared equally often in the right- versus left-hand position. Assignment of the familiar toys was also roughly counterbalanced with respect to experimental condition, toy pair, question type, and trial order (precise counterbalancing could not be achieved because infants differed in terms of which six labels they previously comprehended). Pairs of comprehension questions about the familiar labels alternated with pairs of questions about the novel labels in both

comprehension and preference-control test phases. This alternation occurred in a fixed order for all subjects.

Procedure

After a short warm-up period with two familiar toys, the infant was placed in an infant seat at a table, with the parent seated nearby and the experimenter seated across the table from the infant. Parents filled out the MCDI questionnaire during the session to keep parent–infant interaction to a minimum. The first activity of the experimental procedure was a brief familiarization with the comprehension test format using the familiar toys that were available during warm-up: The infant was asked one or two comprehension questions concerning one of the familiar items (e.g., "Where is the *ball?* Can you find the *ball?*"), and the experimenter clapped and cheered when the infant touched or picked up the correct toy. The familiarization procedure was the same for all infants, regardless of whether they were later asked comprehension or preference-control questions about the novel toys.

Conflict condition: Training. The experimenter produced a blue plastic bucket (rattling it until the infant looked at it), opened the bucket, removed the two novel toys, and placed them side by side on the table. She then demonstrated an interesting action with each toy (e.g., expanding and collapsing the binoculars) and pushed the toys within the infant's reach. She waited until the infant tired of playing with both toys and then retrieved the toys from the infant, asking, "What do you think is going to happen now?" With the toys out of view, the experimenter placed each toy into a separate opaque container, sealed the containers, and then presented the containers to the infant. The containers were placed 2 feet apart on the table top, equidistant from the infant and out of reach. The experimenter lifted the lid of one container and peered inside (the toy inside the container remained hidden from the infant's view) while uttering the novel label three times (e.g., "It's a *modi!* A *modi!* There's a *modi* in here!"). Then the experimenter released the first container, turned to the second container, removed the lid, extracted the hidden novel toy, and handed it to the infant, saying, "What's this? Here. You can see this one." The infant could then play freely with this toy without interruption from the experimenter. After at least 10 s, the experimenter returned to the first container, removed the lid, extracted the toy, and handed it to the infant, again saying, "What's this? Here. You can see this one." The infant played freely with both toys until he or she tired of them (this period typically lasted between 15 and 45 s). The experimenter then removed the toys, and the test phase began.

Coincide condition: Training. Training for the coincide condition was identical to that of the conflict condition, except that after labeling, the experimenter extracted the toy from the first container—the same container into which she had directed her gaze at the time of labeling—and the infant could play freely with this toy without interruption. After a delay of at least 10 s, the experimenter removed the lid from the second container, extracted the toy, and offered it to the infant. The experimenter retrieved the toys when the infant had tired of playing with them, and the test phase began.

Test phase. The test phase examined the consistency with which infants selected a particular toy in response to questioning by the experimenter. The test phase included either 4 comprehension or 4 preference-control questions concerning the novel toys, and during the test phase each child was also asked 4 comprehension questions about a familiar label. Hence, each infant was asked a total of 16 questions across the two trials: 8 questions regarding novel toys and 8 questions regarding familiar toys. A given infant answered the same type of question concerning the novel toys (i.e., comprehension vs. preference-control) on both trials.

When asked questions about novel toys, infants were shown the two novel toys from the immediately preceding training phase. When asked about a familiar label, infants were shown two familiar toys. The same two novel toys appeared for each novel label question on a given trial, and the same two familiar toys appeared for each familiar label question on a given trial. An array of only two toys was decided on to reduce the information-processing load on infants, and the same two toys were used for each question to help reduce the influence of novelty and familiarity effects on infants' toy selections.

Comprehension questions. For infants who were asked comprehension questions during the test phase, the experimenter began by placing the two novel toys on a tray. She offered the tray to the infant while encouraging the infant to select one of the toys (e.g., "There's a *modi* here. Can you point to the *modi?* Point to the *modi*"). The experimenter was careful to look only at the infant's face during questioning to avoid biasing the infant's selection through nonverbal cues. When the infant made a selection, the experimenter said "Did you find it?" in a neutral tone, regardless of which toy was chosen. If the infant showed a toy to the parent seated nearby, the parent likewise responded in a neutral manner (e.g., the parent said "Oh" or "That's nice" in a neutral tone regardless of which toy infants were showing) based on prior instruction from the experimenter. The experimenter then retrieved the toys and began the next question trial. In some cases, infants selected both toys simultaneously in response to the experimenter's question. When this happened, the experimenter made a follow-up request (e.g., "Show Mama/Daddy the *modi*"). It is important to note, however, that the follow-up request was asked only at a time when the infant was either holding both toys or neither toy. This precaution was necessary to avoid biasing infants to respond with a particular toy. If infants failed to respond to a question or a request twice in a row, the experimenter moved to the next question trial. If infants became disturbed or failed to answer four questions in succession, the comprehension testing was discontinued.

Props of different kinds (e.g., a tray, a basket, a transparent cosmetic bag, and a tea cosy) were used to present the toys to infants during questioning. This variety helped maintain infants' interest. For the same reason, questions were asked in several different ways (e.g., "Point to the *modi*," "Where is the *modi?*," "Show Mama/Daddy the *modi*," and "Can you find the *modi?*"). The use of these different questions and props occurred in a prearranged order that was held constant for all test phases.

Preference-control questions. Preference-control questions involved asking infants to select one of the two toys without any mention of the novel label (e.g., "Point to the one you like" or "Where's your favorite one?"). The experimenter asked infants a total of four preference-control questions and four familiar label comprehension questions for each condition. Props and questions varied in the same fixed order as in comprehension questioning.

Coding and Reliability

Test phase coding. Infants' responses to comprehension or preference-control questions were coded in terms of which of the two toys infants selected first in response to the question and, when infants selected the two toys simultaneously, which they used in responding to the experimenter's request (e.g., "Show Mama/Daddy the *modi*"). Coders were unaware of the training conditions of the novel labels and hence did not know which toy was the correct referent of a given label. The test phases of 8 randomly selected infants were coded independently by two coders. They demonstrated 91% agreement in their judgments of which toy infants selected first and which toy infants used to perform a requested action.

Salience during training coding. Coders who were unaware of the condition judged which toy infants picked up first when the toys were made available to them at the beginning of the training phase and when infants looked toward and away from each of the containers at

the edge of the table. The training phases of 5 randomly selected infants were independently coded by two individuals, who demonstrated 90% agreement in their judgments of the toy infants selected first and infants' gaze toward the two containers.

Feedback control coding. Coders who were unaware of the condition as well as of the correctness of children's choices judged whether the experimenter's "Did you find it?" feedback after infants' choices was either enthusiastic or unenthusiastic. These judgments matched children's actual choices (i.e., feedback was judged to be enthusiastic for a correct choice or unenthusiastic for an incorrect choice) only 52% of the time, which did not differ from chance levels. This indicates that the experimenter's feedback was not biased in favor of correct performance on the infants' part.

Results and Discussion

Training Phase Analysis

Because the study was designed to test infants' use of referential cues despite strongly conflicting information from temporal contiguity, it is important to demonstrate that temporal contiguity was indeed powerfully instantiated. The novel objects were hidden from infants' view inside opaque containers at the time of labeling during the training phase; immediately after labeling the infants were given the first toy, and only some time later was the second toy revealed. Thus the total time that elapsed between presentation of the first and second toys provides the best estimate of the power of temporal contiguity in the training situation. This period lasted an average of 15.3 s overall ($SD = 1.4$), and when conditions were examined separately, 15.5 s in the coincide condition ($SD = 1.6$) and 15.1 s in the conflict condition ($SD = 1.3$), which was not a significant difference according to a t test. In summary, then, many seconds elapsed before infants saw the second toy, which was the object specified by referential cues in the conflict condition. In question, then, was whether infants would be able to remember that the label should be linked with that second toy despite the relatively long interval of conflicting information from temporal contiguity.

Test Phase Analysis

Familiar labels. In general, infants performed well on comprehension questions concerning familiar labels, selecting the correct toy on 67% of trials, on average ($SD = 21.7$), a level significantly higher than what would be predicted by chance, $t(31) = 4.38$, $p < .0005$. A 2 (condition: conflict vs. coincide) × 2 (question type: novel label comprehension vs. novel label preference-control) mixed-design analysis of variance (ANOVA) examining the proportion of correct responses to familiar label comprehension questions revealed no significant main effects nor interactions.[2] Thus infants' familiar label comprehension performance was not influenced by whether such questions were asked after conflict training as opposed to coincide training or whether such questions were intermixed with comprehension or preference-control questions concerning the novel labels. Proportions were used as the dependent measure because some infants answered only three of the four comprehension questions asked. It is important to note, however, that no condition or question-type differences occurred in the number of comprehension questions answered.

Novel labels. If infants are unable to use a speaker's referential cues to determine the speaker's reference when those cues compete with temporal contiguity, they should select the toy they saw first immediately after labeling (called the *first toy*), regardless of whether the speaker directed referential cues toward this object at the time of labeling (coincide condition) or not (conflict condition). If, however, infants use referential cues even when they conflict with temporal contiguity, they should be significantly less likely to select the first toy in response to comprehension questions following the conflict condition as opposed to the coincide condition. Furthermore, if this difference between conflict and coincide conditions truly reflects infants' use of referential cues for word learning, the difference should emerge specifically for comprehension questions; no such effect should be observed with preference-control questions.

Once again proportions were used as the dependent measure, but no condition or question-type differences occurred for the total number of comprehension questions answered. In the coincide condition, infants who were asked comprehension questions selected the first toy (the correct toy from the adult point of view) 70% of the time ($SD = 14.9$), which was greater than chance performance, $t(7) = 3.87$, $p < .01$, whereas infants who were asked preference-control questions were unsystematic in their selections, selecting the first toy only 52% of the time ($SD = 29.5$). In the conflict condition, infants asked comprehension questions chose the first toy, which would be incorrect from the adult perspective, only 33% of the time ($SD = 11.5$), which was less frequent than would be predicted by chance, $t(7) = 4.25$, $p < .005$. As in the coincide condition, infants who were asked preference-control questions responded unsystematically, selecting the first toy only 52% of the time ($SD = 27.3$). These findings are presented graphically in Figure 1.

Infants' selections in the coincide versus conflict conditions were compared in a 2 (condition) × 2 (question type) × 2 (trial) mixed-design analysis of covariance (ANCOVA), with proportion of first toy selections out of the total number of questions answered as the dependent variable. If infants use referential cues despite competition from temporal contiguity, this analysis should reveal a significant Condition × Question Type interaction. Three covariates were included in analyses of infants' novel toy selections during the test phase. The first was familiar label comprehension performance (proportion correct out of the total number of familiar label questions answered), which serves as an index of infants' compliance and general ability to answer comprehension questions of the kind used in the present study. A second covariate was the precise amount of time the first toy alone was available immediately following labeling (before the second toy was presented). As described earlier, this measure reflects how powerfully temporal contiguity was instantiated for the individual infant. The third covariate pro-

[2] Based on Winer's (1971) recommendation, proportions in this and all other analyses concerning infants' responses to test questions that involved proportions were submitted to the arcsine transformation, with values close to zero or unity corrected. However, for ease of comprehension, the mean scores (and standard deviations) reported throughout the article are those for the untransformed proportions (expressed as percentages).

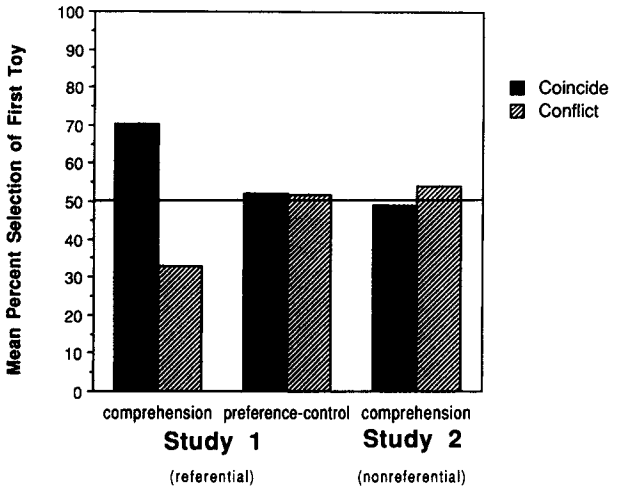

Figure 1. Mean percentage selection of the first toy in response to test questions regarding the novel toys.

vided an index of toy salience; it was a categorical variable reflecting which toy infants picked first at the beginning of the training phase when they were free to play with both toys before the toys were hidden inside the containers and labels were introduced. The covariates were included in the analysis to ensure that condition differences held up over and above any contribution from effects of compliance, salience, or differences in the power with which temporal contiguity was instantiated.

The ANCOVA revealed a significant main effect of condition, $F(1, 25) = 10.19$, $p < .005$, no significant main effects of question type or trial, and a significant interaction between condition and question type, $F(1, 25) = 15.07$, $p < .001$. All other interactions were nonsignificant. Furthermore, the covariates did not significantly predict any of the effects in the analysis. The main effect of condition indicates that overall, infants in the coincide condition were more likely to select the first toy during the test phase than were infants in the conflict condition. However, this overall difference is rendered of little interest by the significant Condition × Question Type interaction.

A simple-effects analysis exploring the locus of the interaction revealed that children who answered comprehension questions about the novel toys showed a different pattern than children who answered preference-control questions. Those who were asked comprehension questions were more likely to select the first toy if they were in the coincide condition than if they were in the conflict condition, $F(1, 25) = 25.45$, $p < .00001$. Thus infants noted the speaker's referential cues and used them to guide the word–object mapping they established, leading them to pick the first toy to comprehension questions in the coincide condition and to avoid picking the first toy in the conflict condition, because in the latter case referential cues had been directed to the second toy. The simple-effects analysis revealed that no significant condition differences emerged for children who were asked preference-control questions. This absence of a condition difference for preference-control questions clarifies that the differences that were obtained for comprehension questions indeed tap word learning, not just infants' preferences.

Systematic differences also emerged in the simple effects analysis between infants who participated in the same condition but were asked different types of questions: Infants in the coincide condition who were asked comprehension questions selected the first toy more frequently than those who were asked preference-control questions, $F(1, 25) = 8.45$, $p < .01$, whereas infants in the conflict condition who were asked comprehension questions selected the first toy less frequently than those who were asked preference-control questions, $F(1, 25) = 6.20$, $p < .05$. These findings clarify that infants' responses to comprehension questions in both the coincide and conflict conditions did not reduce to mere preferential responding.

In summary, the analysis provides evidence for two points: (a) Infants used referential cues to guide their mapping of the new label to a novel object, because they selected the toy specified by referential cues even in the conflict condition that required them to ignore powerfully conflicting information from temporal contiguity, and (b) word learning indeed occurred in both coincide and conflict conditions, because infants' responses to comprehension questions were distinguishable from responses to questions that tapped mere preferential responding.

Study 2

Infants' comprehension performance in the first study demonstrated that they used the experimenter's referential cues to direct a new word–object mapping. Correct mappings were made even in the conflict condition, which required infants to overcome at least two important obstacles: (a) a delay of more than 10 s between the time they heard the label and finally saw the correct object and (b) the presence of a different novel object during this interval. These findings clarify that infants of 19–20 months indeed give referential cues priority over temporal contiguity in guiding their interpretation of new object labels. However, they leave uncertainty about the degree of sophistication underlying infants' reliance on referential cues. First, a relatively low-level explanation can be offered for why referential cues compete so successfully with temporal contiguity. Perhaps infants use referential cues not because they understand them to be an index of a speaker's referential intent, but rather because referential cues merely enhance the salience of a particular object for infants at the time the label is uttered, and infants then simply link the label with the object of greatest salience.

A second issue concerns infants' ability to distinguish referential acts from physically similar nonreferential acts. For instance, when a speaker manipulates an object while uttering a label but does not look toward this object, the label provided may well not refer to the object being touched. Adults, at least, show little inclination to interpret touching as a referential cue unless line-of-regard or some other source of information (e.g., lexical or syntactic) indicates that referential intent is involved. It is unclear whether infants make such distinctions, however; neither the first study nor any other existing evidence provides information on this point.

In Study 2, I addressed both of these questions by introducing infants to new labels for novel toys when labeling was accom-

panied by *nonreferential* acts that increased the salience of a potential referent. As in the first study, two novel toys were hidden in separate opaque containers that were placed on a table out of infants' reach. While gazing at the infant, the experimenter reached toward one container and adjusted the container's lid, at the same time uttering the novel label three times (e.g., "I'm going to show you a *modi.* Want to see a *modi?* A *modi.*"). Thus the salience of one container was enhanced during labeling by the experimenter's action of touching and adjusting the lid, yet this act, from the adult point of view at least, was nonreferential, in this case because handling of the container was not accompanied by a change in line-of-regard. After infants heard the label, the experimenter either immediately gave infants the toy from the container that was contacted during labeling (the coincide condition, because salience coincides with temporal contiguity in specifying the referent), or she immediately gave infants the toy from the container that was not contacted during labeling (the conflict condition). After a delay of at least 10 s, infants were given the remaining toy. Later, the experimenter tested infants' comprehension for the new label. Of particular interest was whether infants would systematically link the label with the toy that had been made salient, nonreferentially, during labeling.

To be assured that salience was indeed enhanced by the nonreferential acts to a degree similar to the salience generated by the referential acts of Study 1, I measured and contrasted the amount of time infants looked toward the containers during labeling with comparable looking times from the first study. It is also important to note that in the second study the experimenter uttered the labels at the same volume and pitch as in the previous study and used the same intonation contour characteristic of parents' labeling utterances (e.g., Fernald, 1985, 1987; Stern, Spieker, & MacKain, 1982). Hence salience of the utterances per se did not differ between the first and second studies.

One possibility was that infants' responses to the comprehension questions would parallel those of Study 1. In that study, infants showed reduced selection of the first toy to comprehension questions following the conflict condition as opposed to the coincide condition. In other words, they tended to select the toy specified by referential cues in the conflict condition, which was the second toy. Perhaps in the second study infants would select the toy that had been made salient by a nonreferential act during labeling, just as, in the first study, they selected the toy that was specified by referential cues during labeling. If so, in the first study, infants' success at using referential cues even when they conflicted with temporal contiguity might well have been grounded in a simple salience mechanism.

An alternative possibility was that comprehension performance in Study 2 would diverge from what was observed in the first study. Such findings would suggest that infants' use of referential cues goes beyond a response to salience. If salience is not the mechanism underlying infants' sensitivity to referential cues, then two possible outcomes for Study 2, both different from the results of Study 1, seemed plausible. One possibility was that infants simply would ignore the nonreferential act and link the label with the first toy—the object viewed immediately after hearing the label—in the conflict as well as the coincide condition. If so, infants would show a greater-than-chance tendency to select the first toy in response to comprehension questions, with no significant difference in this respect between conflict and coincide conditions. These findings would indicate first that salience at the time of labeling is not enough to determine word reference from the infants' point of view, because a salience-enhancing nonreferential act failed to compete successfully with temporal contiguity. At the same time, they would suggest that temporal contiguity between label and object is indeed sufficient to lead to a new word–object mapping, because in the conflict condition, temporal contiguity alone specified the first toy as the referent for the new label.

Quite a different possibility was that infants would fail to link the novel label with any toy in either the coincide or conflict conditions. Perhaps infants (a) distinguish referential from nonreferential acts and (b) give referential acts privileged status for clarifying reference, and hence regard neither temporal contiguity nor nonreferential acts as legitimate sources of referential information. If so, in both conflict and coincide conditions infants would be confused as to the target of the speaker's utterance, because from their point of view, no viable cues were offered concerning the intended referent. Hence infants would show unsystematic (chance) performance when subsequently asked comprehension questions concerning the novel label, regardless of whether such questions followed the conflict or coincide condition.

Method

Subjects

Eighteen infants between 19 and 20 months of age participated in the study. The data from 2 infants were omitted (1 for fussiness and 1 because of experimenter error), leaving 16 infants (*M* age = 19 months, 23 days). Half were girls and half were boys. All infants were full term at birth, were developing normally, and came from monolingual, native English-speaking families.

Parental responses to the MCDI indicated that infants in the study possessed receptive and productive vocabularies comparable with those of infants who participated in the first study. Parents reported that infants understood an average of 287 words (*SD* = 81.3; range = 177–398) and were able to produce 168 words on average (*SD* = 128; range = 5–395). Of the words they comprehended, 58% were object labels on average (*SD* = 4.1; range = 51%–64%), and 56% of their production vocabulary was accounted for by object labels on average (*SD* = 15.4; range = 20%–76%). As in the first study, none of the measures of infants' vocabulary bore any significant relation to their performance in the experimental situation. Furthermore, the vocabulary estimates reported by parents in the second study showed no significant differences compared with those obtained in the first study, indicating that the samples contributing to the two studies were roughly equated with respect to level of vocabulary development.

Materials

The same stimuli, novel labels, equipment, and phone questionnaire used in the first study were used in the second study.

Design

As in Study 1, each infant participated in two trials of either the coincide condition or the conflict condition. However, all infants in the second study answered comprehension questions; none were asked preference-control questions, because the validity of this control was

established in Study 1. The same counterbalanced design was used as in the first study.

Procedure

The procedure in the second study paralleled that of the first study in all details, with three exceptions. First, while labeling, the experimenter manipulated the lid of one container but looked toward the infant, as opposed to both looking and manipulating in Study 1. Second, the carrier phrases used when the experimenter provided the novel labels during the training phases differed slightly compared with those used in the first study. The change was made so that the carrier phrases were ambiguous with respect to referential intent and thus could be consistent with the nonreferential actions (i.e., "I'll show you a *modi*. Want to see a *modi*? A *modi*."). The carrier phrases from Study 1 could not be used (i.e., "A *modi*. It's a *modi*. There's a *modi* in here"), because they contain lexical and syntactic cues implying referential intent toward the object of the speaker's focus. Thus in the second study there were two possible sources of information to infants that labeling was not coupled with referential intent: (a) line-of-regard did not accompany contact with a container during labeling, and (b) the carrier phrases did not imply referential intent to the object in the container. The same carrier phrases were used in both the coincide and conflict conditions.

The third change from Study 1, as already described, was that all children were asked comprehension questions during the test phase; no preference-control questions were asked.

Coding and Reliability

Coding was conducted in the same manner as in the first study. The training phases of 5 randomly selected infants were independently coded by two individuals, who demonstrated 94% agreement in their judgments of the toy infants selected first and the containers toward which infants directed their gaze. Two individuals also independently coded the test phases of 8 randomly selected infants, showing 93% agreement in their judgments of the toy infants selected in response to the experimenter's comprehension questions.

Results and Discussion

Training Phase Analysis

To check the comparability of infants' experience in the second study in relation to the first study, I performed two preliminary analyses. Of greatest importance is to be certain that (a) the nonreferential acts used in Study 2 to enhance the salience of one container during labeling succeeded in this goal and (b) salience was enhanced by nonreferential acts to roughly the same degree as it was enhanced by the referential cues provided in Study 1. The amount of time infants gazed at the container toward which cues were directed during labeling was calculated from the videotape record. This measure revealed that infants in Study 1 looked at the container toward which referential cues were directed for 6.6 s on average (SD = 2.2), whereas they looked at the other container only 1.4 s (SD = 1.1), paired $t(31) = 12.84$, $p < .00001$. In the second study, infants looked at the container that was contacted during labeling an average of 5.9 s (SD = 1.8), whereas they looked at the other container only 1.0 s (SD = 0.8), paired $t(15) = 9.06$, $p < .00001$. A t test revealed no significant differences between the amount of time infants looked at the salience-enhanced container in Study 1 versus Study 2.

The two studies were also balanced in terms of the power with which temporal contiguity was instantiated. That is, there was no difference between the studies in the amount of time that elapsed between presentation of the first and second toys following labeling. As reported earlier, in Study 1 the first toy was available an average of 15.3 s (SD = 1.4) before the second toy was provided; this period lasted an average of 15.4 s (SD = 1.1) in the second study. A t test revealed that this period did not differ statistically between the two studies, either overall or when coincide and conflict conditions were considered separately.

Test Phase Analysis

Familiar labels. Infants performed well on comprehension questions concerning familiar labels, selecting the correct toy on 71% of trials on average (SD = 17.4), a level significantly higher than what would be predicted by chance, $t(15) = 4.85$, $p < .0005$. A t test revealed no significant differences in the proportion of correct selections (number correct out of total number of questions answered) to familiar label comprehension questions for infants in the coincide versus conflict conditions. Thus infants' familiar label comprehension performance was not influenced by whether such questions were asked after conflict training as opposed to coincide training. It is important to note also that infants in the coincide versus conflict conditions did not differ with respect to the number of comprehension questions answered.

To verify that the samples were relatively balanced in their ability to cope with the experimental situation, I also compared infants' performance on familiar label questions between the two studies. A t test revealed no significant differences, either overall or when coincide and conflict conditions were treated separately.

Novel labels. As described earlier, if the mechanism underlying infants' reliance on referential cues reduces to salience, then infants' responses to comprehension questions in the second study should parallel those obtained in the first study. As before, proportions were used as the dependent measure, and no condition differences occurred for the total number of comprehension questions answered. In brief, contrary to what was found in Study 1, infants in the second study performed unsystematically in their responses to novel label comprehension questions (see Figure 1). In the coincide condition, infants selected the first toy on only 49% of trials on average (SD = 19.9), which did not differ from levels predicted by chance. Similarly, infants selected the first toy on an average of only 54% of trials in the conflict condition (SD = 27.1), which also did not differ from chance levels. Thus it seems that infants failed to link the novel labels in a stable way with either of the novel toys.

A 2 (condition) × 2 (trial) ANCOVA with three covariates (comparable with those described for Study 1) was conducted to ascertain whether condition differences occurred in infants' tendency to select the first toy, despite the overall lack of systematicity in their responding. This analysis revealed no significant main effects or interactions.

These results are noteworthy in several respects. First, they

do not parallel the results obtained from the first study, thus the first study's findings cannot be explained by reference to a simple salience mechanism. In the second study, the salience of one container was increased during labeling by means of a nonreferential act (manipulating without looking), and analyses confirmed that infants tended to look at the contacted container during labeling in Study 2 as much as they looked at the container toward which referential cues were directed in Study 1. However, in Study 2, increasing the salience of one container through a nonreferential act during labeling did not lead infants to link the new label with the toy residing in that container. This helps to clarify, then, that the mappings infants established in Study 1 were the result of an understanding of referential cues that goes beyond mere salience effects.

Second, infants' inability to establish firm mappings between the novel labels and a particular object in the second study cannot be easily dismissed as the result of sample differences between the first and second studies. According to parental report, infants in the two studies possessed vocabularies roughly comparable in size both in comprehension and production of total words and, more specifically, of object labels.

Furthermore, the training that infants experienced in the two studies differed in important but fairly subtle ways. Yet infants' responses to comprehension questions in Study 1 were clearly systematic and correct, whereas they were entirely unsystematic in Study 2. This suggests that infants are "tuned in" to relatively subtle aspects of other people's behavior and are able to recognize their significance for interpreting the intent of others' utterances.

Finally, although infants in the second study showed little systematicity in their responses to novel label comprehension questions, they performed just as well on familiar label comprehension questions as infants in the first study, indicating that they understood the comprehension task and were motivated to perform well. They simply seemed unable to fathom with which object the novel label should be linked, though they had the opportunity to use either temporal contiguity or salience to drive such mappings. It is striking that they did not. These findings suggest that infants regard neither temporal contiguity between a label and a possible referent nor salience of a referent at the time of labeling as sufficient grounds for establishing a new word–object link given the absence of clear referential intent.

General Discussion

To recap briefly, in the conflict condition of the first study, infants encountered a labeling scenario in which temporal contiguity was a powerful competitor to referential cues for directing a new word–object mapping. Infants saw only one object immediately after hearing the speaker utter a novel label—a different object than that to which the speaker had referred—and the correct object was not seen until well beyond the time period regarded as typically necessary for a conditioned effect to occur. Yet infants' responses to comprehension questions revealed that they ignored temporal contiguity and linked the label with the correct object—the object specified by referential cues. Moreover, control questions revealed that this did not reduce to a simple preference for the object specified by referential cues, because only infants who were asked comprehension questions showed this pattern. These results support and extend earlier findings (e.g., Baldwin, 1991, in press) and highlight infants' firm reliance on referential cues as their favored guide to word reference.

Infants' ability to cope with the conflict condition in the first study is all the more remarkable because they faced a situation involving many new elements to be coordinated: two novel objects, two containers, one novel label, and a stranger who behaved in a fairly unusual manner. The two possible referents were out of view at the time of labeling, and infants did not know which object resided inside which container. They had to note the label as well as the referential cues during labeling and realize that the label should be linked to the as yet unidentified hidden object. To establish the correct mapping in the conflict condition, infants had to remember the label and either (a) wait until more than 10 s later to map the label to the correct object (while blocking a mapping to the visually available first toy) or else, on viewing the first toy, which was the incorrect object, (b) rule that object out and map their representation of the label to a mental representation of the correct object, which was still hidden from view. Infants' success at this rigorous word learning task reveals their considerable skill in the word learning domain.

The findings of the second study, in conjunction with those of Study 1, clarify that infants' use of referential cues to guide new word–object mappings was not simply a result of the enhanced salience of the container toward which referential cues were directed. Infants showed no tendency to establish a new word–object mapping when a nonreferential act occurred that enhanced one container's salience at the time of labeling. Interestingly, infants established no stable word–object mappings at all in the second study, although they clearly understood the task at hand, judging from their systematic responses to comprehension questions regarding familiar labels. It seems that for infants, as for adults, neither enhanced salience nor temporal contiguity by themselves is sufficient to justify a new word–object link. Rather, infants seem to require clear-cut signs of referential intent before establishing a new word–object mapping. These findings stand in opposition to a commonly held view that word learning during infancy is primarily accomplished through associative mechanisms (e.g., Whitehurst, 1979; Whitehurst, Kedesdy, & White, 1982). It is important to note, however, that the present findings do not lead to the conclusion that temporal contiguity and salience have no impact on word learning; in fact, the evidence suggests that they do (e.g., Valdez-Menchaca & Whitehurst, 1988; Whitehurst & Valdez-Menchaca, 1988). It is just that such mechanisms alone seem to be insufficient for infants to initiate a new mapping; for this, clear-cut signs of referential intent seem to be the crucial trigger.

Infants' ability to distinguish referential from nonreferential acts has important implications for the course of language learning: It is likely of great value in smoothing and speeding the course of language acquisition. It enables them to correctly ignore coincidental word–object pairings that not infrequently occur in the rapid flux of human action and interaction. Infants establish word–object mappings only when such mappings are justified by clear-cut signs of referential intent from the

speaker. Innumerable potential mapping errors may thus be avoided.

The evidence presented here also has implications for our more general understanding of the development of social cognition. The ability to interpret another's intent as referential as opposed to nonreferential implies that infants have some appreciation of intentionality, albeit almost certainly at an entirely tacit level. An understanding of intentionality is one central facet of a theory of mind (e.g., Astington & Gopnik, 1991; Moses, 1993; Shultz, 1980; Wellman, 1993). These findings thus line up in agreement with what others have suggested (e.g., Baron-Cohen, 1991; Wellman, 1993)—that at least some basic elements of a theory of mind are present by late infancy.

Although the findings indicate that infants can distinguish referential from nonreferential acts, the precise basis on which they make this distinction is not clear. Across the two studies, labeling was balanced in terms of volume, pitch, and the use of the exaggerated intonation contour identified as characteristic of speech to infants. Thus the referential and nonreferential acts were distinguishable only in terms of small lexical and syntactic differences between the carrier phrases in which labels were embedded and by differences on the action plane (i.e., line-of-regard plus contact vs. contact alone). The presence versus absence of the line-of-regard cue was perhaps the most striking change, but any one or any combination of the differing lexical, syntactic, and action factors might underlie the differences observed between the two studies in infants' tendency to interpret the utterances as referring to the contents of the contacted container. All in all, this research cannot clarify how infants distinguish referential from nonreferential action, only that they are capable of doing so in at least some cases in which multiple and redundant cues support this distinction.

A number of additional questions remain about the specific skill that infants displayed in these two studies, as well as about the development of referential understanding. First, it may be that language is a privileged domain developmentally and that infants' appreciation of referential intent is limited to the linguistic context. Alternatively, infants' ability to interpret actions as referential may be broader in scope. Many aspects of human action are referential in nature; for example, emotion has a quality of "aboutness" that is shared with language: One feels sad, ecstatic, disgusted, or fearful about something—an object, event, action, or outcome. In this sense, emotion is referential, and perhaps infants are as skilled in interpreting the reference of others' emotional displays as they are at interpreting the reference of others' utterances. Some existing evidence concerning "social referencing" in infants as young as 12–18 months suggests that this is a plausible hypothesis (e.g., Feinman, 1985; Harris, 1989; Hornik, Risenhoover, & Gunnar, 1987; Klinnert, Emde, Butterfield, & Campos, 1986). If this is correct, it may be that the ability to interpret another's referential intent emerges as a more general social skill, which infants can recruit to expedite acquisition in the language domain.

In closing, this research provides the strongest evidence to date that an understanding of referential intent emerges during infancy. On the one hand, this is perhaps not entirely unexpected; it is hard to imagine how language acquisition could proceed at such a phenomenal pace were infants and young children to lack such referential understanding. On the other hand, infants' referential abilities point to a level of sophistication in the linguistic and social–cognitive realms that is very striking indeed. They recognize that speakers provide information to clarify their linguistic intentions, actively seek such information, and are sophisticated consumers of the information provided. It begins to become clear how language learning can be such a robust phenomenon despite great variability in the quality of input that infants receive: Infants are actively employed in unearthing the roots of reference for themselves.

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