

Broadening the units of analysis in communication: speech and nonverbal behaviours in pragmatic comprehension*

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ABSTRACT

Recently, much research has explored the role that nonverbal pointing behaviours play in children's early acquisition of language, for example during word learning. However, few researchers have considered the possibility that these behaviours may continue to play a role in language comprehension as children develop more sophisticated language skills. The present study investigates the role that eye gaze and pointing gestures play in three- to five-year-olds understanding of complex pragmatic communication. Experiment 1 demonstrates that children ($N = 29$) better understand videotapes of a mother making indirect requests to a child when the requests are accompanied by nonverbal pointing behaviours. Experiment 2 uses a different methodology in which children ($N = 27$) are actual participants rather than observers in order to generalize the findings to naturalistic, face-to-face interactions. The results from both experiments suggest that broader units of analysis beyond the verbal message may be needed in studying children's continuing understanding of pragmatic processes.

INTRODUCTION

Ambiguity is a serious problem in language comprehension. For example, one major problem that young children face when learning new words is that, theoretically, there are an infinite number of ways that a word can map onto

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things in the world (Quine, 1960). Further, even when children master word learning, ambiguity continues to be a problem. The next challenge that children face is ambiguity at the sentence level. This problem falls into the domain of pragmatics.

Pragmatic ambiguity consists of one basic problem: What people SAY is often very different from what they MEAN. For example, when a mother tells a child, ‘It’s almost dinner time,’ she might be trying to communicate information about the time of dinner, or she might be (indirectly) requesting the child to do something like clean up a mess or wash hands. This type of pragmatically ambiguous speech is called an indirect request.

The reason that psycholinguists study indirect requests is that they pose a special problem for language users: there is nothing inherent in the speech that reveals the meaning of the requests. This is sometimes described as the problem of ‘speech underdetermining meaning.’ So how do listeners solve this problem?

Traditionally, psycholinguists have argued that the key to understanding indirect requests is to use context to disambiguate speech (Austin, 1962; Grice, 1975; Searle, 1975). For example, the child in the above situation would need to relate his mother’s speech to a particular feature of the physical context, such as a pile of toys on the floor. Indeed, developmental research has shown that children around the age of five or six begin to use information in the physical context in order to disambiguate complex indirect requests (Ackerman, 1978; Elrod, 1986; Bernicot & Legros, 1987). However, it is not clear from this research just how children make this connection between speech and context.

At the core of the traditional approach to studying comprehension of pragmatically ambiguous speech is the idea that VERBAL INFORMATION is the point of departure in understanding meaning. That is, ambiguous speech forces an examination of the context in order to make sense out of the speech. This approach presupposes that information about a speaker’s intention lies somewhere outside of what is communicated, which, in turn, is traditionally presumed to be equivalent to the SPOKEN portion of the message.

The problem is that in everyday, face-to-face interactions, we do more than just speak. We glance. We point. We smile. The voice is but one component of a larger system of bodily expression. Nonverbal behaviours add important information to a communicator’s speech. For example, understanding pragmatically ambiguous speech requires people to understand a communicator’s intentions. Nonverbal behaviours are excellent at revealing intentions (Argyle, 1973; Bates, 1976; Bruner, 1984; McNeill, 1985, 1987, 1992; Baldwin, 1991; Clark, 1996; Carpenter, Nagell & Tomasello, 1998). Thus, nonverbal behaviours may serve as an important link between speech and context.

Indeed, Clark (1996) discusses how speech, which is very good at

describing things (objects, events, locations, etc.), is greatly supported by nonverbal behaviours such as eye gaze and pointing gestures, which, in turn, are very good at indexing speech to context. For example, consider the indexical role that gaze and gesture may play with speech in the above utterance, 'It's almost dinner time.' Suppose that the mother simultaneously looked at and pointed to the pile of toys next to the child as she delivered her speech. By looking at and pointing to the pile of toys, the mother indicates that the 'dinner time' utterance is somehow relevant to the mess next to the child (for more on relevance, see Sperber & Wilson, 1987). In this way, speech, eye gaze, and hand gesture come together to create a deeper and more meaningful message than just the speech alone.

Thus, there are sound reasons to believe that nonverbal behaviours such as eye gaze and hand gesture play a significant role in pragmatic comprehension. Indeed, recent studies have provided evidence that children and adults are sensitive to information that is conveyed through gaze and gesture in multiple contexts (problem solving: Goldin-Meadow, Wein & Chang, 1992; Kelly & Church, 1997, 1998; lexical discrimination: Thompson & Massaro, 1994; narrative processing: McNeill, Cassell & McCullough, 1994; object retrieval: Murphy & Messer, 1977; Povinelli, Reaux, Bierschwale, Allain & Simon, 1997; word learning: Baldwin, 1991, 1993a, 1993b; Morford & Goldin-Meadow, 1992; Moore, Angelopoulos & Bennett, 1999; Butcher & Goldin-Meadow, 2000).

Given this research, it seems surprising that many psycholinguists have not also considered the role that nonverbal behaviours play in pragmatic processing. This lack of attention to nonverbal behaviours is particularly surprising in light of the classic observation in pragmatics that 'speech underdetermines meaning.' Traditionally, the move that theorists and researchers have made in response to this observation has been to look outside the communicative act to determine meaning. However, valuable information about an utterance's meaning may be contained within the communicative act itself – in the nonverbal behaviours that naturally and pervasively accompany speech.

Almost all of the research on the role that nonverbal behaviours play in pragmatic comprehension has focused on the earliest stages of language acquisition (Bates, 1976; Baldwin, 1991; Ninio & Snow, 1996; Carpenter *et al.*, 1998; Moore *et al.*, 1999). For example, Baldwin (1991) demonstrated that infants use an adult's eye gaze to understand an adult's intention to label an object. However, there is evidence that even adults use nonverbal behaviours to interpret pragmatic meaning (Winner, 1988; Capelli, Nakagawa & Madden, 1990; Kelly, Barr, Church & Lynch, 1999). For example, Kelly *et al.* (1999) found that adults' understanding of the intended meaning of complex indirect requests (as in the 'dinner time' example) was significantly influenced by the presence of information conveyed through eye

gaze and hand gesture. Thus, it is likely that children continue to use nonverbal behaviours throughout development to understand pragmatic meaning.

In addition to not knowing the role that nonverbal behaviours play in later stages of children's pragmatic development, little is known about HOW nonverbal behaviours interact with speech to reveal pragmatic meaning. The general assumption is that nonverbal behaviour is merely 'add-on' information. That is, it is to be used only as a last resort, for example, when speech is ambiguous, insufficient, or absent. However, theorists such as McNeill (1992) and Clark (1996) have challenged this notion and have argued that speech and nonverbal behaviours interact from the start to CO-DETERMINE meaning.

The present study explores these issues by investigating the role that nonverbal pointing behaviours – eye gaze and deictic gestures – play in children's emerging understanding of complex indirect requests.¹ Two experiments approach this topic from two different perspectives. Experiment 1 used a video methodology in which three- to five-year-old children watched videotapes of a mother making indirect requests to a child with and without nonverbal pointing behaviours. Children were then asked to interpret the indirect requests on the tape. Experiment 2 used a naturalistic methodology in which an experimenter made indirect requests to three- to five-year-old children with and without nonverbal pointing behaviours. Children's own BEHAVIOURAL RESPONSES were used to determine comprehension of the indirect requests.

Both experiments converged on two main questions: (1) Do children use nonverbal pointing behaviours to understand complex indirect requests? (2) If so, at what age do children begin to do so? Experiment 2 also asked a third question: (3) How do children combine speech and nonverbal pointing behaviours in pragmatic comprehension? That is, do nonverbal pointing behaviours merely provide 'add-on' information to speech, or do speech and nonverbal pointing behaviours interact to CO-DETERMINE meaning?

EXPERIMENT 1

Previous research has argued that children begin to use context to understand unconventional indirect requests at the age of five or six (Ackerman, 1978; Elrod, 1986; Bernicot & Legros, 1987). However, it is not clear from these studies how children link indirect requests to context. One reason for this gap in our knowledge may be the method used to study indirect requests. The

[1] For the remainder of the paper, 'nonverbal pointing behaviours' will refer to eye gaze and deictic gestures. In addition, 'complex indirect requests' will refer to indirect requests that are unconventional in nature, as in the 'dinner time' example.

indirect requests in the above studies were presented in narratives that were read to children. Children's understanding of the requests was measured by questions about the narratives. This method is far removed from the way children experience communication in everyday, face-to-face interactions. One piece of information that is conspicuously missing is nonverbal behaviour that naturally accompanies speech. As described above, nonverbal information may serve as an important link between speech and context. For this reason, Experiment 1 used a video methodology – in which children watched videos instead of heard texts – to investigate the role that eye gaze and hand gesture play along with speech in children's understanding of indirect requests.

Experiment 1 had two major goals. It investigated whether (1) eye gaze and deictic gestures help children understand the meaning of complex indirect requests, and (2) children younger than previously shown would be able to understand indirect requests when they could both hear and see the requests.

METHOD

Participants

Twenty-nine three- to five-year-old children (mean age: 4;3, 18 females and 11 males) participated in the experiment. The children were divided into two age groups: 14 children younger than 4;2 (mean age: 3;8, range: 3;1 to 4;1) and 15 children older than 4;2 (mean age: 4;9, range: 4;2 to 6;2). Children were recruited from a daycare centre in the Chicago metropolitan area.

Procedure

Participants were tested individually. They were told that they would be playing a 'game' with the experimenter. The game asked participants to watch videotapes of a mother interacting with her child (the mother and child were paid actors). After each video clip, participants were asked questions about their understanding of the interaction. The entire procedure lasted approximately 20 minutes.

An experimental stimulus tape was created to test participants' understanding of indirect requests in a 'semi-naturalistic' setting. The tape consisted of a mother and a child interacting in everyday settings. There were a total of 8 vignettes. All of the vignettes ended with a target sentence that was an indirect request. Each request encouraged action on an object in the environment, which I refer to as the target object.

The actors were instructed to act out two different versions of each scenario – in accordance with the two conditions of the experiment. In the first condition, the Speech Only condition, the mother made the indirect

request without directing any nonverbal behaviours toward the target object. In the second condition, the Speech + Nonverbal condition, the mother delivered the target sentence while looking at and pointing to the target object. Table 1 presents an example.

TABLE 1. *Sample scenario for experiment 1*

SCENE	Mother is watching the child put his shoes on in preparation for school. They are at the front door. There are boots, a raincoat, and an umbrella in the hallway.
DIALOGUE	Mother: You better hurry, or you might be late for school. Child: I'm going as fast as I can (finishes putting on shoes and stands up).
TARGET SENTENCE	<i>Mother: Don't forget, it's raining.</i>
EXPERIMENTAL CONDITIONS	DESCRIPTION
1. Speech Only:	The mother utters the target sentence and keeps her hands at her side.
2. Speech + Nonverbal:	The mother utters the target sentence and looks at and points to the raincoat.

The experimental stimulus was set up based on a within-subjects design. Each participant viewed all 8 scenarios, half of which were in the Speech Only condition and the other half in the Speech + Nonverbal condition. There were two different versions of the stimulus tape. In each version, the order of the scenarios was held constant, but the order of the conditions was counterbalanced. Appendix A presents all of the scenarios and the order in which they appeared in each version of the stimulus tape. Sixteen children received Order 1, and thirteen received Order 2.

Participants were instructed to pay close attention to the scenarios because the experimenter would be asking questions about them. Children were asked to interpret what the person communicating the indirect requests wanted. Specifically, they were asked, 'What do you think that the mother/child wanted the child/mother to do?' This question is called the 'interpretation' question. A second question asked the children to predict what would happen next in the videos. This 'prediction' question yielded the same results as the interpretation question. Therefore, in the interest of space, I only present data from the interpretation question.

Coding and analysis

Responses to the interpretation question fell into three major categories. Occasionally, children did not know what the communicator wanted. These responses were coded as No Understanding responses. Other times, children

interpreted the communicators' speech as a literal statement – these were called Reiteration responses. For example, in response to the scenario in Table 1, a Reiteration code would be assigned if a child said, 'The mother wanted to tell the child that it was raining.' Finally, if children responded by saying that the communicator wanted the addressee to perform some sort of an action, the response was coded as an Action response. Action responses indicated that participants understood that a request had been made.

There were three types of action responses. An Intended Action response is when a child understood the exact intention of the communicator, for example, saying, 'The mother wanted the boy to take his raincoat.' A Relevant Action response is when a child did not understand the exact meaning of the request, but did interpret a meaning that was relevant to the context, for example, saying, 'The mother wanted the boy to take the umbrella.' Finally, an Irrelevant Action response is when a child interpreted a meaning that was not relevant to the context, for example, saying, 'The mother wanted the boy to go nite-nite.'

Inter-rater reliability was obtained by having a second coder independently score 24 % of the participants' responses (7 children). Inter-rater agreement for assigning codes was 93 % (Cohen's kappa: 88%).

RESULTS AND DISCUSSION

The preceding description of the different codes should make it clear that the coding categories were not independent. That is, more of one code meant less of another. For this reason, parametric data analysis could not be performed on each code – rather, only the most germane codes were statistically analysed. The following results present descriptive data for several codes, but present statistically analysed data for the two most relevant codes: Action and Intended Action responses. All results are reported as proportions of the total number of responses produced for a given age and condition. In addition, all data are included, as there were no missing trials.

The Action and Intended Action responses were analysed using a (2) age \times (2) condition repeated measures ANOVA. The data were arcsin transformed, and a Greenhouse-Geisser procedure controlled for the problem of sphericity. Planned comparisons used Dunn's (Bonferroni) t tests to compare individual means with adjusted p values.

No Understanding, Reiteration, and Action responses

The first pass through the data examined children's general understanding of the indirect requests. Occasionally, children did not understand the requests. Younger children produced No Understanding responses 29 % (*s.d.* = 33 %) of the time for the Speech Only condition and 23 % (*s.d.* = 30 %) of the time

for the Speech + Nonverbal condition. Older children produced No Understanding responses 5% (*s.d.* = 15%) of the time for the Speech Only condition and 5% (*s.d.* = 18%) of the time for the Speech + Nonverbal condition. Refer to Table 2.

TABLE 2. *No Understanding, Reiteration, and Action responses, experiment I (%)*

	Younger children		Older children	
	SO	S+N	SO	S+N
No Understanding	29	23	5	5
Reiteration	12	11	10	3
Action	59	66	85	92

Children sometimes interpreted the requests as literal statements. Younger children produced Reiteration responses 12% (*s.d.* = 18%) of the time for the Speech Only condition and 11% (*s.d.* = 18%) of the time for the Speech + Nonverbal condition. Older children produced Reiteration responses 10% (*s.d.* = 13%) of the time for the Speech Only condition and 3% (*s.d.* = 9%) of the time for the Speech + Nonverbal condition. Refer to Table 2.

Most of the children's responses were Action responses. Younger children produced Action responses 59% (*s.d.* = 39%) of the time for the Speech Only condition and 66% (*s.d.* = 30%) of the time for the Speech + Nonverbal condition. Older children produced Action responses 85% (*s.d.* = 16%) of the time for the Speech Only condition and 92% (*s.d.* = 18%) of the time for the Speech + Nonverbal condition. A repeated-measures ANOVA revealed a main effect of age ($F(1, 27) = 7.53, p < 0.001$) but not for condition ($F(1, 27) = 1.59, \text{ ns}$), and there was no interaction effect ($F(1, 27) = 0.15, \text{ ns}$). In addition, a separate ANOVA collapsing across age demonstrated that there was no effect of order (2 different orders) of stimulus presentation ($F(1, 27) = 0.02, \text{ ns}$). Refer to Table 2 and Figure 1.

The preceding results suggest that younger children understood the scenarios less well than older children. Though this claim was not statistically instantiated, it can be explained by the fact that older children understood that actions were required in response to indirect requests MORE OFTEN than younger children.

Irrelevant Action, Relevant Action, and Intended Action responses

The next set of data described the TYPES of Action responses that children produced. Sometimes children misunderstood the intended meaning of the requests and interpreted an action that DID NOT make sense in the context of

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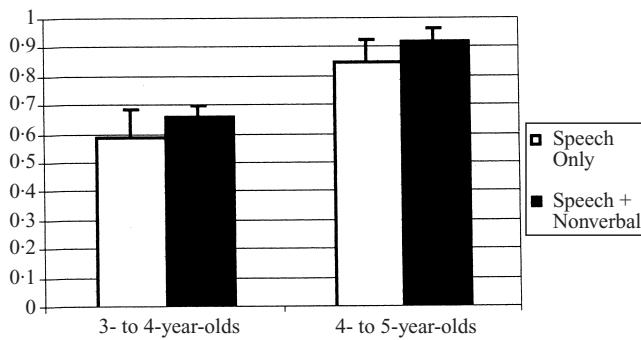


Fig. 1. Action responses by age and condition, experiment 1.

TABLE 3. *Irrelevant, Relevant, and Intended Action responses, experiment I** (%)

	Younger children		Older children	
	SO	S+N	SO	S+N
Irrelevant Action	30	29	8	2
Relevant Action	25	30	65	47
Intended Action	4	7	12	43

* To avoid the problem of shifting denominators across conditions, this table presents the proportion of total responses, not of Action responses. Thus, the sum of these responses equals the total proportion of Action responses presented in Table 2.

the requests (Irrelevant Action). Younger children produced Irrelevant Action responses 30% (*s.d.* = 33%) of the time for the Speech Only condition and 29% (*s.d.* = 35%) of the time for the Speech+Nonverbal condition. Older children produced Irrelevant Action responses 8% (*s.d.* = 18%) of the time for the Speech Only condition and 2% (*s.d.* = 7%) of the time for the Speech+Nonverbal condition. Refer to Table 3.

More frequently, children misunderstood the intended meaning of the requests, but interpreted an action that DID make sense in the context of the requests (Relevant Action). Younger children produced Relevant Action responses 25% (*s.d.* = 27%) of the time for the Speech Only condition and 30% (*s.d.* = 23%) of the time for the Speech+Nonverbal condition. Older children produced Relevant Action responses 65% (*s.d.* = 26%) of the time for the Speech Only condition and 47% (*s.d.* = 19%) of the time for the Speech+Nonverbal condition. Refer to Table 3.

Though these Relevant and Irrelevant Action data are only descriptive, the pattern suggests that younger children were less sensitive to the context of

indirect requests than older children. This finding is similar to work by Shatz (1978a, 1978b) who showed that young children (two years old) responded to their mother's speech indiscriminately with actions, whereas older children (three years old) began to use the context to guide the actions they performed.

The Intended Action responses are the most relevant to the question of how nonverbal behaviours influence children's understanding of indirect requests. Younger children correctly understood the specific intentions of the experimenter's indirect requests, on average, 4% (*s.d.* = 13%) of the time for the Speech Only condition and 7% (*s.d.* = 11%) of the time for the Speech + Nonverbal condition. Older children produced Intended Action responses 12% (*s.d.* = 16%) of the time for the Speech Only condition and 43% (*s.d.* = 22%) of the time for the Speech + Nonverbal condition. There was a main effect of age ($F(1, 27) = 19.28, p < 0.001$) and condition ($F(1, 27) = 26.52, p < 0.001$), and there was a significant interaction effect ($F(1, 27) = 16.86, p < 0.001$). In addition, a separate ANOVA collapsing across age demonstrated that there was no effect of order of stimulus presentation ($F(1, 27) = 0.89, \text{ ns}$). Dunn's planned comparisons indicated that older children produced more Intended Action responses in the Speech + Nonverbal condition compared to the Speech Only condition ($t(3, 27) = 3.22, p < 0.01$) and compared to the younger children in both the Speech Only condition ($t(3, 27) = 4.04, p < 0.01$) and Speech + Nonverbal condition ($t(3, 27) = 3.68, p < 0.01$). Refer to Table 3 and Figure 2.

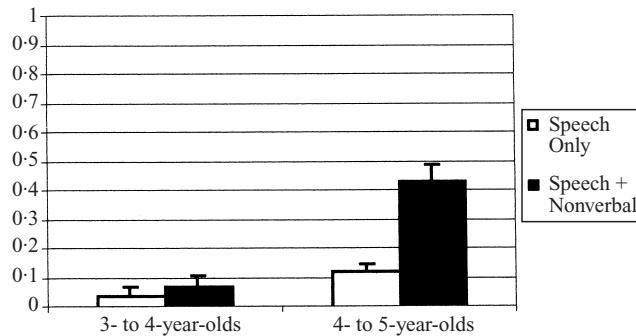


Fig. 2. Intended action responses by age and condition, experiment 1.

The preceding analyses do not reveal anything about individual differences in understanding the requests, as the analyses were based on the proportion of all of the participants' responses that were Intended Action codes out of the total number of possible responses. To address the question of individual differences, a final analysis compared the number of children in each age

group that followed the pattern of producing more Intended Action responses for the Speech + Nonverbal condition compared to the Speech Only condition. Only 29% (*S.D.* = 47%) of the younger children showed the pattern compared to 87% (*S.D.* = 35%) of the older children ($t(1, 27) = 3.79, p < 0.01$). Thus, within an age group, there are minimal individual differences in using speech and gesture to interpret the meaning of the indirect requests: younger children rarely benefit from the combination of speech and gesture, whereas older children almost always profit.

The two goals of Experiment 1 were to determine whether, and when, nonverbal pointing behaviours would help children understand the meaning of complex indirect requests. The results from the Intended Action responses suggest that older children, the four- and five-year-olds, understood the intended meaning of the indirect requests when nonverbal pointing behaviours accompanied the requests. This age is a full year below what previous researchers have reported (Ackerman, 1978; Elrod, 1986; Bernicot & Legros, 1987). One explanation for the difference between the present experiment and previous experiments might be the methods used to measure comprehension. Viewing videotapes is much more similar to everyday, face-to-face interaction than listening to narratives.

However, the video methodology in Experiment 1 still suffered from some of the problems of text-based studies. Specifically, children were OBSERVERS OF interactions instead of PARTICIPANTS IN interactions. Researchers have argued that understanding communication as an observer is quite different from understanding it as a participant (Shober & Clark, 1989; Clark, 1996, 1997). Consequently, the results from the video methodology may not accurately reflect the age at which children understand pragmatically ambiguous speech in everyday, face-to-face interactions.

Another problem with Experiment 1 is that it was unclear just how the nonverbal behaviours interacted with speech to reveal pragmatic meaning. One of the issues addressed in this paper is whether the units of analysis in communication need to be broadened to focus on the COMBINED contribution of verbal and nonverbal information in pragmatic comprehension. However, Experiment 1 did not provide a clear answer to this question. That is, Experiment 1 may have simply demonstrated that nonverbal pointing behaviours BY THEMSELVES can constitute an indirect request instead of demonstrating that speech and nonverbal pointing behaviours COMBINE to determine pragmatic meaning.

EXPERIMENT 2

Experiment 2 was designed to address the above problems in Experiment 1. First, it investigated comprehension of pragmatically ambiguous speech when children were PARTICIPANTS IN rather than OBSERVERS OF com-

municative interactions. And second, it introduced a new request condition – a Nonverbal Only condition – to determine whether speech and nonverbal behaviours interact to co-determine meaning in pragmatic comprehension. Thus, Experiment 2 attempted to replicate Experiment 1 using a different methodology, and in addition, attempted to address the question of how speech and nonverbal pointing behaviours interact in pragmatic comprehension.

METHOD

Participants

Twenty-seven three- to five-year-old children (mean age: 4; 7, 14 females and 13 males) participated in the experiment. The children were divided into two groups: 13 younger children (mean age: 4; 0, range: 3; 7 to 4; 4) and 14 older children (mean age: 5; 0 months, range: 4; 5 to 5; 11). Children were recruited from two preschools in the Chicago metropolitan area.

Procedure

Testing took place in the children's school. Children were introduced to the experimenter in the classroom to familiarize the students with the adult. Children were tested individually. When children were brought to the testing room, they were told that they would be playing with toys and playing games with the adult. The children first played with a set of jumbo-sized Lego blocks. Next, the experimenter replaced the Lego blocks with a set of action figures. Finally, the experimenter read a picture book with the children. Afterward, as a reward, children were allowed to choose a page of stickers from a sticker book. The entire interaction was videotaped.

In general, the interaction was loosely structured and relatively unconstrained. The children could do what they wanted with the toys and books. However, interwoven within the interaction, the experimenter made six highly controlled indirect requests.

Each of the indirect requests was issued in one of three ways, corresponding to the three within-subject conditions. In the Speech Only condition, the experimenter made the request without any special nonverbal behaviours. That is, the experimenter kept his hands at his side and maintained eye contact with the child. In the Speech+Nonverbal condition, the experimenter said the indirect request while looking at and pointing to the target object. A third condition – the Nonverbal Only – was added to Experiment 2 to explore the relative contributions of speech and nonverbal behaviours in comprehension. In the Nonverbal Only condition, the experimenter made the indirect request through his gaze and gesture only, by simply looking at and pointing to the object of the 'request.' Importantly, the

TABLE 4. *Sample interaction for experiment 2*

SITUATION:	The experimenter brings the child into the testing room. The door is left open.
TARGET SENTENCE: <i>It's going to get loud in here.</i>	
EXPERIMENTAL CONDITION	DESCRIPTION
1. Speech Only:	The experimenter utters the target sentence and makes eye contact with the child and keeps his hands at his side.
2. Nonverbal Only	The experimenter DOES NOT utter the target sentence but looks at and points to the open door.
3. Speech + Nonverbal:	The experimenter utters the target sentence and looks at and points to the open door.

child's name was said before each request in all conditions in order to ensure that the child was attending to the experimenter. Table 4 presents an example one of the requests.

The order of the interactions was held constant, but the order in which participants received the experimental conditions was counterbalanced to yield three different orders. In total, children received two Speech Only, two Nonverbal Only, and two Speech + Nonverbal requests. Appendix B presents all of the interactions and the three orders in which they occurred in the interaction sequence. Nine children received Order 1, nine received Order 2, and nine received Order 3.

Because the interaction was free play, it varied from child to child in its length. The duration ranged from as short as 10 minutes to as long as 25 minutes.

Coding

To determine understanding of the indirect requests, the videotapes of children's behavioural responses to the requests were coded. The codes turned out to be roughly similar to the codes in Experiment 1. Occasionally, children behaved as though they did not understand the experimenter ('No Understanding' code). Responses such as looking around the room or at the experimenter, asking 'What?', or doing nothing at all were assigned No Understanding codes. Other times, children focused on the speech content of the experimenter's message ('Speech' responses). These Speech responses were similar to the Reiteration code in Experiment 1, but instead of reiterating speech, the child commented on, or asked questions about, the literal content of the speech. For example, a Speech response would be assigned for the scenario in Table 4 if the child said, 'It's not loud' or asked, 'Why will it get loud?' Finally, 'Action' responses were assigned when children performed some sort of physical action in response to the experimenter's request.

There were three types of Action responses. An 'Intended Action' response is when a child understood the exact intention of the communicator, for example, by getting up and closing the door. A 'Relevant Action' response is when a child did not understand the exact meaning of the request, but did interpret a meaning that was relevant to the context, for example, by getting up and handing the experimenter a sign that was hanging on the door. Finally, children produced a new type of response in Experiment 2 – a Nonverbal Action response. For example, children responded to some of the experimenter's requests by simply looking at or pointing to the object of a request.

Inter-rater reliability was obtained by having a second coder independently score 26% of the participants' responses (7 children). Inter-rater agreement for assigning codes was 91% (Cohen's kappa: 87%).

RESULTS AND DISCUSSION

The data were analysed in the same way as Experiment 1. The results present descriptive data for many of the codes and parametric tests for Action and Intended Action responses. All results are reported as proportions of the total number of responses produced for a given age and condition. In addition, all data are included, as there were no missing trials.

No Understanding, Speech, and Action responses

The first set of data examined children's general understanding of the indirect requests. Occasionally, children did not understand that an indirect request had been made. Younger children produced No Understanding responses 35% (*s.d.* = 32%) of the time for the Speech Only condition, 12% (*s.d.* = 22%) of the time for the Nonverbal Only condition, and 8% (*s.d.* = 19%) of the time for the Speech+Nonverbal condition. Older children produced No Understanding responses 46% (*s.d.* = 37%) of the time for the Speech Only condition, 10% (*s.d.* = 21%) of the time for the Nonverbal Only condition, and 7% (*s.d.* = 18%) of the time for the Speech+Nonverbal condition. Refer to Table 5.

TABLE 5. *No Understanding, Speech, and Action responses, experiment 2 (%)*

	Younger children			Older children		
	SO	NO	S+N	SO	NO	S+N
No Understanding	35	12	8	46	10	7
Speech	40	0	4	25	0	7
Action	25	88	88	29	90	86

Other times, children interpreted the experimenter's speech as a literal statement. Younger children produced Speech responses 40% (*s.d.* = 42%) of the time for the Speech Only condition, 0% (*s.d.* = 0%) of the time for the Nonverbal Only condition, and 4% (*s.d.* = 14%) of the time for the Speech+Nonverbal condition. Older children produced Speech responses 25% (*s.d.* = 33%) of the time for the Speech Only condition, 0% (*s.d.* = 0%) of the time for the Nonverbal Only condition, and 7% (*s.d.* = 18%) of the time for the Speech+Nonverbal condition. Refer to Table 5.

Most of the children's responses were Action responses. Younger children produced Action responses 25% (*s.d.* = 25%) of the time for the Speech Only condition, 88% (*s.d.* = 22%) of the time for the Nonverbal Only condition, and 88% (*s.d.* = 22%) of the time for the Speech+Nonverbal condition. Older children produced Action responses 29% (*s.d.* = 32%) of the time for the Speech Only condition, 90% (*s.d.* = 21%) of the time for the Nonverbal Only condition, and 86% (*s.d.* = 31%) of the time for the Speech+Nonverbal condition. There was not a main effect of age ($F(1, 25) = 0.06$, ns) but there was for condition ($F(2, 50) = 58.67$, $p < 0.001$), and there was no interaction effect ($F(2, 50) = 0.25$, ns). In addition, a separate ANOVA collapsing across age demonstrated that there was no effect of order (3 different orders) of stimulus presentation ($F(2, 24) = 2.33$, ns). Dunn's planned comparisons indicated that children produced the fewest actions in response to the Speech Only condition compared to Nonverbal Only ($t(2, 50) = 6.72$, $p < 0.01$) and Speech+Nonverbal ($t(2, 50) = 6.54$, $p < 0.01$) conditions. Refer to Table 5 and Figure 3.

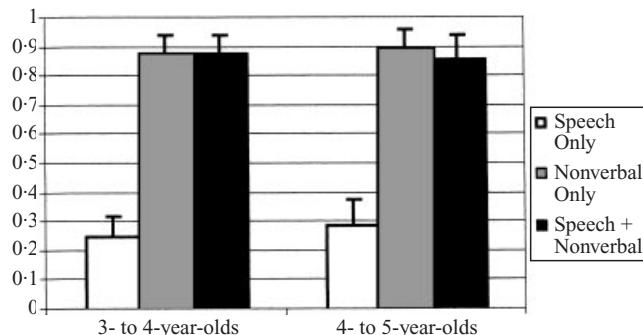


Fig. 3. Action responses by age and condition, experiment 2.

To summarize thus far, the Speech Only condition appeared to cause children to either not understand the experimenter or to interpret him literally. In contrast, the two nonverbal conditions – Nonverbal Only and Speech+Nonverbal – appeared to cause children to respond to the experimenter with an action.

Nonverbal Action, Relevant Action, and Intended Action responses

The next set of data explored the TYPES of Action responses that children produced. Children occasionally produced Nonverbal Action responses, that is, responses that nonverbally indicated the target objects. These responses suggest that children understood that they should pay attention to the target objects, but also that they were not sure what to DO with those objects. Younger children produced Nonverbal Action responses 8% (*s.d.* = 19%) of the time for the Speech Only condition, 48% (*s.d.* = 43%) of the time for the Nonverbal Only condition, and 15% (*s.d.* = 24%) of the time for the Speech + Nonverbal condition. Older children produced Nonverbal Action responses 4% (*s.d.* = 13%) of the time for the Speech Only condition, and 25% (*s.d.* = 38%) of the time for the Nonverbal Only condition, and 25% (*s.d.* = 33%) of the time for the Speech + Nonverbal condition. Refer to Table 6.

TABLE 6. *Nonverbal, Relevant, and Intended Action responses, experiment 2** (%)

	Younger children			Older children		
	SO	NO	S+N	SO	NO	S+N
Nonverbal Action	8	48	15	4	25	25
Relevant Action	5	22	0	4	32	0
Intended Action	12	22	73	21	33	61

* This was created in the same way as Table 3.

Other times, children misunderstood the intended meaning of the requests, but interpreted an action that DID make sense in the context of the request (Relevant Action). Younger children produced Relevant Action responses 5% (*s.d.* = 15%) of the time for the Speech Only condition, 22% (*s.d.* = 39%) of the time for the Nonverbal Only condition, and 0% (*s.d.* = 0%) of the time for the Speech + Nonverbal condition. Older children produced Relevant Action responses 4% (*s.d.* = 13%) of the time for the Speech Only condition, 32% (*s.d.* = 37%) of the time for the Nonverbal Only condition, and 0% (*s.d.* = 0%) of the time for the Speech + Nonverbal condition. Refer to Table 6.

The data from children's Nonverbal and Relevant Action responses, though not statistically analysed, suggest that the Nonverbal Only condition caused children to respond with actions that were not exactly what the experimenter intended. What information do children need to home in on the intended meaning?

The Intended Action analysis addressed this question. Younger children

produced Intended Action responses 12% (*s.d.* = 20%) of the time for the Speech Only condition, 22% (*s.d.* = 33%) of the time for the Nonverbal Only condition, and 73% (*s.d.* = 33%) of the time for the Speech+Nonverbal condition. Older children produced Intended Action responses 21% (*s.d.* = 26%) of the time for the Speech Only condition, 33% (*s.d.* = 25%) of the time for the Nonverbal Only condition, and 61% (*s.d.* = 35%) of the time for the Speech+Nonverbal condition. There was not a main effect of age ($F(1, 25) = 0.34$, ns) but there was for condition ($F(2, 50) = 28.47$, $p < 0.001$), and there was no interaction effect ($F(2, 50) = 1.91$, ns). In addition, a separate ANOVA collapsing across age demonstrated that there was no effect of order of stimulus presentation ($F(2, 24) = 1.61$, ns). Dunn's planned comparisons indicated that children understood the intended meaning of the experimenter most often in the Speech+Nonverbal condition compared to Speech Only ($t(2, 50) = 5.03$, $p < 0.01$) and Speech+Nonverbal ($t(2, 50) = 4.06$, $p < 0.01$). Refer to Table 6 and Figure 4.

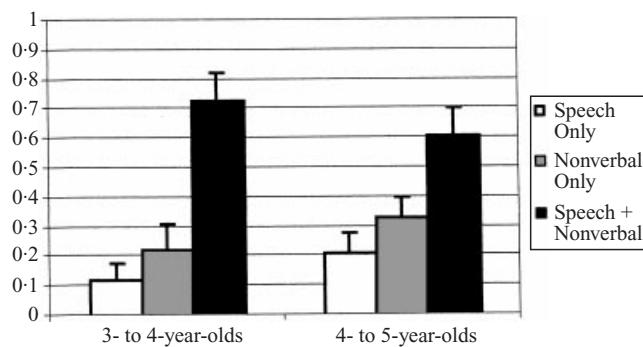


Fig. 4. Intended action responses by age and condition, experiment 2.

From inspection of Figure 4, it appears that the combination of speech and nonverbal behaviours had a more profound influence on younger compared to older children. Indeed, student's *t* tests indicated that younger children produced more Intended Action responses in the Speech+Nonverbal condition (73%) compared to both the Speech Only and Nonverbal Only conditions (34%) ($t(25) = 3.09$, $p < 0.01$). In contrast, older children DID NOT produce more Intended Action responses in the Speech+Nonverbal condition (61%) compared to both the Speech Only and Nonverbal Only conditions (54%) ($t(25) = 0.51$, ns). These results suggest that the combination of speech and nonverbal pointing behaviours may be necessary for younger children to 'break into' an understanding of complex pragmatic processes.

This possibility is supported by an individual difference subjects analysis. As with Experiment 1, a *t* test analysis compared the number of children in

each age group that followed the pattern of producing more Intended Action responses for the Speech + Nonverbal condition compared to the Speech Only and Nonverbal Only conditions. Different from Experiment 1, only 50% (*s.d.* = 52%) of the OLDER children showed the pattern compared to 85% (*s.d.* = 38%) of the YOUNGER children ($t(1, 25) = 1.97, p < 0.05$). This pattern suggests that the large majority of the younger children have difficulty understanding the indirect requests without the combination of speech and gesture, whereas as many as half of the older children are able to understand the requests even when they are presented in one modality. These interesting age differences will be addressed in the General Discussion.

Experiment 2 has added to Experiment 1 in two important ways. First, the results from Experiment 2 suggest that children are much more sensitive to nonverbal behaviours when they are actual PARTICIPANTS IN rather than OBSERVERS OF communicative interactions. This sensitivity allowed even the youngest children in Experiment 2 (three-year-olds) to comprehend the intended meaning of indirect requests when speech was accompanied by nonverbal pointing behaviours. This age is below children's understanding in Experiment 1 using the video methodology, and well below previous research using text-based methods.

Second, Experiment 2 explored the interaction of speech and nonverbal pointing behaviours in comprehension. Nonverbal behaviours ALONE were not sufficient to reveal pragmatic meaning – rather, speech and nonverbal behaviours worked TOGETHER to co-determine meaning. This relationship suggests that speech and nonverbal behaviours may interact in a dynamic and synergistic fashion in comprehension.

GENERAL DISCUSSION

One of the main questions of the present study was, do nonverbal pointing behaviours play a role in children's understanding of pragmatically ambiguous speech? The results from children's Intended Action responses in both experiments strongly suggest that the answer is yes. However, the answer to the second main question about the age at which this occurs was less clear.

One inconsistency was that in Experiment 1, older children had a better general understanding of the indirect requests – that is, they produced more Action responses – than younger children. In addition, in all but the Intended Action measure, children in Experiment 1 did not appear to show sensitivity to nonverbal behaviours. In contrast, Experiment 2 found that children were very sensitive to nonverbal behaviours. Moreover, there appeared to be fewer age differences between younger and older children. How might this apparent discrepancy be reconciled?

One of the main differences between the two experiments was that children were OBSERVERS in Experiment 1 and PARTICIPANTS in Experiment 2. This is

important in light of research on adults that has argued that observing an interaction is quite different from actually participating in it (Shober & Clark, 1989; Clark, 1996, 1997). This problem is especially true for children. It is well known that young children are not very good at taking the perspective of others (Piaget, 1954; Glucksberg & Krauss, 1967). Consequently, three- and four-year-olds' poor performance in Experiment 1 may have resulted from an inability to take the perspective of the addressees in the video interactions. Under this view, the results from both experiments may be compatible. Perhaps Experiment 1 simply presented a delayed picture of what children understand as observers compared to what they understand as participants. This would explain why Experiment 1 found age differences in children's general understanding of the indirect requests (Action responses), but Experiment 2 did not. For example, younger children (three- and four-year-olds) as participants in Experiment 2 may have already had a basic understanding of indirect requests, which might have made those children look similar to older children (four- and five-year-olds). In contrast, younger children as observers in Experiment 1 may NOT have understood the indirect requests. Perhaps only older children understand indirect requests as observers. In other words, both experiments may have captured two opposite sides of children's 'entry' into understanding indirect requests.

This possibility helps explain another apparent discrepancy between the experiments. Recall that there were different age patterns across experiments in children's specific understanding of the indirect requests, that is, in their Intended Action responses. For example, the Intended Action difference in Experiment 1 between Speech and Speech+Nonverbal was greatest for older children. In contrast, the difference in Experiment 2 was greatest for younger children. This apparent discrepancy actually makes sense under the view that both experiments capture opposite sides of children's understanding of indirect requests. Specifically, the difference in Experiment 1 between the younger and older children may reflect the transition from not understanding the specific meaning of indirect requests to beginning to understand that meaning. Conversely, the difference in Experiment 2 between the younger and older children may reflect the transition from beginning to understand the specific indirect meaning to further mastering that understanding. Indeed, the older children in Experiment 2 were good at understanding the intended meaning of the indirect requests not just in the Speech + Nonverbal condition, but in all three conditions. This suggests that children who are just learning about indirect requests may initially need the combination of modalities (verbal and nonverbal) to understand pragmatic meaning, whereas older children and adults (Kelly *et al.*, 1999) are able to glean meaning from only a single modality.

This interpretation is similar to the idea of prosodic bootstrapping. The prosodic bootstrapping hypothesis argues that intonation and prosody guide

children's initial understanding of syntax (for a recent conceptualization of this hypothesis, see Hirsh-Pasek, Tucker & Golinkoff, 1996). Analogously, 'deictic' bootstrapping may work to initially make the meaning of pragmatic communication clear for younger children through the combination of speech and nonverbal pointing behaviours, and then as children get older, this understanding may generalize to more impoverished cases, for example, when speech or nonverbal behaviours are presented alone.

This idea nicely complements the existing literature on children's understanding of indirect requests. For example, Shatz (1978a, 1978b) found that very young children aged between 1;6 to 3;0 respond with actions indiscriminately to their mother's speech. However, Shatz notes that as children get older, they begin to learn that certain actions are required for certain contexts. It is possible that nonverbal pointing behaviours—behaviours that naturally and frequently accompany child-directed speech—may help to initially guide children's actions in different contexts. Finally, once children develop a stable understanding of how to use contextual information, context alone may be sufficient to reveal the meaning of speech (Ackerman, 1978; Elrod, 1986; Bernicot & Legros, 1987).

The results from the present study have implications for other areas in language development as well. For example, although much research has demonstrated that nonverbal behaviours play a major role in word learning, few researchers have directly explored just how speech and nonverbal behaviours interact to determine meaning. The results from Experiment 2 bear directly on this issue.

Experiment 2 introduced a Nonverbal Only condition that allowed for an investigation of the relative contributions of speech and nonverbal behaviours in pragmatic comprehension. The data suggested that when VERBAL cues were the only source of information, children either misunderstood the requests or interpreted them literally. In contrast, when NONVERBAL cues were the only source of information, children responded with actions—however, they were actions that did not directly reflect the intentions of the experimenter. It was only when BOTH cues were simultaneously presented that children accurately understood, and correctly acted upon, the specific intentions of the experimenter.

Consider an example. In the 'open door' interaction, a glance and point to the door without the corresponding speech, 'It's going to get loud in here,' elicited non-intended actions or just glances toward the door. And when speech was presented without nonverbal pointing behaviours, children also had difficulty interpreting the meaning, reacting with looks of confusion or literal responses such as, 'OK' or, 'It's not loud.' However, with information from both modalities instead of just one, children easily understood the experimenter and got up and closed the door.

Examples such as these suggest that not only do nonverbal behaviours

disambiguate the meaning of speech, speech disambiguates the meaning of nonverbal behaviours. In other words, speech and nonverbal behaviours may MUTUALLY CONSTRAIN pragmatic meaning. This idea goes further than most claims about the role of nonverbal pointing behaviours in development. For example, in the word learning literature (e.g. Baldwin, 1993a, 1993b; Carpenter *et al.*, 1998; Moore *et al.*, 1999), the emphasis is placed on the disambiguating role that eye gaze plays on children's interpretation of novel words. However, the data from the present study suggest that the direction of influence may go in two ways. That is, in word learning situations, it is possible that words THEMSELVES may disambiguate the meaning of certain nonverbal behaviours.

In conclusion, the implications of the present study extend beyond the realm of developmental research. Language researchers such as Clark (1996) and McNeill (1992) have cautioned against focusing primarily on speech in studying face-to-face communication. However, from its foundations in the philosophical literature to present-day psycholinguistic research, the field of pragmatics has taken as its point of departure the spoken word. This rarefied view of communication leads us to look for pragmatic meaning outside of the face-to-face conditions that constitute the primary arena of human communication. As a consequence, the traditional pragmatic problem that 'speech underdetermines meaning' might be overstated, simply because an important source of pragmatic information – nonverbal behaviour – has not been considered. By expanding the linguistic unit of analysis to include information conveyed through a communicator's hands, face, or tone of voice – that along with speech are likely to actively co-determine the meaning of an utterance – researchers may begin to approach the study of language from a perspective that is more in line with what happens in everyday, face-to-face interaction.

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APPENDIX A

EXPERIMENT I

Order One: 1: **SO**, 2: **S+N**, 3: **SO**, 4: **SO**, 5: **S+N**, 6: **SO**, 7: **S+N**, 8: **S+N**
Order Two: 1: **S+N**, 2: **SO**, 3: **S+N**, 4: **S+N**, 5: **SO**, 6: **S+N**, 7: **SO**,
8: **SO**

Scene 1: M and C in kitchen. An over-flowing garbage can is in sight.

C: Can I go outside and play mom?

Mother's indirect request

SO: Do you know what you have to do first?

S+N: Do you know what you have to do first? (Point to garbage)

Scene 2: C is playing with toys in the TV room. M enters.

M: Where's your sister?

C: Oh, she's upstairs Mom.

Mother's indirect request

SO: Well, it's almost time for dinner.

S+N: Well, it's almost time for dinner. (Point to toys on floor)

Scene 3: M is in kitchen. C enters.

M: Did you have fun outside with Johnny.

C: Yea, we played catch out in the rain. (Hangs jacket on chair)

Mother's indirect request

SO: Do you remember what I said about coming in from outside?

S+N: Do you remember what I said about coming in from outside?
(Point to child's boots)

Scene 4: M is sitting in dark area. C enters.

C: Look Mom I made you a story.

M: Oh good.

Mother's indirect request

SO: I can't read this.

S+N: I can't read this. (Point to lamp)

Scene 5: C lying down on couch. M enters.

M: I brought you some nice hot soup. How are you feeling (feels child's forehead)?

KELLY

C: Not so good.

Child's indirect request

SO: I'm getting a little chilly Mom.

S+N: I'm getting a little chilly Mom. (Point to blanket on other couch)

Scene 6: C is working at table. M enters.

C: Mom I don't want to do my homework anymore.

M: But you are almost done.

Child's indirect request

SO: But I am getting hungry.

S+N: But I am getting hungry. (Point to cupcakes on table)

Scene 7: M is in kitchen looking toward other room.

M: You better hurry, or you might be late for school.

C: I'm going as fast as I can. (Finishes putting on shoes and stands up)

Mother's indirect request

SO: Don't forget it's raining.

S+N: Don't forget it's raining. (Point to jacket)

Scene 8: C and M are in the bathroom. C just finished washing hands.

C: I hate getting ready for bed Mom.

M: I know.

Mother's indirect request

SO: Just one more thing.

S+N: Just one more thing. (Point to toothpaste)

APPENDIX B

EXPERIMENT 2

Order One: 1: **S+N**, 2: **SO**, 3: **NO**, 4: **S+N**, 5: **SO**, 6: **NO**

Order Two: 1: **SO**, 2: **NO**, 3: **S+N**, 4: **SO**, 5: **NO**, 6: **S+N**

Order Three: 1: **NO**, 2: **S+N**, 3: **SO**, 4: **NO**, 5: **S+N**, 6: **SO**

Scene # 1: Child is next to open door, picking out stickers.

Experimenter's indirect request

SO: It's going to get loud in here.

NO: Point and look at the open door.

S+N: It's going to get loud in here. (Point and look at the open door)

Scene # 2: Child is playing with Lego blocks.

Experimenter's indirect request

SO: It's getting cold in here.

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NO: Point and look at sweater hanging on wall.

S+N: It's getting cold in here. (Point and look at sweater)

Scene # 3: Experimenter brings some toys to table. The Lego blocks are still in front of the child.

Experimenter's indirect request

SO: We need to make room for the toys.

NO: Point and look at the Lego box.

S+N: We need to make room for the toys. (Point and look at Lego box)

Scene # 4: Child is playing with toys next to a water bottle, a pen, and a piece of paper.

Experimenter's indirect request

SO: I'm getting kind of thirsty.

NO: Point and look at water bottle.

S+N: I'm getting kind of thirsty. (Point and look at water bottle)

Scene # 5: Experimenter asks child to put toys back in box and takes box.
The experimenter stands up. The Lego box is next to the child.

Experimenter's indirect request

SO: We need to put things away.

NO: Point and look at Lego box.

S+N: We need to put things away. (Point and look at Lego box)

Scene # 6: Child is reading picture book next to a water bottle, a pen, and paper.

Experimenter's indirect request

SO: I need to write something down.

NO: Point and look at pen.

S+N: I need to write something down. (Point and look at pen)