

Two-year-old children's sensitivity to the referential (in)efficacy of their own pointing gestures*

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ABSTRACT

In three studies, two-year-old children communicated to a parent which of two out-of-reach objects contained a sticker. Across trials, the objects were positioned in different configurations so that it was possible or impossible for a child's pointing gesture to unambiguously specify one object. In Study 1, the objects used were two boxes distinguished by a different picture of a vehicle on the front, and children ($n = 16$; mean age 2;8) were significantly more likely to name the box's picture on trials where pointing alone could not unambiguously specify the box than on trials where it could. In Studies 2 and 3, the stickers were hidden inside different animal figures. Older two-year-olds ($n = 16$, mean age 2;9), but not younger two-year-olds ($n = 16$, mean age 2;4), showed an ability to recognize the referential (in)efficacy of their pointing gestures and to adapt their communication accordingly.

INTRODUCTION

Children's referential communication skills have been the topic of a long history of research, beginning in the late 1960's with the work of Glucksberg & Krauss and their associates (e.g. Glucksberg, Krauss & Weisberg, 1966;

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Glucksberg & Krauss, 1967; Krauss & Glucksberg, 1969) and the work of Flavell and associates (e.g. Flavell, Botkin, Fry, Wright & Jarvis, 1968). In the initial referential communication paradigm devised by Glucksberg & Krauss (1967), the child is given the task of describing an object from an array in a way that unambiguously identifies it for a listener. Typically, the array consists of items varying on such dimensions as colour, size, and shape.

This paradigm has been used widely and reviews of this literature generally indicate that prior to age 6;0 or 7;0, children produce a verbal description of the object that fails to uniquely specify that object (Glucksberg, Krauss & Higgins, 1975; Asher, 1979; Dickson, 1981). For example, a child might ask for 'the blue one' when both a blue square and blue triangle are present in the array. In 1982, Pechmann & Deutsch (1982) included children's pointing behaviour as a measure of interest in order to further elucidate the nature of younger children's errors in referential communication situations. In particular, the authors were curious as to whether younger children would differ from older children and adults in continuing to use a pointing gesture in circumstances in which it cannot help the addressee to identify the referent. In a series of studies, two-, four-, five-, six-, and nine-year-old children were asked, in a play situation, to select a birthday present for an imaginary recipient from an array of toys. Depending on the choice of the child, either two or three dimensions of the object (e.g. colour, type of object, and also in some cases size) had to be specified for it to be unequivocally distinguished from the remaining objects of the referential domain. For example, in one study (Experiment 1), two- and six-year-old children were shown an array of eight objects that included a small green spoon, a big green spoon, a small yellow spoon, a big yellow spoon, a red watering can, a green watering can, a green shovel, and a yellow shovel. The experimenter elicited the child's description by posing the question 'Which thing?'. Because the toys were placed close together and approximately 3m from the child, a pointing gesture could not be used to unambiguously specify one object. In accord with previous findings, the researchers found that even by six years of age only 50% of the children were capable of providing an adequate description. None of the two-year-old children ever provided an adequate verbal description. When incorrect, the majority of the two-year-old children produced a point with an inadequate verbal description, whereas the six-year-old children tended to produce solely an inadequate verbal description. Among the adults, it is of interest to note that pointing did accompany a small percentage (14%) of adequate verbal descriptions, suggesting that verbal descriptions do not entirely replace the use of pointing. In another study (Experiment 3), involving four- and five-year-old children, the array was reduced to four toys that varied with respect to colour and toy type. For example, the children were presented with a red and blue candle and a red and blue car. The children provided unambiguous

verbal descriptions on 56% of the trials and pointed in 24% of all cases. Unfortunately, the results with respect to pointing are not detailed further and it is unclear how many of these points occurred alone or in conjunction with an adequate or inadequate verbal description. Pechmann & Deutsch (1982) concluded from their findings that 'when children are not yet able to produce adequate verbal descriptions, they are likely to employ nonverbal means that are inappropriate in the particular situation (p. 341).'

One problem with respect to interpreting the findings with respect to the younger children in the studies by Pechmann & Deutsch (1982) is that their methodology did not include any controls to ensure that the children in the studies actually possessed the vocabulary terms required to unambiguously specify each of the toys in the given arrays. Indeed, in a further paper discussing the results of these studies, Deutsch & Pechmann (1982) state that a certain number of the youngest children did not have the vocabulary required. Thus, it is impossible to determine from their studies whether the overuse of pointing by the younger children was due to the fact that these children did not have an adequate verbal alternative available within their capability, or whether it was due to a true misuse of pointing that would have arisen even if such an alternative verbal response had been available.

We are not aware of any further studies in the referential communication literature to have further explored the factors governing children's decision to use a nonverbal versus verbal device of reference. However, within the literature on children's developing theory of mind (Astington, Harris & Olson, 1988) and early communicative development, the results of a small, but growing, number of studies (e.g. Tomasello, Anselmi & Farrar, 1984/85; Anselmi, Tomasello & Acunzo, 1986; Tomasello & Akhtar, 1995; Akhtar, Carpenter & Tomasello, 1996; O'Neill, 1996; Shwe & Markman, 1997) have suggested that children as young as two years of age possess an impressive ability to take the situational context into account in communicative tasks, and even to adjust their communication to another person's conceptual perspective.

For example, in novel word-learning situations, Tomasello & Akhtar (1995) found that children at 2;3 interpreted a new word as a word for a target action or target object depending on whether the action or the object was the one new element in the discourse context at the time of the naming event. Children at 2;0 will also use information about shared and nonshared experiences to help interpret the meaning of a novel word uttered by an adult (Akhtar *et al.*, 1996). For example, in Akhtar *et al.* (1996), children watched as an adult exclaimed 'There's a modi!' while looking at a set of four nameless objects, three of which the adult and the child had played with together earlier and the fourth of which the child had played with alone. Later, in a comprehension test, children revealed that they had interpreted the novel word to mean the fourth object that was novel to the adult.

In a request situation, O'Neill (1996) found that younger and older two-year-old children will adapt their nonverbal and verbal communication depending on the knowledge state of their listener. For example, in their requests for an out-of-reach, hidden toy, these children provided their parent with the location and name of a hidden toy more often when their parent had not seen the hiding of the toy than when the parent had seen the hiding and was knowledgeable about the toy's identity and location. Similarly, Shwe & Markman (1997) found that children aged 2;0 to 2;6 appreciated the mental component of their communicative signals. When the children were presented with situations in which they did not get a toy they wanted, they acted more satisfied when their listener conveyed comprehension of their signal than when their listener conveyed no understanding of their request. Furthermore, even in cases where children obtained the toy they requested, they persisted to clarify their signal more when the experimenter conveyed no understanding of their request compared to when she expressed understanding of the request. And, perhaps most interestingly, with respect to children's ability to assess the effectiveness of their communicative behaviours, Tomasello *et al.* (1984/85) found that children two to three years of age combined their pointing gesture differentially with language of different degrees of referential specificity. In this study, children were observed, in response to an adult signal of noncomprehension, to be more likely to retain or add a gesture (and less likely to drop or not add a gesture) in their reformulated messages, if their original utterance used a pronoun rather than a noun. The results of such studies reviewed above raise the possibility that, if given a simplified version of a referential communication task, even very young children might adapt the use of their verbal and nonverbal devices of reference when the communicative context demands it.

The aim of the present study was to determine whether two-year-old children appreciate that the SPATIAL CONFIGURATION of objects in an array may impact on the effectiveness of their pointing gestures and would choose to adopt the more effective strategy of verbally specifying the intended referent in situations in which a pointing gesture could not specify a referent unambiguously. Briefly stated, in all three studies to be reported, two-year-old children had to communicate to a parent which of two out-of-reach objects (two boxes with pictures on the front in Study 1, two rubber animal toys in Studies 2 and 3) contained a sticker so that the parent could retrieve it for them. Control trials ensured that children possessed the vocabulary needed to unambiguously describe each object. On each trial, the child, but not the parent, witnessed the hiding of the sticker in one of the objects. Across trials the objects were positioned in several different configurations so as to make it possible or impossible for a pointing gesture to specify one of the objects unambiguously. The measure of interest was whether the children would be more likely to describe the object verbally on trials where

pointing alone would not be sufficient to indicate unambiguously, to their parent, the object containing the sticker.

In Study 1, the participants were older two-year-old children and the sticker was hidden in one of two little boxes, distinguished by a picture of a different vehicle on the front. In Study 2, the participants were also older two-year-olds, but the sticker was hidden inside one of two different toy animals. The design of Study 3 was identical to that of Study 2, but the participants were younger two-year-olds. These studies will show that older two-year-old children do possess an appreciation of one factor contributing to referential ambiguity, namely the spatial configuration of objects in an array, and will adjust their use of nonverbal and verbal devices of reference accordingly.

STUDY 1

In Study 1, children had to communicate to a parent which of two out-of-reach boxes, distinguished by a different picture of a vehicle on the front of each, contained a sticker so that he/she could retrieve it for them. The parent did not witness the placement of the sticker in either box and was therefore ignorant of the sticker's location. On half of the trials, the boxes were positioned so as to make it possible for a child's pointing gesture to specify unambiguously the location of the box containing the sticker (i.e. one box alone or two boxes far apart). On the other half of the trials, the positioning of the boxes (i.e. side-by-side or stacked) did not permit the location of the box to be specified unambiguously with a pointing gesture; rather, a verbal description was required. It was predicted that children would name the picture on the box containing the sticker (rather than just gesturing to its location) more often on trials where pointing alone was not sufficient to indicate a box unambiguously than on trials where it was.

METHOD

Participants

Sixteen children (seven boys and nine girls; mean age 2;8, range 2;6 to 2;10) participated in the study. Fifteen mothers and one female nanny took part. Children were largely from middle-class families and were recruited from a database of volunteers at the MRC's Cognitive Development Unit in London, England. Data from an additional six children was omitted because either the parent gave feedback contrary to the instructions asked of him/her ($n = 5$) or because the child refused to name the sticker on the boxes in the control task ($n = 1$).

Materials

Equipment. The experimenter sat to the right of the child at a small rectangular table (60 × 90 cm). The parent sat to the left of the child. One camera recorded children's behaviour face-on, while a second camera recorded the behaviour of the parent onto a split-screen. A small microphone was placed at the far end of the table. The boxes were also placed at the far end of the table, out of reach of the children (at a distance of 85 cm) but within reach of the parent. A videocassette recorder equipped with frame-by-frame viewing capability was used to view and code the videotapes.

Stimuli. Four small boxes with drawers (used to hold hardware items such as nails) were used. These boxes were 5 cm³ and could be attached flush with each other on the side or on top. The sides were opaque and on the front of each drawer a different picture of a vehicle (boat, car, train, plane) was placed. Eleven stickers of different farm animals were also used. A picture of a farm-yard was used for children to place their stickers on during the game.





Procedure

Introduction. Once seated at the table, the children were first shown a picture of a farmyard scene and given a sticker to put on it. They were then told that in the game they would be able to get some more stickers to put on their picture. The first two boxes (with a car and plane picture on the front) were then shown to children and they were asked to name each picture as a control that they could describe each box by its picture on the front. The children were told that in the game the experimenter would hide a sticker in one of the boxes and that their parent would be their helper in the game and would help them to get the sticker.

Practice trial. One practice trial was used to familiarize the children with the procedure of telling a parent where the sticker had been hidden. At the beginning of the practice trial, the parent was asked to close her (his) eyes. One box (car or plane) was placed in the centre of the far end of the table from the child. The experimenter then hid the sticker (with the back of the sticker towards the children) in this box while saying, 'Look where the sticker's going. I'm putting the sticker in here. Mommy (daddy) can't see where the sticker's going'. Once the sticker had been hidden, the parent was asked to open her (his) eyes. If children responded spontaneously with a verbal or gestural response, the parent retrieved the sticker for them. If a response was not made spontaneously (within 1–2 seconds), the children were given the prompt, 'Tell mommy (daddy) where the sticker is?'. Following the child's first response, the parent retrieved the sticker and the children were reminded that the parent was their helper in the game and would help them to get the stickers.

Experimental trials. Eight experimental trials followed in two blocks of

four trials. In the first block the car and plane boxes were always used and, in the second block, the train and boat boxes were always used. At the beginning of the second block of trials, the children were shown the train and boat boxes and asked to name the picture on each. Within each block of four trials, one or two boxes were placed at the far end of the table in one of the following four configurations:

1.  One box at the far centre of the table (identical to practice trial).
2.  One box each in the far corners of the table, about 50 cm apart.
3.  Both boxes in one far corner, side-by-side.
4.  Both boxes in one far corner, stacked on top of each other.

Due to the location of the boxes, configurations 1 and 2 will be referred to as the NONADJACENT trials and configurations 3 and 4 will be referred to as the ADJACENT trials. On the nonadjacent trials, the location of the box(es) was such that a pointing gesture alone would suffice to unambiguously specify the box containing the sticker. On the adjacent trials, the small size of the boxes and their proximity to each other rendered a pointing gesture uninformative. Thus, one box could only be referred to unambiguously by verbally identifying it; for example, by stating *the car one* or *the plane one* depending on what picture was on the front of the box containing the sticker. The procedure on each experimental trial was identical to that of the practice trials. The children were given a prompt only if they did not spontaneously respond once a parent had uncovered their eyes.

A latin-square design was used to counterbalance the order of presentation of each of the four configurations within a block. This yielded four orders which were counterbalanced as to the left/right positioning of the boxes with respect to the far corners of the table, the left/right (or top/bottom) positioning of the boxes in configurations 2 to 4, and the particular box used on configuration 1, to produce 16 final orders for the trials in block 1. The order of presentation of the four configurations in block 1 was repeated for the second block of trials but the left/right (top/bottom) orientations of the box containing the sticker were reversed from block 1. The trials were presented in two blocks in order to preserve a fully counterbalanced design for the first block of trials should children's attention wane during the second block of trials as was suggested as a possibility in piloting.

Feedback trials. All the children received two final extra trials using configurations 3 and 4 (with the plane and boat boxes). On these trials, children were given feedback by the experimenter (before the parent retrieved the sticker) if they failed to verbally identify a box in their first response. In particular, children were first given the feedback prompt 'Which one?'. Following this, if children still did not specify one of the boxes verbally, they were given the forced-choice question 'The boat one or the

train one?' as the second feedback prompt, with the order of the choices counterbalanced. Once a child had verbally specified one of the boxes, the parent retrieved the sticker. The two feedback trials were included to gain a better sense, particularly among children failing to use the name when required, of how unaware children might be of the potential ambiguity and the means by which to repair this ambiguity. For example, children failing to use the name might recognize that it is required immediately after being given the non-specific prompt 'Which one?' However, it might also be the case that more specific prompting is required in the form of presenting the forced-choice alternatives before children can resolve the ambiguity. Children's responses on Feedback Trial 2 can also speak to the issue of any transfer of learning from Feedback Trial 1. That is, the observation that children fail to apply the feedback from Trial 1 to Trial 2 might be an additional indication of the difficulty such a task might present to young children.

Instructions to parents. Upon arrival, the children were given some toys to play with to familiarize themselves with the room and the experimenter. During this time, the parents were given detailed instructions that specifically asked them to do several things: (a) to say as little as possible during the task, (b) to look at their child with a neutral, attentive expression while waiting for their child to tell them where the sticker was, (c) not to look at the boxes when they uncovered their eyes, (d) to retrieve the toys on all trials REGARDLESS of whether their child adequately told them where it was. The parents were instructed not to wait for more information and not to ask 'Which one?', 'This one?', or use any nonverbal cues to prompt their child to provide more information.

The goal was for the parent to simply retrieve the toy on all eight trials following the child's first request, regardless of its adequacy. To enable parents to carry out this instruction, they were asked to peek while covering their eyes. Parental feedback was not used because once feedback has been given on a trial it is impossible to determine whether children's responses on subsequent trials are the result of the feedback or the manipulation of the location of the boxes. Similar reasoning for not using feedback can be found in other studies (Maratsos, 1975, O'Neill, 1996). Any violation of these feedback instructions by the parent on the introductory or main experimental trials resulted in the replacement of that child in the sample. Two final feedback trials did include feedback given by the experimenter (i.e. Which one?) as discussed. During the testing session, once the experimental trials were over, parents were reminded that the feedback trials would now be presented. In a few instances, when children specifically asked a parent for an incorrect box, the parent first retrieved the incorrect box that was empty and then subsequently retrieved the sticker from the correct box. Such instances were rare and did not appear to affect subsequent behaviour.

Coding of videotapes

All videotapes for Studies 1 to 3 were coded independently by the primary investigator and a research assistant who was blind to the hypothesis of the studies. In each study, the child's first request to the parent on each trial was coded. The verbal and nonverbal components of children's requests were coded as follows.

Gestural responses. The OCCURRENCE of any gesture toward the box(es) was noted. If a gesture was produced, two specific aspects of the gesture were coded: (a) the direction of the gesture (e.g. left, right, centre of table), and (b) GESTURE TYPE. Three types of gestures were distinguished: (a) POINTS, which consisted of any gesture with index finger extension relative to the other fingers, (b) REACHES, which consisted of any gesture in which all fingers were extended in a grasping fashion, and (c) INDICATES, which consisted of any gesture in which all fingers were extended straight out (i.e. not grasping). Attention was paid as to whether the children tried to indicate left/right for configuration 3 or top/bottom for configuration 4 in their use of gestures, but no such instances were observed in any of the three studies. Gestures produced toward the incorrect box (i.e. the child forgot where the sticker was) were also included as gestures to the box's location, as they were used to unambiguously specify the location of the sticker (albeit incorrect) as opposed to a response that provided no such information. Over all three studies, such incorrect gestures were produced on four trials, and the statistical significance of the findings reported do not change if these gestures are not included.

Verbal responses. Children's verbal responses immediately following the uncovering of the parent's eyes (e.g. *that one, there, in the car one*) were independently transcribed by the primary investigator and the research assistant. From these transcripts, the occurrence of three types of utterances were noted: (a) use of the NAME of the picture to identify the box (e.g. *in that car one*), (b) the use of the DEICTIC terms *there* or *that*, and (c) the use of a nonspecific request (e.g. *in the box, get it out, sticker*). Note that although children could have used a deictic spatial term such as *left/right* (configuration 3) or *top/bottom* (configuration 4) to unambiguously specify a given box rather than the name of the picture on the box, this was never observed. Full transcripts are available from the first author.

Agreement between coders for Studies 1 to 3

Because the behavioural responses of the children that were coded were identical in all three studies, and the rates of agreement between the coders were very high (96% to 100%) in all three studies, the results will be presented here in aggregate form. Agreement was 100% for the occurrence of all gestures, the classification of gesture types, and the occurrence of all

instances of naming. Agreement was 96% for the codings of gesture direction, and the few discrepancies involved largely cases of gesturing to the centre (vs. left or right) in configurations 2 and 3. There were two instances of discrepancy for the occurrence of the use of a deictic term. All discrepancies were resolved through discussion.

Description of gestures observed in Study 1

The majority of gestures were points (97%) and the remainder were reach gestures. Given the small number of gestures other than points, all gestures were subsumed under the one dependent measure of gesture. Six instances of gesturing appeared to be directed more to the centre of the table than to one side for configurations 2, 3, and 4. These gestures were included in the main analyses as gestures to location because they were clearly directed to the far end of the table where the boxes were and thereby served at minimum to specify the boxes as the sticker's location. In addition, in three of these cases, the children may have been trying to specify the innermost box (closer to the centre) in configuration 3. Two gestures were produced towards the incorrect box, but included as gestures to the box's location.

RESULTS

The hypothesis of this study was that children would be more likely to verbally identify the box containing the sticker on the adjacent trials (configurations 3 and 4) than on the nonadjacent trials (configurations 1 and 2).

Practice trial results

All of the children responded on the first practice trial, 12% spontaneously and the remainder after the prompt, 'Tell mommy where the sticker is.'

Experimental trial results

Overall occurrence of gesturing and naming of the picture. All children correctly named the pictures on the front of the boxes during the control naming task. For the purposes of the analyses to follow, responses which were supplied immediately by the child once the mother opened her eyes (spontaneous) or which were prompted by the experimenter if the child did not respond within 1–2 s were collapsed because they did not differ systematically in relation to the experimental manipulation, nor did they differ in terms of informativeness. In addition, the behaviour of the mother did not differ on these trials: she was simply waiting with a neutral expression for her child to make his/her first request. Thus children's propensity to respond spontaneously or not was not due to differences in her behaviour. Over the four configurations (two trials each), the percentage of trials on which children responded spontaneously was 47% (configuration 1), 56% (configuration 2), 53%

(configuration 3), and 47 % (configuration 4). The percentage of spontaneous responses on Block 1 trials was 42 % versus 50 % on Block 2 trials.

Analysis of these experimental trials focused on the two dependent variables outlined above: (1) a point or other gesture to the box containing the sticker, and (2) the use of a verbal descriptor naming the picture on the front of the box. Table 1 shows the percentage of trials for each configuration

TABLE 1. *Percentage of experimental trials per configuration type on which children provided a gesture toward or the name of the box/toy with the sticker in Studies 1 to 3 (n = 32 per configuration type)*

	Study 1		Study 2		Study 3	
	Gesture	Name	Gesture	Name	Gesture	Name
Nonadjacent trials						
Configuration 1	91	13	78	50	94	41
Configuration 2	94	9	84	50	91	38
Adjacent trials						
Configuration 3	88	25	78	59	97	38
Configuration 4	97	31	81	59	91	41

type on which children provided information about the location of the sticker in the form of a gesture or a verbal descriptor. Note that a gesture was only adequate to unambiguously specify a box in configurations 1 and 2, but a verbal descriptor was adequate for all configurations.

Children produced a gesture in the direction of the location of the box on almost every trial (92 % overall) and the frequency of gesturing did not vary significantly across the different configuration types. In contrast, although instances of naming the picture were not frequent, their occurrence followed the pattern predicted. That is, children named the picture almost three times more often (19 instances produced by 7 children) on the two adjacent trials when the boxes were side-by-side or stacked than on the nonadjacent trials (7 instances produced by 4 children) when the boxes were separated or only one was present. Statistical analysis was performed with respect to the dependent measure of naming the picture using the Cochran–Mantel–Haenzel test (Cochran, 1954; Mantel & Haenzel, 1959). The Cochran–Mantel–Haenzel test is essentially a chi-square test that, instead of producing expected values for aggregate data, produces expected values for each child on each trial. These expected values are then used when the chi-square is performed on the data as a whole. It is necessary to take these individual values into account because of the repeated-measures design of the study and the fact that each particular child's response tendencies may vary in general, and their performance on one trial is not independent of their performance on another trial. According to this analysis, children differed significantly

across the four configurations in how often they named the picture on the box ($Q_{cmh} = 16.12$, $df = 4$, $p = 0.003$), doing so significantly more often on the adjacent trials than on the nonadjacent trials (contrast $Q_{cmh} = 11.72$, $df = 1$, $p = 0.001$). The possibility that these results are due to children becoming more experienced with the task and consequently providing more information regardless of the configuration of the boxes can be ruled out by the fact that the counterbalancing ensured there existed later trials that required only a gesture to designate the box containing the sticker. Moreover, there was no significant effect of order of counterbalancing, and all but one child was observed to produce a response without a name after having produced a response with a name.

Individual analysis of naming provided on adjacent vs. nonadjacent trials. An examination of children's individual response patterns bolsters the finding that on adjacent trials children were more likely to name the box's picture than on nonadjacent trials. On each trial, children were given a 0/1 score depending on whether they named the box or not. Then, for each child separately, the total score (maximum = 4) for naming on adjacent trials was compared to the total score on the nonadjacent trials. Table 2 displays the

TABLE 2. *Number (and percentage) of children displaying various response patterns for the dependent measure of naming the box/toy in Studies 1 to 3 (n = 16)*

Response pattern	Number and percentage of children displaying pattern		
	Study 1	Study 2	Study 3
1. Adjacent > nonadjacent	7 (44)	9 (56)	2 (12.5)
2. Nonadjacent = adjacent	0	2 (12.5)	5 (31)
3. Adjacent < nonadjacent	1 (6)	2 (12.5)	2 (12.5)
4. Never names	8 (50)	3 (19)	7 (44)

percentage of children naming the box (1) more often on the adjacent than nonadjacent trials, (2) sometimes, but equally often on both types of trials, (3) less often on the adjacent than nonadjacent trials; or (4) never at all across all trials. The results show that seven children's responses fell into category (1) above, and it is these seven children (44%) who are accounting for the significant contrast found between adjacent and nonadjacent configurations. Only one child showed a response pattern completely opposite to that predicted (i.e. category 3). Indeed, this comparison (7:1) is significant according to a binomial sign test, $p = 0.035$ one-tailed.

The following example illustrates the differential use of naming by one child whose responses fell into category 1. When the boxes were placed far apart in configuration 2, the child's request was, 'It's in that one', ac-

accompanied by a point to the box in right far corner of the table. However, when the boxes were side-by-side in configuration 3, the child's request was, 'Can I have that sticker? It's in that car one.', accompanied by a point to boxes in left far corner of table.

Use of gesture accompanied by a deictic term vs. the name of the box. Children's responses on adjacent versus nonadjacent trials were also examined with respect to whether they took one of the five following forms: (1) a gesture alone with no accompanying utterance, (2) a nonspecific utterance (e.g. in the box), (3) a gesture in conjunction with the deictic term *there* or *that*, (4) a gesture accompanied by the name of the box, (5) the name of the box (with no accompanying gesture). Note that for the adjacent configurations, only requests of the type 4 or 5 were adequate to identify unambiguously the box containing the sticker. All uses of the deictic terms *there* and *that* were accompanied by a pointing gesture and, of all deictics used, 91% were of the form *there*. One instance of a the deictic phrase 'in there' along with an alternating glance between the parent and the box was included in this category.

Table 3 shows the frequency of these five different response patterns for the two trial types. Of all 128 trials across children, the frequency with which a gesture alone was produced as a response was approximately equal for nonadjacent and adjacent trials. Nonspecific utterances were rare. The use of the name of the box alone was very infrequent and observed on only three trials. The main change in response type on the adjacent trials as compared to the nonadjacent trials was a decrease in the use of a GESTURE + DEICTIC and an increase in the use of a GESTURE + NAME. Indeed, the distribution of gesture + deictic and gesture + name responses was found to be significantly different on nonadjacent versus adjacent trials ($\chi^2(1, n = 71) = 8.25, p < 0.01$), in the direction of an increased proportion of gesture + name responses on adjacent versus nonadjacent trials and a decreased proportion of gesture + deictic responses on adjacent versus nonadjacent trials (as shown in Table 3). In addition, it was found that only the children who used a deictic term in configurations 1 and 2 were observed to name the picture on the box in configurations 3 and 4. That is, a child was never observed to name the picture on the box if a deictic term was not used in configurations 1 and 2. It is pure speculation at this point, but these findings raise the possibility that the use of a deictic term such as 'there' or 'that' may be a precursor to the ability to recognize when, at least with respect to the stimuli used in this study, verbal specification of the objects was needed. Perhaps the children who were not observed to use any deictic terms had not yet even realized that the intended referent could be unclear. In contrast, the children who had begun to use the deictics 'there' or 'that' may have realized the potential for a referent to be ambiguous, although they may not have been fully aware of the means whereby to resolve this ambiguity. Another possibility is that the

TABLE 3. *Frequency of the five different response types observed on nonadjacent and adjacent trials in Studies 1 to 3*

	Response type				
	Gesture alone	Nonspecific utterance	Gesture + deictic	Gesture + name	Name alone
Study 1: older 2's					
Nonadjacent	23	4	30	6	1
Adjacent	22	5	18	17	2
Study 2: older 2's					
Nonadjacent	21	1	10	20	12
Adjacent	19	0	7	25	13
Study 3: young 2's					
Nonadjacent	26	0	13	20	5
Adjacent	24	0	15	22	3

TABLE 4. *Number of children producing name spontaneously or after prompt (Which one? or forced-choice alternatives (FC)) on feedback trials among children who did or who never used name on the experimental trials*

Experimental trials	<i>n</i>	Feedback trial 1			Feedback Trial 2		
		Spont.	Which one?	FC	Spont.	Which one?	FC
Study 1							
Never used name	8	0	5	3	1	6	1
Provided name	8	5	3	0	7	0	1
Study 2							
Never used name	3	1	2	0	2	1	0
Provided name	13	9	0	4	12	1	0
Study 3							
Never used name	7	1	2	4	1	4	2
Provided name	9	7	1	1	8	0	1

use of deictic terms and the use of verbal specification in such ambiguous situations both rely on some underlying common conceptual development. Such a view would be in agreement with Gopnik & Meltzoff's (1986) 'SPECIFICITY HYPOTHESIS' which postulates associations or parallelisms between particular cognitive and linguistic phenomena at specific points in development.

Feedback trials

The responses of children to the feedback given speak to difficulty of this task for some two-year-old children and also reveal striking differences among the children with respect to their sensitivity to the information needed by the

parent to the find the sticker. As mentioned in the procedure section, all children were given two extra trials of configurations 3 and 4 following the experimental trials. If on these trials the children did not provide the name of the box's picture, they were given the prompt 'Which one?', and the forced-choice prompt 'The boat one or the train one?', if necessary.

The responses of the children who NEVER provided the name of the box's picture on any of the experimental trials are most pertinent and will be discussed first. As can be seen in Table 4, of the eight children who never provided the box's picture name, five answered with the name after the prompt 'Which one?' but three children required the forced-choice prompt having responded to 'Which one?' either by leaning over the table until their pointing finger touched the box with the sticker or stating with great emphasis 'That one!'. Surprisingly, almost no transfer of learning was observed from the first to the second feedback trial. Only one of these eight children gave the box's name spontaneously (without any prompt) on the second feedback trial.

Among the remaining eight children who had provided the box's name at some point during the experimental trials, the majority provided the box's name spontaneously on both feedback trials. Of the three children who had required a prompt on the first feedback trial, two responded spontaneously with the box's name on the second feedback trial.

Summary

The results of Study 1 suggest that older two-year-old children are beginning to appropriately assess the effectiveness of a pointing gesture in uniquely identifying a referent for a communicative partner and to use an unambiguous verbal descriptor when necessary. That is, the children chose to use an unambiguous verbal descriptor to specify the particular box with the sticker significantly more often on trials in which the configuration of the boxes rendered pointing ineffective than on trials in which the configuration of the boxes was such that pointing alone could unambiguously specify the particular box with the sticker. The distribution of gesture + deictic versus gesture + name responses also differed significantly between adjacent and nonadjacent trials in the predicted direction.

One unexpected result of Study 1 was the low incidence of naming the picture on the box despite the fact that a control question had ensured that all children could do so. It was thought that this low incidence of naming might be due to the fact that the picture was acting as a label for the box, and perhaps this was more difficult for children than simply naming the identity of an object. Thus, a second study was conducted with a similar age group of two-year-old children in which the sticker was hidden inside actual toys. It was thought that this might encourage more naming among children and that one might see their ability to adapt their communication more clearly.

STUDY 2

METHOD

Participants

Sixteen older two-year-old children (8 boys and 8 girls; mean age 2;9, range 2;7 to 2;10) participated in this study. Fourteen children participated with their mother and two with their father. Children were largely from middle-class families and were recruited from a database of volunteers at the University of Waterloo's Centre for Child Studies. The data from an additional two children were omitted because in one case the parent gave feedback contrary to the instructions asked of them, and in the other case the child was extremely fussy.

Materials

Stimuli. Four small rubber toys of a pig, dog, duck and frog were used in this study. A hole, just large enough to fit a sticker into, was cut out of the bottom of each toy. In addition, two small, clear, plexiglass platforms were constructed to allow the toys to be placed one on top of the other for configuration 4. All other materials and equipment used were identical to Study 1.

Procedure

All aspects of the procedure were identical to Study 1, except that actual toys were used instead of the boxes with pictures. Thus, in the control task, children were asked to provide the identity of the toys (e.g. 'What's this?'). (For simplicity, this will be referred to henceforth as providing the name of the toy). The counterbalancing was identical to Study 1 and during the experimental trials the dog and pig were used for the first block of four trials and the duck and frog were used in the second block of trials and the feedback trials.

Description of gestures observed in Study 2

All gestures observed were points. One point gesture was directed more to the centre of the table than to one side in configuration 2 and one gesture was produced towards the incorrect toy, but both were included as a gesture to the toy's location.

RESULTS

Practice trial results

All children responded on the practice trial (88% needed a prompt).

Experimental trial results

Overall occurrence of gesturing and naming of the picture. For the purposes of the analyses to follow, spontaneous and prompted responses were collapsed because they did not differ systematically in relation to the experimental manipulation, nor did they differ in terms of informativeness. Over the four configurations (two trials each), the percentage of trials on which children responded spontaneously was 78% (configuration 1), 72% (configuration 2), 84% (configuration 3), and 63% (configuration 4). The percentage of spontaneous responses on Block 1 trials was 66% versus 83% on Block 2 trials. The higher rates of spontaneous responding in this study compared to Study 1 may be an indication that children found this version of the task easier.

The percentage of trials for each configuration type on which children provided information about the location of the sticker in the form of a gesture or a verbal descriptor are shown in Table 1. Children produced a gesture in the direction of the location of the toy on almost every trial (81% overall) and the frequency of gesturing did not vary significantly across the different configuration types. Unfortunately, the average amount of naming per child was quite high overall (50% of the children produced a name on 7 or more of the 8 experimental trials), making it more difficult at the aggregate level to detect any difference in responding between the adjacent and nonadjacent trials. Indeed, according to the Cochran-Mantel-Haenszel chi-square analysis, the children did not differ significantly across the four configurations in how often they named the toy ($Q_{cmh} = 6.84$, $df = 4$, $p = 0.145$).

Individual analysis of naming provided on adjacent vs. nonadjacent trials. If the incidence of naming on nonadjacent versus adjacent trials is examined at the individual level, as in Study 1, it is apparent that over half of these older two-year-old children (56%) were adapting their communication in the predicted direction. This percentage is actually higher than that seen in Study 1 (44%) despite the nonsignificant contrast results between nonadjacent and adjacent trials found in Study 2. Table 2 displays children's response patterns with respect to naming the toy. The results show that nine (i.e. 56% of all subjects) showed a difference in the predicted direction (i.e. response pattern 1). Only two children showed a response pattern completely opposite to that predicted (i.e. category 3), and the comparison (9:2) is significant according to a binomial sign test, $p = 0.033$ one-tailed.

Use of gesture accompanied by a deictic term vs. the name of toy. Children's responses on adjacent versus nonadjacent trials were also examined with respect to whether they took one of the five forms outlined in Study 1 and shown in Table 3. All deictics used were of the form *there* and accompanied by a point. Of all 128 trials across children, the frequency with which a gesture alone was produced as a response was approximately equal for

nonadjacent and adjacent trials. The main change in response type on the adjacent trials as compared to the nonadjacent trials was more difficult to detect than in Study 1 given the high rate of naming on both types of trials. The overall distribution of gesture+deictic and gesture+name responses was not found to be significantly different on nonadjacent versus adjacent trials ($\chi^2(1, n = 71) = 1.02, p = 0.31$).

However, if the production of these response types is examined among the subset of nine children who showed MORE use of the name on adjacent than nonadjacent trials, the nature of the change in response type between these two types of trials is similar to that observed in Study 1. Among these children, on adjacent trials as compared to nonadjacent trials, the use of a gesture+deictic decreased from 10 instances to 4, the use of a gesture+name increased almost double fold from 14 to 23 instances, and the use of a name more than quadrupled from 3 to 13 instances. And indeed, these latter distributions of gesture+deictic and gesture+name responses were found to be significantly different on nonadjacent versus adjacent trials ($\chi^2(1, n = 51) = 4.69, p < 0.05$). This significant difference was due largely to the increase in the proportion of gesture+name responses on adjacent trials.

Feedback trials

The majority of children (13) in Study 2 did provide the toy's name at least once during the experimental trials and nine of these children provided it spontaneously on both feedback trials. As can be seen in Table 4, among the remaining seven children, five provided the toy's name spontaneously by the second feedback trial.

Summary

Although a significant difference in amount of naming between the adjacent and nonadjacent conditions was not found in Study 2 at the aggregate level, when the data was examined at the individual level, it was apparent that 56% of the two-year-old children in Study 2 used a verbal descriptor more often on the adjacent than nonadjacent trials, in comparison to 44% in Study 1. In addition, the response patterns of the subset of nine children who showed MORE use of the name on adjacent than nonadjacent trials revealed that the proportion of gesture+name versus gesture+deictic responses differed significantly between adjacent and nonadjacent trials in the predicted direction.

In Study 3, we decided to replicate the procedure of Study 2 using a younger group of two-year-old children, to see whether any ability to adapt their communication would be evident. Given that the children in Study 2 produced the name of the toy much more frequently than in Study 1, this aspect of the task appeared to be well within the capability of even younger two-year-old children. In addition, it was assumed that among a younger

group of children the propensity to name throughout might be less strong (i.e. they would be more likely to just use a gesture) than among the older two-year-old children and thus any adaptation in their response patterns among the different configuration types might be more evident.

STUDY 3

METHOD

Participants

Sixteen younger two-year-old children (7 boys and 9 girls; mean age 2;4, range 2;2 to 2;6) participated in Study 3. All children participated with their mother. Children were largely from middle-class families and were recruited from a database of volunteers at the University of Waterloo's Centre for Child Studies. The data from an additional seven children were omitted for reasons that included the parent giving feedback contrary to the instructions asked of them ($n = 2$), the child refusing to name the toy in the control task ($n = 1$), and excessive fussiness ($n = 4$).

Materials and procedure

The procedure and the materials used were identical to that of Study 2.

Description of gestures observed in Study 3

Although the overall frequency of gestures produced by this younger group of two-year-old children did not differ from the two older groups in Studies 1 and 2, a greater variety of gestures was observed, in accordance with other findings in the literature (e.g. Murphy, 1978). Of all gestures produced, 85 % were points, 10 % were indicates, and 5 % were reaches. All gestures were subsumed under the one dependent measure of gesture as the production of the different gesture types did not vary systematically with configuration type. One instance of gesturing appeared to be directed more to the centre of the table than to one side for configuration 4 and one gesture was produced towards the incorrect box, but both were included as a gesture to the box's location.

RESULTS

Practice trial results

All children responded on the practice trial (81 % needed a prompt).

Experimental trial results

Overall occurrence of gesturing and naming the toy. For the purposes of the analyses to follow, prompted and spontaneous responses were collapsed, as they bore no systematic relation to the experimental manipulation, nor did

they differ in terms of informativeness. Over the four configurations (two trials each), the percentage of trials on which children responded spontaneously was 50% (configuration 1), 63% (configuration 2), 47% (configuration 3), and 32% (configuration 4). The percentage of spontaneous responses on Block 1 trials was 47% versus 61% on Block 2 trials.

The percentage of trials for each configuration type on which children provided information about the location of the sticker in the form of a gesture or a verbal descriptor are shown in Table 1. Children produced a gesture in the direction of the location of the toy on almost every trial (93% overall) and the frequency of gesturing did not vary significantly across the different configuration types. Although the overall frequency of naming was lower among these younger children, occurring on 39% of all trials as compared to 55% of all trials among the older two-year-old group in Study 2, a difference in responding at the aggregate level was not evident between the adjacent and nonadjacent trials. According to the Cochran–Mantel–Haenszel chi-square analysis, as in Study 2, the children did not differ significantly across the four configurations in how often they named the toy ($Q_{cmh} = 0.83$, $df = 4$, $p = 0.93$).

Individual analysis of naming provided on adjacent vs. nonadjacent trials. When the incidence of naming on adjacent versus nonadjacent trials was examined at the individual level, as in Studies 1 and 2, the pattern of responding that emerged for these younger two-year-old children was strikingly different from that of the older two-year-old children. Table 2 displays children's response patterns with respect to naming the toy. Only 4 children showed a difference in responding across the two different types of trials and of these, only 2 (i.e. 12.5% of all subjects) showed a difference in the predicted direction (i.e. response pattern 1). Of the remaining 12 children, 7 were never observed to name the toy on any experimental trial, and 5 did so equally often across adjacent and nonadjacent trials.

Comparison of individual response patterns on adjacent vs. nonadjacent trials over all 3 studies. In order to compare the findings across the three studies, the children in each study were placed into one of two categories: (1) ADAPTED responses: children who displayed the *adjacent > nonadjacent* response pattern (see Table 2, pattern 1) and (2) NONADAPTED responses: children who displayed any of the remaining three response patterns (patterns 2, 3, and 4). A chi-square analysis was used to investigate whether differences existed across all of the studies, and between each study, with respect to the number of children falling into these two categories. The omnibus chi-square revealed that the proportion of children falling into these two categories differed significantly across the three studies. Further comparisons showed that the proportion of adapted and nonadapted responses in Study 3 differed significantly from those in Study 1 ($\chi^2(1, n = 32) = 3.87$, $p < 0.05$) and from those in Study 2 ($\chi^2(1, n = 32) = 6.79$, $p < 0.01$), which in turn did not differ

significantly from one another. Thus, the response patterns of the older two-year-old children in both Studies 1 and 2 differed significantly from the response patterns of the younger two-year-old children in Study 3.

Use of gesture accompanied by a deictic term vs. the name of the toy. Children's responses on adjacent versus nonadjacent trials were also examined with respect to whether they took one of the five forms outlined in Study 1 and shown in Table 3. All deictics used were of the form *there* and accompanied by a gesture. Among this younger group, the frequency of all five response types was approximately equal for nonadjacent and adjacent trials. Moreover, in contrast to the older group of children in Study 2, among these younger children the use of the toy's name alone was relatively infrequent, as in Study 1. Thus, the methodology of hiding the stickers in the actual toys appears to have led to a greater instance of using a verbal descriptor without a gesture only among older, and not younger, two-year-old children.

Feedback trials

The results of the feedback trials in Study 3 were similar to those in Study 1. As can be seen in Table 4, among the seven children who did not provide the name of the box's picture on any of the experimental trials, the majority needed prompting on the first feedback trial (four children even required the forced-choice prompt). As in Study 1, among this group of children very little transfer of learning to the second feedback trial was observed. Only one child provided the name spontaneously on the second feedback trial. Among the nine children who had provided the toy's name at some point during the experimental trials, seven provided it spontaneously on both feedback trials and all but one child provided it spontaneously by the second feedback trial.

Summary of feedback results over the three studies. Combining the results of the feedback trials over the three studies, an interesting contrast emerges between the children who never provided a verbal descriptor on experimental trials and the children who did. Of the 18 children across studies who never provided a verbal descriptor, 78% continued to require a prompt on the second feedback trial, suggesting very little transfer of learning and a profound lack of appreciation for the referential ambiguity present in the communicative context. However, among the 30 children who had provided a verbal descriptor on the experimental trials at least once, 70% responded spontaneously with a verbal descriptor on both feedback trials and only 10% required a prompt on the second feedback trial. Thus, even though among these 30 children who had used a verbal descriptor on experimental trials only 60% had provided the box's or toy's name more often on adjacent than nonadjacent trials, a greater sensitivity to the existence of referential ambiguity appeared to exist as indicated by the high numbers responding either spontaneously on both feedback trials or by the second feedback trial.

Summary

The results of Study 3 suggest that the ability to adapt their communication and provide a verbal descriptor when needed in the adjacent configurations is a difficult task for younger two-year-old children. Indeed, even though the methodology made it easier for these children to name the location of the sticker, almost no sensitivity to the potential referential inefficacy of their pointing gestures was evident.

DISCUSSION

The results of these three studies suggest that during the latter half of the third year of life children begin to appropriately adapt their communication when trying to uniquely identify a referent for a communicative partner by using an unambiguous verbal descriptor rather than a gesture alone or a gesture+deictic when the spatial parameters render a pointing gesture ineffective. In Studies 1 and 2, 44% and 56% of the older two-year-old children, respectively, provided the name of the location of the sticker more often on adjacent than nonadjacent trials. The development of this ability during the third year of life is also suggested by the fact that only 13% of the younger two-year-old children in Study 3 showed such adaptation in the use of the name of the location despite the fact that it had been previously established that the task was within the linguistic capability of this group.

Among two-year-old children, it is well recognized that abilities can vary widely on a number of dimensions: social, cognitive, and linguistic. As such, we believe that the truest picture of their abilities may come from close inspection of their behaviour on a number of levels, and not necessarily with respect to only one predetermined dependent measure. Thus, although it was only in Study 1 that the older two-year-old children were found to produce a verbal descriptor significantly more often on adjacent than on nonadjacent trials, we nevertheless believe that the findings of these studies point to a distinct, and newly emerging, ability to recognize the potential inefficacy of pointing gestures in uniquely specifying a referent. First, it is the case that the proportion of adapted and nonadapted responses among both older groups of two-year-olds in Studies 1 and 2 was significantly different from those of the younger two-year-olds in Study 3. Second, in both Studies 1 and 2, analyses revealed that the proportion of gesture+name versus gesture+deictic responses differed significantly between adjacent and nonadjacent trials in the predicted direction. Third, the results of Study 1, and to some extent Study 2, revealed that very few of the older children ever showed the response patterns $\text{NONADJACENT} = \text{ADJACENT}$ or $\text{ADJACENT} < \text{NONADJACENT}$. This suggests that the emergence of children's use of a name in this task was not a random phenomenon: it either supplanted the use of the deictic when used along with a gesture or supplanted the use of a gesture (Study 2).

(Indeed, in further piloting we have found that by age 3, in both tasks, children tend overwhelmingly to use the name all the time.) And finally, the obvious difficulty that some children (approximately 25 % per study) had on the feedback trials in realizing the nature of the information being sought, suggests that the provision of the name is not an automatic choice for children even when asked 'Which one?' That is, some children really did not appear to understand that 'That one!' did not serve to disambiguate the referent intended on adjacent trials.

With respect to the present studies, to what factors specifically should one attribute children's inadequate descriptions? As mentioned previously in the introduction, the reasons for children's failures on referential communication tasks have been the topic of much debate (see for example Bishop & Adams, 1991). However, generally two classes of factors have been suggested: (1) linguistic deficits that include inadequate vocabulary or syntactic difficulties in constructing complex noun phrases, and (2) cognitive difficulties that include difficulty taking the addressee's point of view into account or determining the attributes of the intended referent that discriminate it unequivocally from the other alternatives in the relevant context. The methodology of the present studies does allow us to rule out a number of these possibilities.

First, the control naming task ensured that all children possessed the required vocabulary to unambiguously specify each object. Thus, vocabulary limitations can be ruled out as contributing to children's difficulty on this task. Second, a lack of syntactical knowledge can also be ruled out for Studies 2 and 3, as an adequate verbal description required only the name of the toy, and not a noun phrase containing an adjective. In hindsight, however, syntactical difficulties may have played a role in Study 1, contributing to the lower amount of naming in that study. Although an adequate verbal description did not require a construction containing both an adjective and a noun to be uniquely specified (as in, for example, *red/blue car/boat*), the construction *the train/boat/plane/car one* does represent an adjectival phrase nevertheless. Thus, even though the noun (object) was the same in both cases (i.e. box), the fact that an adequate verbal description required not just a noun to be specified, but an adjectival phrase to be used, may have made the task more difficult than was necessary for children. Indeed this realization led to the use of the actual toys as hiding places for the stickers in Studies 2 and 3.

Third, with respect to cognitive difficulties, it would be hard to argue that children did not distinguish the relevant dimension that distinguished the two objects in any of the three studies. The different identities of the objects in Studies 2 and 3 were easily named by children as were the pictures distinguishing the boxes in Study 1. The other cognitive factor that has been suggested in the past to contribute to children's difficulty with referential

communication tasks is an inability to take the addressee's point of view. However, this task did not necessarily require children to take their parent's perspective to determine if referential ambiguity existed. That is, the existence of referential ambiguity was evident from an examination of the spatial configuration of the boxes alone. In these studies, referential ambiguity was not determined by the parent's conceptual perspective which remained constant across trials (i.e. he/she was always ignorant of the sticker's location). Thus it would appear that knowledge of the spatial parameters related to the location of objects that render a point ineffective may be most important factor distinguishing the performance of children. However, it could be argued that the ability to take another person's perspective did play a role in the sense that one would not expect a child to produce an adequate description unless that child appreciates, if only at a very simple or general level, that communication always entails the possibility that the addressee may not understand the intended message/referent. Without this minimal level of understanding that referential ambiguity can arise, a child would always think that the intended referent is clear to others because it is known to themselves (i.e. profound egocentrism).

Another way of conceptualizing the developmental trend seen in these studies may be in terms of Karmiloff-Smith's (1979) distinction between a DETERMINER having the function of a DESCRIPTOR versus a DETERMINOR. Based on her studies of determiners and reference among three- to nine- year-old children, Karmiloff-Smith has argued that children first ascribe to such words as definite and indefinite articles, demonstrative adjectives, and colour modifiers a descriptor function and use such words to give 'additional information about a referent already implicitly or explicitly under attention by speaker and addressee' (p. 46). At this stage, children may produce quite elaborate descriptions of an object, but these descriptions are centred on the attributes of the referent and therefore children may either fail to provide the information that would enable an addressee to pick out a referent among other potential candidates (e.g. a child refers to *two cars* when four cars are present in an array) or may furnish a lot of redundant information in attempt to describe as fully as possible the referent under focus of attention (e.g. a child refers to the *green airplane* when it is the only airplane in an array of toys). In terms of deictic reference in particular, Karmiloff-Smith (1979) suggests that children may first consider an object's location as if it were a permanent attribute of an object rather than a temporary location. Children at Level 1 above, who appeared in the present study to be unaware of the potential for referential ambiguity, may not have been considering the location of the object as temporary and as something that would affect its identifiability in relation to any other objects present.

Karmiloff-Smith (1979) found that it was only by about five years of age that children began to distinguish between the dual descriptor and deter-

minor functions of words such as *a*, *the*, *my*, and *same* and began to produce utterances that enabled an addressee to pick out a referent amongst other potential candidates. That is, these words were now used to 'define a RELATIONSHIP between the referent and its extralinguistic context (the concrete situation or world knowledge about the situation) or its intralinguistic context (created by the temporary universe of discourse set up between the speakers)' (Karmiloff-Smith, 1979, p. 46). It should be noted that although Karmiloff-Smith's (1979) discussion focuses on the use of fairly sophisticated linguistic constructions such as definite and indefinite articles and pronouns, she does acknowledge that demonstrative adjectives (e.g. *that one*, *that car*) and simple modifiers, such as colour and size adjectives, appear in children's vocabularies before the appearance of articles and that children may use such terms before understanding their determinor function. From our results, we suggest that children do show evidence of understanding the determinor function of familiar nouns and simple modifiers (in our case the use of the adjectival phrases *the car/boat/plane/train one*) as early as the later half of their third year.

The lack of understanding of verbal ambiguity among much older children when speaking and listening is a well-documented finding, however, in the referential communication literature of which many readers are no doubt aware. As a last point, we will address how we view the understanding of referential ambiguity revealed by the older two-year-old children in our studies as quite different from that assessed in much older children. An understanding and recognition of referential ambiguity is a lengthy and protracted process that requires the consideration of a multitude of possible factors that can contribute to the existence of referential ambiguity. The task presented to the two-year-olds in our studies required only a most basic understanding. That is, children had only to recognize that two small objects placed near to each other could not be distinguished unambiguously using a point gesture. Moreover, the children in our study did not have to discern by themselves the one dimension by which these objects could be differentiated – they were made aware of this when they named the pictures or the toys before the study began.

This type of procedure is very different from, and much simpler than, the more typical referential communication paradigm used with older children in which they have had to consider multiple dimensions and discern for themselves how each object can be uniquely specified given its particular attribute on each dimension (Whitehurst, 1976; Whitehurst & Sonnenschein, 1978).

In addition to having to consider multiple dimensions, other factors older children have had to take into account in referential communication tasks include the presence of a partition between the speaker and the listener (e.g. Glucksberg & Krauss, 1967; Flavell *et al.*, 1968), listener characteristics such

as age (e.g. Sonnenschein, 1986a, 1988); the prior knowledge possessed (or not possessed) by the listener (e.g. Sonnenschein, 1986b, 1988); and the evaluation of message adequacy (e.g. Robinson & Robinson, 1977; Markman, 1979; Sodian, 1988; Ackerman, 1994). Furthermore, the fact that such tasks have also required considerable role-taking (e.g. Flavell, 1968; Shantz, 1981; Sonnenschein & Whitehurst, 1984), attentional, and memory skills, has led to debate about what exactly is being measured in referential communication tasks (e.g. Bishop & Adams, 1991). The point we wish to stress is that it may not be correct to view the understanding of referential ambiguity by the two-year-old children in our studies as TACIT compared to a more EXPLICIT understanding possessed by older children. Rather, given the simplicity of our task, the understanding of the older two-year-old children may have been explicit in the sense that these children were aware of when their point gesture could not unambiguously specify the location of the sticker. However, this type of explicit understanding of the presence of referential ambiguity would be limited only to contexts in which the same few factors determined its presence. Thus, these children would not reveal any explicit understanding of the presence of referential ambiguity (nor how to resolve it) if the task required them to consider other factors such as multiple dimensions or different perspectives.

In sum, these results point once again to the remarkable pragmatic competence developing among two-year-old children. These studies reveal an ability among older two-year-old children to consider another important factor affecting the process of sharing knowledge and information among communicative partners, namely the specificity with which gestures can and cannot pick out an intended referent and the superiority of verbal description in doing so in certain circumstances. This ability is a remarkable pragmatic achievement that represents an important building block in their understanding of how to communicate successfully with others.

REFERENCES

- Ackerman, B. P. (1994). Children's source errors in referential communication. *Journal of Experimental Child Psychology* **58**, 432-64.
- Akhtar, N., Carpenter, M. & Tomasello, M. (1996). The role of discourse novelty in early word learning. *Child Development* **67**, 635-45.
- Anselmi, D., Tomasello, M. & Acunzo, M. (1986). Young children's responses to neutral and specific contingent queries. *Journal of Child Language* **13**, 135-44.
- Asher, S. R. (1979). Referential communication. In G. J. Whitehurst & B. J. Zimmerman (eds), *The functions of language and cognition*. New York: Academic.
- Astington, J. W., Harris, P. L. & Olson, D. R. (eds.). (1988). *Developing theories of mind*. Cambridge: C.U.P.
- Bishop, D. V. M. & Adams, C. (1991). What do referential communication tasks measure? A study of children with specific language impairment. *Applied Psycholinguistics* **12**, 199-215.
- Cochran, W. G. (1954). Some methods for strengthening the common tests. *Biometrics* **10**, 417-51.

- Deutsch, W. & Pechmann, T. (1982). Social interaction and the development of definite descriptions. *Cognition* **11**, 159–84.
- Dickson, W. P. (1981). Referential communication activities in research and in the curriculum: a metaanalysis. In W. P. Dickson (ed.), *Children's oral communication skills*. New York: Academic.
- Flavell, J. H. (1968). *The development of role taking and communication skills in children*. New York: Wiley.
- Flavell, J. H., Botkin, P. T., Fry, C. L., Wright, J. C. & Jarvis, P. E. (1968). *The development of role taking and communication skills in children*. New York: Wiley Press.
- Glucksberg, S. & Krauss, R. M. (1967). What do people say after they have learned to talk? Studies of the development of referential communication. *Merrill-Palmer Quarterly* **13**, 309–16.
- Glucksberg, S., Krauss, R. & Higgins, E. T. (1975). The development of referential communication skills. In F. D. Horowitz (ed.), *Review of child development research* (Vol. 4). Chicago: Chicago University Press.
- Glucksberg, S., Krauss, R. & Weisberg, R. (1966). Referential communication in nursery school children: Method and some preliminary findings. *Journal of Experimental Child Psychology* **3**, 333–42.
- Gopnik, A. & Meltzoff, A. (1986). Relations between semantic and cognitive development in the one-word-stage: the specificity hypothesis. *Child Development* **57**, 1040–53.
- Karmiloff-Smith, A. (1979). *A functional approach to child language: A study of determiners and reference*. Cambridge: C.U.P.
- Krauss, R. M. & Glucksberg, S. (1969). The development of communication: competence as a function of age. *Child Development* **40**, 255–66.
- Mantel, N. & Haenzel, W. (1959). Statistical aspects of the analysis of data from retrospective studies of disease. *Journal of the National Cancer Institute* **22**, 719–48.
- Maratsos, M. P. (1975). Nongocentric communication abilities in preschool children. *Child Development* **44**, 697–700.
- Markman, E. M. (1979). Realizing that you don't understand: elementary school children's awareness of inconsistencies. *Child Development* **50**, 643–55.
- Murphy, C. M. (1978). Pointing in the context of a shared activity. *Child Development* **49**, 371–80.
- O'Neill, D. K. (1996). Two-year-old children's sensitivity to a parent's knowledge state when making requests. *Child Development* **67**, 659–77.
- Pechmann, T. & Deutsch, W. (1982). The development of verbal and nonverbal devices for reference. *Journal of Experimental and Child Psychology* **34**, 330–41.
- Robinson, E. J. & Robinson, W. P. (1977). Children's explanations of communication failure and the inadequacy of the misunderstood message. *Developmental Psychology* **13**, 156–61.
- Shantz, C. U. (1981). The role of role-taking in children's referential communication. In W. P. Dickson (ed.), *Children's oral communication skills*. New York: Academic.
- Shwe, H. I. & Markman, E. M. (1997). Young children's appreciation of the mental impact of their communicative signals. *Developmental Psychology* **33**, 630–36.
- Sodian, B. (1988). Children's attributions of knowledge to a listener in a referential communication task. *Child Development* **59**, 378–85.
- Sonnenschein, S. (1986a). Development of referential communication: deciding that a message is uninformative. *Developmental Psychology* **22**, 164–68.
- Sonnenschein, S. (1986b). Development of referential communication skills: how familiarity with a listener affects a speaker's production of redundant messages. *Developmental Psychology* **22**, 549–52.
- Sonnenschein, S. (1988). The development of referential communication: speaking to different listeners. *Child Development* **59**, 694–702.
- Sonnenschein, S. & Whitehurst, G. J. (1984). Developing referential communication: a hierarchy of skills. *Child Development* **55**, 1936–46.
- Tomasello, M. & Akhtar, N. (1995). Two-year-olds use pragmatic cues to differentiate reference to objects and actions. *Cognitive Development* **10**, 201–24.

- Tomasello, M., Anselmi, D. & Farrar, M. J. (1984/85). Young children's coordination of gestural and linguistic reference. *First Language* **5**, 199-210.
- Whitehurst, G. J. (1976). The development of communication: changes with age and modeling. *Child Development* **47**, 473-82.
- Whitehurst, G. J. & Sonnenschein, S. (1978). Referential communication: attribute variation leads to contrast failure. *Journal of Experimental Child Psychology* **25**, 490-504.