How 2;6-year-olds tailor verbal expressions to interlocutor informational needs

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Abstract

Although preschoolers are pervasively under-informative in their actual usage of verbal reference, a number of studies have shown that they nonetheless demonstrate sensitivity to listener informational needs, at least when environmental cues to this are obvious. We investigated two issues. The first concerned the types of visual cues to interlocutor informational needs which 2;6-year-olds can process whilst producing complex referring expressions. The second was whether performance in experimental tasks related to naturalistic conversational proficiency. We found 2;6-year-olds used fewer complex expressions when the objects were dissimilar compared to highly similar objects, indicating that they tailor their verbal expressions to the informational needs of another person, even when the cue to the informational need is relatively opaque. We also found a correlation between conversational skills as rated by the parents and the degree to which 2;6-year-olds could learn from feedback to produce complex referring expressions.

(144 words)

When speakers refer to objects, they select from a range of referring expressions that vary in complexity (see (1) to (4)). All of these expressions may be appropriately informative; they may provide sufficient information for the interlocutor to interpret which object is intended. Whether or not an utterance *is* appropriately informative depends on the degree to which it conforms to COMMON GROUND, the knowledge which the speaker and interlocutor know they share and the aspects of the current environment which they can expect one another to find salient (e.g. Clark, 1992).

(1) PRONOUN *(Can I have) it?*

(2) HEAD NOUN ALONE *(Can I have the) rabbit?*

(3) COMPLEX REFERRING EXPRESSION

(a) *(Can I have the) rabbit <u>on (the) boat</u>?*

(b) (*Can I have the) rabbit (that is) dancing?*

(4) MODIFIER ALONE (*Can I have the one on the) boat?*

Despite one- and two-year-olds being quite adept at interpreting and using non-verbal cues to reference (e.g. Liebal, Carpenter & Tomasello, 2010; Moll, Carpenter, & Tomasello, 2007), verbal reference is more difficult since it requires the child to select an appropriately-informative referring expression. While children continue to be sensitive to the interlocutor's informational needs when they start to use verbal reference, this sensitivity coexists with pervasive UNDER-INFORMATIVITY; that is, they frequently do not provide sufficient information to allow the interlocutor to determine which object or event is being referred to (e.g. Bahtiyar & Kuentay, 2009; see Graf & Davies, 2014, for a review). Pervasive under-informativity continues long after the structural language required for complex referring expressions has been acquired (e.g. Deutsch & Pechmannn, 1982; Lloyd & Bahnham, 1997). One of the paradigms most frequently used to investigate this issue is the referential

communication paradigm (e.g. Glucksberg & Krauss, 1967) in which the participant has to describe an object from an array in a manner sufficient to allow an interlocutor to select it.

To illustrate, Nilsen and Graham (2009: Study 1) compared the performance of 4½-5½-year-olds in two key conditions. In the COMMON GROUND condition the child could see that the interlocutor could see two objects of the same lexical type (e.g. two rabbits). In the PRIVILEGED GROUND condition one of the rabbits was occluded from the interlocutor's view (rendering (2) appropriately informative). The children were highly under-informative, producing utterances equivalent to (2) at least half the time in the COMMON GROUND condition (see also Salomo, Graf, Lieven & Tomasello, 2010). However, a comparison between the COMMON GROUND and PRIVILEGED GROUND conditions revealed concurrent sensitivity to listener informational needs; they were more likely to produce type (2) utterances in the latter (see also Saylor, Baird & Gallerani, 2006; also e.g. Serratrice, 2004; Hughes & Allen, 2013, for naturalistic evidence). In fact, O'Neill and Topolovec (2001; see also O'Neill, 1996) have shown similar patterns of sensitivity to listener informational needs in two-year-olds. Seventy-two% of 2;8-year-olds used only a pointing gesture to identify an ambiguous location, however they were more likely to verbalise an object's location when pointing alone was underinformative.

Long-term, this type of sensitivity to listener informational need is not sufficient; eventually children must develop adult-like levels of informativity. One possibility is that feedback from listeners indicates the need to repair ambiguous utterances (e.g. Robinson & Robinson, 1985). Feedback such as (5) and (6) can rapidly lead pre-schoolers to select fully informative verbal referring expressions. This was demonstrated in a series of training studies by Matthews and colleagues (e.g. Matthews, Lieven & Tomasello, 2007; Matthews, Butcher, Lieven & Tomasello, 2012), in which the child first sat with experimenter one (E1) who showed the child that they had two identical books, but the child's book had some missing

pictures. As E1 read the book, the child had to go to E2, (who could not see the two picture books) to ask for each missing picture from an array of pictures. E2 gave feedback (along the lines of (5) and (6)) to children whose initial requests for each trial were under-informative.

(5) GENERIC FEEDBACK: *Which rabbit?*

(6) SPECIFIC FEEDBACK: *The rabbit dancing or the rabbit eating?*

All age groups of pre-schoolers in Matthews et al.'s (2007, 2012) studies quickly learnt to produce complex referring expressions such as (3). However, such training might have led children to simply always provide longer utterances, ignoring listener informational need (see Whitehurst, Sonnenschein, & Ianfolla, 1981). To examine whether the trained pre-schoolers would take listener informational needs into account, Matthews et al. (2012) investigated whether they would produce fewer complex referring expressions in conditions in which these would be OVER-INFORMATIVE. The degree to which pre-schoolers were able to curtail their usage of complex referring expressions appeared to depend on the type of environmental cue to the listener's informational needs. If the cue was array size, they produced significantly more complex referring expressions in the presence of many (as opposed to just one) distractors (Matthews et al., 2007; 2012: Study 1).

However, when the environmental cue was distractor similarity, neither 2½- nor 4-year-olds learned to take listener informational need into account when using verbal reference, regardless of whether the feedback was GENERIC (e.g. (5)) or SPECIFIC (e.g. (6)) (Matthews et al., 2012: Study 2). To illustrate, if the target were a picture of a rabbit dancing and at least one distractor was SIMILAR (i.e. also showing a rabbit) then an utterance such as (3b) would be appropriately informative. However, if all the distractor pictures were DISSIMILAR (i.e. none depicted a rabbit), then (3b) would be over-informative. Matthews et al. (2012) concluded that distractor similarity is too opaque to cue pre-schoolers to take their listener's informational needs into account when producing

referring expressions, presumably because of difficulty in attending to the details of each picture (e.g. Vurpillot, 1968).

The present study

The current study investigates two key questions.

Is distractor similarity always too opaque a cue for pre-schoolers?

One rationale for the current study was to query Matthews et al.'s (2012) claim that the 'distractor similarity' cue is too opaque for preschoolers to process as an indicator of listener informational need. We hypothesized that even 2;6-year-olds2;6-year-oldswould be able to do this if the cognitive load of the task were reduced. To test this, we reduced the visual array size to two pictures per trial (one target, one distractor); Matthews et al. (2012) alternated arrays of four with arrays of two or (at test) six pictures. Replicating Matthews et al. (2012), we manipulated two between-subjects feedback (training) conditions. Children then completed a (post-training) test composed of two within-subjects conditions: one with similar distractor pictures (in alignment with the training phase) and one with dissimilar distractor pictures. If 2;6-year-olds2;6-year-oldsare capable of taking listener informational needs into account on the basis of the environmental cue of object similarity, they should produce fewer complex referring expressions in the presence of a dissimilar distractor than when the distractor is similar to the target. To further reduce cognitive load of the task, we chose complex referring expressions involving nouns modified by a prepositional phrase (e.g. *the rabbit <u>on</u> a boat*, see Appendix) rather than the reduced relative clauses used by Matthews et al. (2007, 2012), since these are not used frequently until later in the pre-school years (e.g. Brandt, 2011).

The relationship with naturalistic pragmatic skill

Another key issue is ecological validity. This is particularly problematic in developmental

pragmatics since this domain by definition taps how language is used and interpreted in a socially meaningful way. Yet this ability is often measured in experimental paradigms which are not part of real social interaction. In contrast, researchers in clinical pragmatics prefer measures of naturalistic observation (e.g. Adams, Gaile, Lockton & Freed, 2011) or parental questionnaires (see Norbury, 2014). This is because high-functioning adolescents with Autism Spectrum Disorder (ASD), who are symptomatically impaired on taking listener informational need into account when using verbal reference in conversation (e.g. Adams, Green, Gilchrist & Cox, 2002), are frequently indistinguishable from controls in referential communication experiments (e.g. Santiesban, Shah, White, Bird & Hayes, 2015; Begeer, Malle, Nieuwland & Keysar, 2010; see also Bishop & Adams, 1991). The current experimental paradigm, like that of Matthews and colleagues (2007, 2012) and O'Neill and colleagues (1996, 2001), may well be closer to real social interaction than more traditional referential communication paradigms because children here are motivated to obtain stickers to complete a game and are unable to obtain the stickers without the assistance of the interlocutor. We tested the ecological validity of our task by relating children's ability to learn to produce complex referring expressions in the presence of similar distractors to pre-existing individual differences in naturalistic conversation, using the Language Use Inventory (LUI, O'Neill, 2009). Since we were interested specifically in how task performance might relate to children's conversational skills, we focussed on the 'Conversational skills' sub-scale.

METHOD

Participants

We tested 32 typically-developing, monolingual English 2;6-year-olds in a child lab in southern England. One additional participant was excluded from analysis due to failure to complete the task from lack of interest. Participant details are given in Table 1 below.

Table 1: Participant characteristics

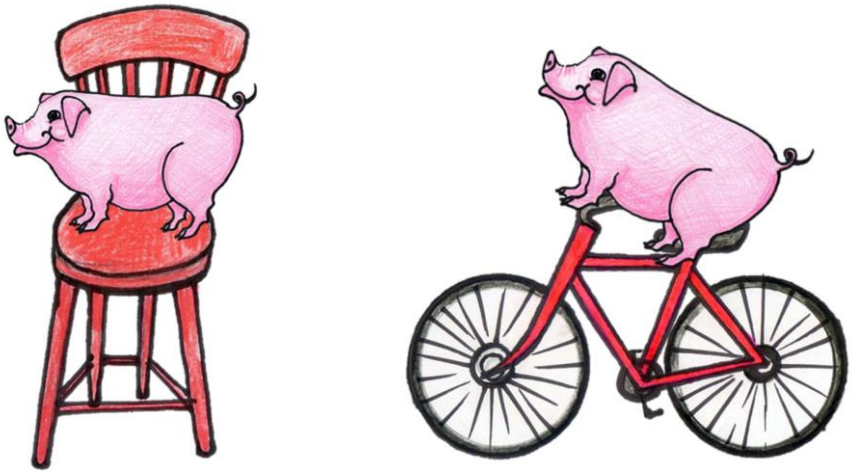
	Specific Feedback Condition	**Generic Feedback condition**
Age (n.s. p = .59)	2;6;22 (range = 2;5-2;9)	2;7;5 (range = 2;5-2;8)
Number	16	16
Gender ratio	6 boys, 10 girls	6 boys, 10 girls
LUI Total Raw (poss max = 174, n.s p = .163)	127.13 (SD 21.81)	139.06 (SD 25.23)
LUI Conversation Sub-scale (poss max = 15, n.s. p = .384)	10.31 (SD 2.52)	11.19 (SD 3.06)

Design

We followed Matthews et al. (2012) in having two between-subjects training conditions which differed with respect to the feedback children received if their initial request for a given trial was under-informative. In the GENERIC feedback condition, feedback signalled that the interlocutor could not determine reference (e.g. (5)). The SPECIFIC feedback condition included at least one model of an appropriate complex referring expression (e.g. *Do you want the pig on the bike or the pig with the cake?*). After this training, children in both conditions participated in two within-subjects conditions at test (4 trials for each): i) similar distractors (Figure 1) for which complex referring expressions were needed to disambiguate

the target, and ii) dissimilar distractors (for which a complex referring expression would be over-informative, see Figure 2).

Figure 1: Example of a distractor (left) which is ‘similar’ to the target (right)



Materials and Procedure

Pre-test

To ensure all children understood the concept of ‘same’, a pre-test was conducted using six pairs of cards depicting identical objects (e.g. boy, girl, cat, bird) where children had to find objects which were ‘the same’. This was repeated with one target picture from an experimental trial. Then E1 asked the child to name each of the animals (see Appendix A). All children could spontaneously name all animals.

Training trials

E1 and E2 were in adjacent rooms. Each room was video-recorded. The child was shown a ‘story-book’ by E1 which contained pictures of animals in various locations or in conjunction with a particular object. For each of E1’s story-books, the child was given a book which was almost identical to E1’s but the child’s version had missing pictures. The child’s task was to

collect the missing pictures from E2. For each missing picture, when the child arrived 'next door' s/he saw the missing picture paired with another (similar distractor, see Figure 1) depicting the same animal but in a different spatial configuration (e.g. *with a hat, in a bath*). During training E1 showed the child two such story-books, each with five missing pictures (for a total of ten training trials for each child). The order of the books was counterbalanced across children.

When asking E2 for the picture, the child stood in a 'magic asking circle' on the ground in front of two pictures, placed so as to ensure children's pointing would be ambiguous. The requisite animal and object names and spatial prepositions were in the expressive vocabularies of the majority of 2;5-year-olds (see Appendix A for the percentage of 29-month-olds on the US CLEX database who had each word in their expressive vocabularies). For both training and test trials, the location of the target in E2's room was counterbalanced (left vs. right) both within and between participants.

For each training trial, if the child's first request was ambiguous, E2 provided the following types of feedback.

a) (For both training conditions) If the child pointed, E2 stated that she could not see which one the child was pointing at (see e.g. 7b, 8b, 8c).

b) If the child simply named the animal, then specific versus generic feedback was given depending on the child's between-subjects condition. In the generic condition feedback signalled that the interlocutor could not determine reference (see e.g. (7b) and (7c)) but the appropriate form of the complex referring expression was never modelled. The specific feedback condition included at least one model of an appropriate complex referring expression (see e.g. (8)).

c) If the child continued to use ambiguous requests for two more turns, E2 pointed at one of the two pictures randomly and asked '*that one?*' (see e.g. (7d)). E1 gave the child a sticker at the end of each trial.

(7) Example first training trial from Generic Feedback Condition

(7a) E2: *Can you tell me which picture you need?*

Child (P5): *Rabbit* (points)

(7b) E2: *Which rabbit? I can't tell where you're pointing.*

Child: *That rabbit.*

(7c) E2: *Which one? Do you need this one*?

Child: *No, that rabbit.*

(7d) E2: *This one?*

Child: [nod]

(8) Example first training trial from Specific Feedback Condition

(8a) E2: *Which picture do you need?*

Child (P4): *That one* (points)

(8b) E2: *I can't tell where you're pointing.*

Child: *That one! That one!* (pointing)

(8c) E2: *I can't tell where you are pointing. Can you tell me which one you need?*

Child: *That one* (points)

(8d) E2: *Do you need the bunny in the bath or the bunny in the boat?*

Child: *Erm bunny in bath*

Test

The test used a new book, with eight pictures missing, alternating between similar distractor trials (for which, a complex referring expression was required to disambiguate the target from distractor) and dissimilar distractors (for which only the animal name was need to disambiguate the pictures). For each trial we coded only children's first requests immediately following the first prompt (e.g. (7a), (8a)).

FIGURE 2 Example of a distractor (left) which is 'dissimilar' from the target (right)

Language Use Inventory

The LUI has high sensitivity (81%) and specificity (93%) for 2;0-3;11-year-olds. The 'conversation' (M) sub-scale items tap the ability of the child to stay on topic, show motivation to spontaneously comment on conversations of others, repair unclear utterances for the interlocutor, ask for clarification if their interlocutor's utterance is ambiguous, relay past events in a coherent fashion and understand mental state verbs. Parents completed the LUI prior to the lab visit and raw scores obtained (see Table 1).

RESULTS

Coding

The data were transcribed by E1 and E2. Every fifth child was transcribed separately by both E1 and E2, with 97% agreement. Only the child's initial request for each trial, given prior to any feedback, was coded and analysed. Trials with no response for the first elicitation questions constituted 7% of the data and were excluded from all analyses. Responses were binary coded by the first author for each of the categories in i-v below. 10% of the data encompassing the full range of response categories were coded by a second coder, blind to the first author's coding. There was 94% agreement (Cohen's Kappa = 0.93) and disagreements were resolved via discussion.

i. Pointing only
ii. Ambiguous pronoun only (usually with co-occurring pointing)
iii. Head noun (i.e. animal name, e.g. *the/that dog*)
iv. Modifying noun (i.e. inanimate object name) only (e.g. *boat one*)
v. Complex unambiguous (i.e. mentioning either both head noun and modifying noun (or even e.g. *rabbit uh boat*) or the head noun and an action (e.g. *pig riding*) or colour (e.g. *bunny on blue* for the rabbit on a blue boat) which clearly disambiguates it from the distractor picture).

Pre- versus post-training referential strategy descriptives

On their initial requests for training trial 1 (i.e. pre-training), 50% of children pointed and/ or used an ambiguous pronoun (e.g. *I want that one*). 17% used the head noun (animate) only (as in (2)), which was under-informative in the context of a similar distractor. None used a complex referring expression (as in (3a)). However, 33% of children used a modifying noun alone (e.g. inanimate location, as in (4)), which was of an appropriate level of informativity since it distinguished the target picture from the distractor. Post-training, pooled over initial requests for all test trials and groups, children used complex referring expressions on average

33% of the time, the head noun alone 16% of the time, the modifying noun alone 27% of the time and pointing and/ or pronoun only 23% of the time.

Main analyses

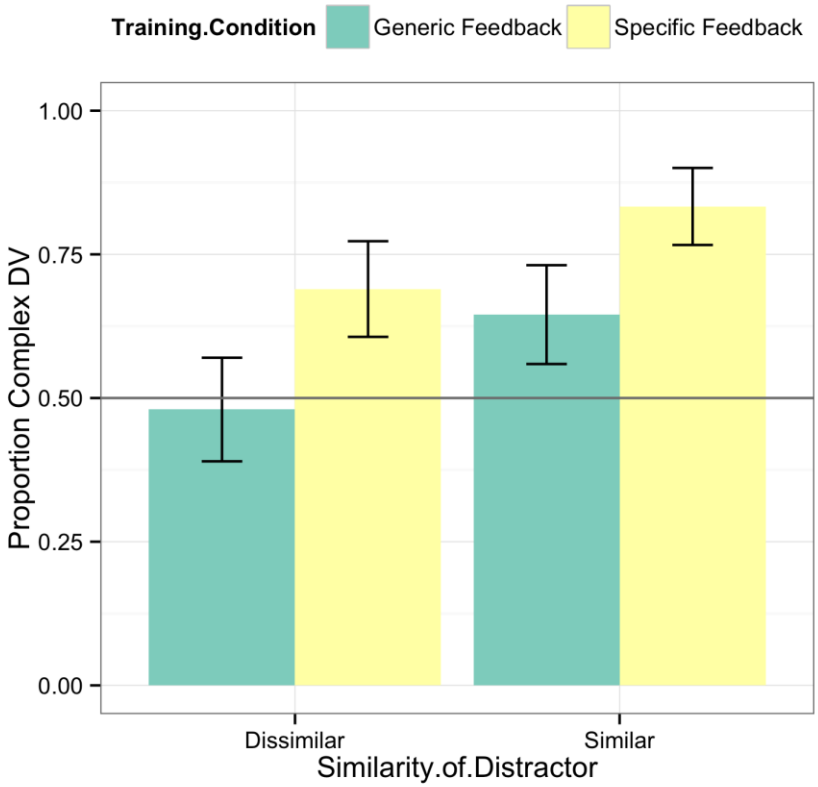
Our dependent variable was 'Complex DV', which excluded all 'pointing only' and 'ambiguous pronoun only' responses (since these were always ambiguous) and all modifying noun only utterances (since these always disambiguated, regardless of distractor type). The denominator was thus all utterances which were either complex referring expressions (e.g. (3a)) or specified the head noun (animal name) only (e.g. (2)). Therefore, for our analyses for a given trial, a score of 1 indicates that a child produced a complex referring expression and a score of 0 indicates that a child produced the head noun. Any other response type was coded as NA and excluded from analyses. Figure 3 shows the mean responses for all post-training test trials, by feedback training condition and distractor type. If children's initial requests for each trial were always appropriately informative, then 'Complex DV' would be 1.0 in the similar distractor condition (in which an utterance such as (2) would be under-informative and (3a) would be appropriately informative), and 0 in the dissimilar distractor condition (in which an utterance such as (2) would be appropriately informative and (3a) would be over-informative).

RQ1: Did 2;6-year-olds2;6-year-oldstailor linguistic reference to interlocutor's informational needs?

We entered Complex DV into a binominal mixed effects model using the lme4 1.1-7 package in R (http://www.R-project.org) with training (feedback) condition (specific vs. generic) and distractor type (similar vs. dissimilar) as effect coded factors (e.g. Baayan, Davidson, & Bates, 2008). The p-values for logistic mixed effect models were computed by comparing

models with likelihood-ratio tests, and chi-square values are reported. We included random slopes for distractor type as this was nested within participants. We found that there was no main effect of training condition (specific feedback mean = .76, generic feedback mean = .56, p = 0.10) nor an interaction (p = .8). Importantly for our key research question, we found the predicted main effect for distractor type (b = 1.72, SE = 1.03, $\chi^2(1) = 4.78$, $p < .05$); children were more likely to use complex utterances when faced with similar distractors (M = .74) than when the distractors had dissimilar animals (M = .59) (see Figure 3). Thus, our 2;6-year-olds showed an awareness of listener informational need in that they curtailed their use of complex referring expressions in contexts where they would be over-informative.

Figure 3: Mean 'Complex DV' referring expressions used on first requests of each trial, by (post-training) test distractor type



RQ2: Relationship between experimental measure and naturalistic pragmatic language

Using Complex DV as our dependent variable we included the LUI in a binomial mixed effects model with fixed effects for training (feedback) condition and time. For time we pooled data over the first four training trials and compared this with performance during the four test trials which had, like the training trials, similar distractors. We included random slopes for time as this was nested within participants. There was no main effect for training condition nor an interaction, but there was a main effect for time (b = 2.56, SE = 0.76, $\chi^2(1)= 8.57$, $p < .01$)), indicating that across both conditions children learned to produce proportionally more complex initial requests for each trial. Importantly, we also found a significant main effect for the LUI total score (b = 0.05, SE = 0.02, $\chi^2(1)= 5.44$, $p < .05$), indicating that children with more developed pragmatic language skills in the naturalistic environment were more likely to learn to produce more complex requests in the current experimental task. There were no interactions with the LUI (ps > .2). When the same analysis was run with the LUI conversation subscale (M), the pattern of effects for all experimental main effects and interactions remained the same (Time b = 3.02, SE = 0.90, $\chi^2(1)= 8.57$, $p < .01$) but the relationship with 'Conversation' was stronger than with the LUI total score (b = 0.57, SE = 0.21, $\chi^2(1)=11.73$, $p < .001$). This indicates both that the experimental paradigm held ecological validity and that pre-existing individual differences determined the degree to which children were able to benefit from feedback to learn to produce complex referring expressions.

GENERAL DISCUSSION

The current study shows that when cognitive load in Matthews et al.'s (2012) paradigm is reduced, 2;6-year-olds can take visual similarity into account when selecting an appropriate

verbal referring expression. On test trials children produced significantly fewer complex referring expressions on initial requests in the presence of dissimilar distractors than similar distractors, indicating they were considering their interlocutor's information needs to some degree.

Nevertheless, our 2;6-year-olds clearly did not reach adult-like levels of informativity. While adults tend to avoid using ambiguous linguistic reference (e.g. Ferreira, Slevc & Rogers, 2005), our 2;6-year-olds only selected (appropriately informative) complex referring expressions on average 74% of the time in the presence of similar distractors. Conversely, from Figure 3 it is clear that they were frequently over-informative in their selections of verbal referring expressions (in the presence of dissimilar distractors). Moreover, although the proportion of initial requests involving what we termed 'non-verbal' reference (i.e. pointing with or without an pronoun) sharply declined between pre- and post-training, even at test this remained a frequent prepotent response (e.g. Carlson, Moses & Hix, 1998). Therefore, 2;6-year-olds have far to go in reaching adult-like levels in the production of linguistic reference. There are many potential reasons for why 2;6-year-olds might have the COMPETENCE to take their listener's mental perspective into account whilst planning and producing an utterance, but nonetheless show a great many errors in PERFORMANCE (see e.g. Brown-Schmidt, 2009; Gillis & Nilsen, 2014; Rossnagel, 2004; Lin, Keysar & Epley, 2010, for the role of various executive functions). One key contribution of our current study is to show that (contra Matthews et al., 2012) taking environmental cues to the interlocutor's visual perspective into account whilst planning and producing linguistic reference is not beyond the *competence* of children this age.

Another key contribution of the current study is to show (contra Bishop & Adams, 1991) that performance in referential communication tasks relates to naturalistic pragmatic language skills, as rated by their parents. We state this with two caveats. The first is that this may only

be the case for typical pragmatic language development. It remains to be seen whether a similar relationship would be found for children with developmental disorders in which pragmatic language is symptomatically impaired (i.e. ASD, Social Communication Disorder). The second is that this relationship may only hold for tasks in which children are highly motivated (see Resches & Perez Pereira, 2007, for similar logic). In the current task, children were highly motivated to obtain the missing pictures to complete their books. This may have enhanced the pattern of linguistic reference in their requests to levels used for requests in the home environment.

The other important finding is that there is great variety in the degree to which individual 2;6-year-olds are receptive to interlocutor feedback which highlights the need to repair ambiguous utterances (see also O'Neill & Topolovec, 2001; Shwe & Markman, 1997). At the group level, this feedback led extremely rapidly to improved ability to produce a complex referring expression in the initial request per trial. Therefore, it is more plausible to refer to our feedback regarding ambiguity as activation rather than of training/ teaching the children to produce unambiguous linguistic reference. Importantly, the degree to which this activation or training 'worked' related to parental ratings of children's conversation skills. Notably, this relationship would not have been evident without our feedback regarding ambiguity, since none of the children produced complex referring expressions (and half simply pointed and/ or said 'that one') prior to training.

In sum, the current adaptation of Matthews et al.'s (2012) task demonstrates that 2½ -year-olds as a group have the ability to take their interlocutor's information needs into account when planning and producing linguistic reference. Future research could investigate the degree to which individual differences in this ability are related to the development of executive functions.

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Appendix: Percentage of 2;5-year-olds who had each item in their expressive vocabularies according to the CLEX database (http://www.cdi-clex.org/vocabulary/singleword/search/corpora/2)

Head NPs & Prepositions	**% of 2;5-year-olds**	**Modifier NPs**	**% of 2;5-year-olds**	**Modifier NPs**	**% of 2;5-year-olds**
bunny	83.6%	boat	81.3%	truck	88.8%
dog	97.5%	hat	90.0%	swing	75.0%
pig	86.3%	bike	86.3%	table	81.3%
duck	86.3%	bath	88.8%	keys	37.5%
cat	97.5%	ball	97.5%	book	91.3%
in	71.3%	cake	85.0%	chair	87.5%
on	82.5%	train	81.3%	tree	85%
with	52.5%	bed	88.8%		