The Development of Reference from Two to Four Years

Danielle E. Matthews (danielle.matthews@manchester.ac.uk)
Max Planck Child Study Centre, School of Psychological Sciences,
University of Manchester, Manchester, M13 9PL UK

Elena V. M. Lieven (lieven@eva.mpg.de)
MPI EVA, Deutscher Platz 6, D-04103 Leipzig, Germany

Michael Tomasello (tomas@eva.mpg.de)
MPI EVA , Deutscher Platz 6, D-04103 Leipzig, Germany

Abstract

Recent psychological studies demonstrate that infants have a remarkable ability to engage with others communicatively. Yet clearly school aged children, indeed even adults, sometimes have real difficulty making themselves understood when referring to things. One of the major challenges of cognitive science, then, is to explain 1) the nature of early referring abilities and difficulties and 2) the experiences that enable children to produce appropriate referring expressions in context. We will review a series of five studies designed to address these issues.

Keywords: language development; pragmatics; referring expressions; learning; feedback; preschool; infancy

Introduction

One of the very first things children do with language is to use it to refer to things (Bruner, 1983). The most obvious way in which children achieve this is with pointing gestures that emerge around the first birthday (Tomasello, Carpenter, & Liszkowski, 2007) and with their first words, which emerge shortly after (REF). Both gestural and vocal referring strategies are quite nebulous at the outset: it is impossible to say when a child first produced a real pointing gesture or ***word*** in the sense we typically intend (Matthews, Behne, Lieven, & Tomasello, in prep). Nonetheless, most children rapidly go on to develop sizeable repertoire of referring expressions and, as they do, it becomes interesting to question how they learn to choose appropriate expressions given the context. In the current paper we will present two studies that assess children's use of referring expressions in different situations (study 1 noun/pronouns, study 2 definite/indefinite referring expressions). We then consider how children learn to produce appropriate referring expressions and report on two training studies (studies 3, 4 and 5).

All of the studies we review are experimental. We should note however, that there is a rich literature investigating children's production of referring expressions in naturalistic and narrative contexts (e.g., Allen, 2007; Bates, 1976; Clancy, 2003; Greenfield, 1979; Hickmann & Hendriks, 1999; Küntay & Özyürek, 2006; Rozendaal & Baker, 2008).

Studies of naturalistic speech suggest that, from the onset of combinatorial speech, children adapt their production of referring expressions according whether something is accessible for the listener based mainly on (a) the perceptual context, or (b) the immediately preceding discourse context. For example, Clancy (2003) found that two Korean children aged 1;8 through to 2;10 systematically introduced new (i.e. inaccessible) referents with fully informative noun phrases. However, Clancy points out that this sensitivity to referential form interacts with lexical choice and grammatical role. The children she studied commonly introduced new referents with lexical referring expressions and a small set of intransitive verbs. Equally a small set of transitive verbs were generally used to talk about actions that the child or caregiver performed on an inanimate object, giving rise to elliptical or pronominal forms for the animate, given subject and lexical forms for the new, acted-upon object. Consequently, it is difficult to establish if and when the children became aware of the informational status of different referring expressions as separate from the restricted lexical and grammatical contexts in which they were used (c.f. Karmiloff-Smith, 1981). Therefore, whilst naturalistic observation suggests very early sensitivity to referential choice, experimental studies are helpful in defining precisely when and how this is mastered.

Study 1: Noun and pronouns

In this study (Matthews, Theakston, Lieven, & Tomasello, 2006) we assessed when in development English speaking children would produce different referring expressions (noun vs pronoun) depending on whether or not their addressee A) could see the intended referent and B) had heard about the referent in the prior discourse. One hundred and one normally developing, monolingual, English-speaking children were included in the study. There were 31 2-year-olds (mean age 2;6), 33 3-year-olds (mean age 3;5) and 37 4-year-olds (mean age 4;6).

Study 1A: Visual Accessibility

In study A children were asked to describe short videos of a single character performing a simple action (e.g., a clown jumping up and down) to an experimenter, E, who simply asked them 'What's happening?'. We varied whether the child was sitting next to E at this time (and thus could see the video) or not as can be seen in Figures 1 and 2 below.

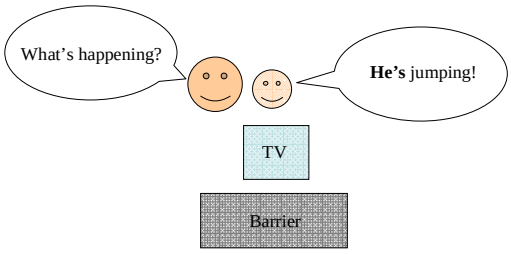

Figure 1: Set up in study 1A: Addressee can see.

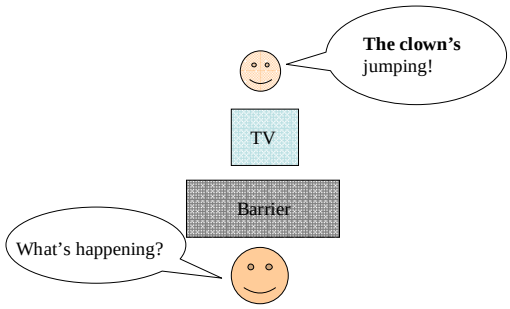

Figure 2: Set up in study 1A: Addressee can't see.

In general, older children tended to use more pronouns as they were more likely to respond with pronoun-verb constructions than by simply naming the characters. To assess how informative children's referring expressions were, we calculated the mean proportion of responses where children referred to the video character with a full noun (e.g. "***the clown***") as opposed to a pronoun (denominator = full noun responses + pronoun responses). Table 1 reports this measure. We found that 3- and 4-year-olds, but not 2-year-olds were significantly more likely to produce full nouns when their addressee could not see the video as opposed to when she could.

Table 1: Mean % of referring expressions that were full nouns (as opposed to pronouns) in study 1A.

Age	E Can See	E Can't See
2-years	62 %	57 %
3-years	57 %	75 %
4-years	54 %	66 %

A more detailed analysis revealed that in addition to using pronouns, 3-year-olds were more likely to express the verb alone (i.e. have a null argument) when the addressee could see the scene (see also Campbell, Brooks, & Tomasello, 2000). It seems, then, that what children are most sensitive to at three years is the need to provide a full lexical noun to inform people of inaccessible information. When this is not required, pronouns and null references are more likely to be used. As children get older they become aware that (in English) it is generally necessary to explicitly express given referents with pronouns rather than to continue to omit this information.

Study 1B: Accessibility in Prior Discourse

In study B we investigated the effect of prior discourse on children's production of referring expressions. Children always sat next to one adult, E1, who commented on the videos. We varied whether E1 referred to the character or not. On this basis, a second experimenter, E2, who could not see the video asked what was happening either by saying, e.g., "Was that the Clown? Oh! What happened?" or by saying, e.g., "That sounds like fun! What happened?". We assessed whether children would adjust their responses according to whether E2 had made prior mention of the character. Three- and 4-year-olds, but not 2-year-olds were significantly more likely to produce full nouns when their addressee had not referred to the character previously. Two-year-olds nonetheless showed some sensitivity to prior discourse: when a character had not previously been referred to, the 2-year-olds were significantly more likely to respond by naming the referent (i.e. to say '***The clown!***') rather than by describing the action with a verb (i.e. to say '***Jumping***!').

Table 2: Mean % of referring expressions that were full nouns (as opposed to pronouns) in study 1B.

Age	Prior mention	No mention
2-years	95 %	71 %
3-years	85 %	45 %
4-years	71 %	43 %

Taken together, these studies suggest that children respond to prior mention as an indicator of referent accessibility before they do to perceptual availability. Obviously one crucial difference here is that prior mention of the noun affects accessibility for both the adult-addressee and the child-speaker. Thus children's production of referring expressions in study 1B may not necessarily have been 'audience designed'. In contrast, in study 1A, differences in the children's use of referring expressions can be attributed to sensitivity to the addressee's perceptual access to the referent.

We now consider whether children's sensitivity to prior discourse extends to a more subtle linguistic distinction: the choice between definite and indefinite articles.

Study 2: Definite and indefinite articles

Perhaps one of the most challenging tasks when learning about the referring expressions of English, is the mastery of the definite and indefinite articles 'the' and 'a'. Many non-native speakers are baffled by their use (Thomas, 1989). Young children often omit them from their speech altogether (Gerken, 1996) or produce them as fillers (Peters, 2001). Even linguistics struggle to come up with a good account for determiners (see, e.g., Abbott, 2006; Gundel, Hedberg, & Zacharski, 1993; Lambrecht, 1994). Here we

simplify things by assuming that there are two dimensions that account for the use of definite 'the' as opposed to indefinite 'a'. Along a ***specificity*** dimension, 'the' implies the speaker has a specific referent in mind whereas 'a' does not (compare ***Can you see the dog?*** with ***Can you see a dog?***). Along a givenness dimension 'the' implies that the referent is given to speaker and addressee whereas 'a' does not (Compare ***I have the car*** with ***I have a car***). Despite studies demonstrating early and appropriate production (Brown, 1973; Rozendaal & Baker, 2008) it is generally accepted that naturalistic settings rarely allow us to test whether children fully understand the function of articles. Indeed, in experimental settings children tend to show sensitivity to the givenness dimension very late (Karmiloff-Smith, 1979; Maratsos, 1976). In contrast, sensitivity to the specificity dimension has been noted in children at least as young as three years old (Maratsos, 1974). In the current study we modified the sentence repetition procedure used by Maratsos (1974) to establish the age at which children first show sensitivity to the function of articles in marking specificity.

Children were asked to repeat the final sentence of stories like the one below. The third line of the story was varied in order to make either a definite or an indefinite article appropriate in the fourth sentence. In the fourth sentence, we spliced in a cough at the point at which the critical determiner occurred. We then measured which determiner children chose to replace this cough with when repeating the sentence.

A little boy was in a shop
There were lots of toys on a shelf
His mum said he could have one
He saw [some cars/a car] so
He chose [cough] car

We calculated the proportion of articles that were correct (number of target articles / total number of articles produced) and report this measure for a preliminary study in Table 3. We found that children were above chance when required to produce the indefinite article 'a' from a very early age. However, when required to produce 'the' children were below or at chance in all age groups. This asymmetry might be due in large part to the fact that the English indefinite article can be realized as a schwa. It is therefore impossible to differentiate filler syllables from correct indefinite articles.

Table 3: Mean % of articles that were appropriate given the previous sentence in study 2.

Age	Target = 'a'	Target = 'the'
2 ½ years	61 %	33 %
3 years	64 %	42 %
3 ½ years	64 %	45 %
Adult	81 %	88 %

It is worth noting that adults were not at ceiling in this task. In the indefinite target condition this may be due to the nature of the repetition task. However, we have no explanation as to why adults made so many errors even in the definite target condition. We are currently investigating how children might learn the multiple functions of determiners in a training study. One noteworthy finding so far is that although children had difficulty in producing the correct article in study 2, they ***are*** able to understand the function of determiners in marking specificity in comprehension studies. Thus when shown pictures like the one in figure 3, children reliably point to the single novel character on the right when asked to 'point to **the** flep' but point to one of the group of novel characters on the left when asked to 'point to **a** flep'.

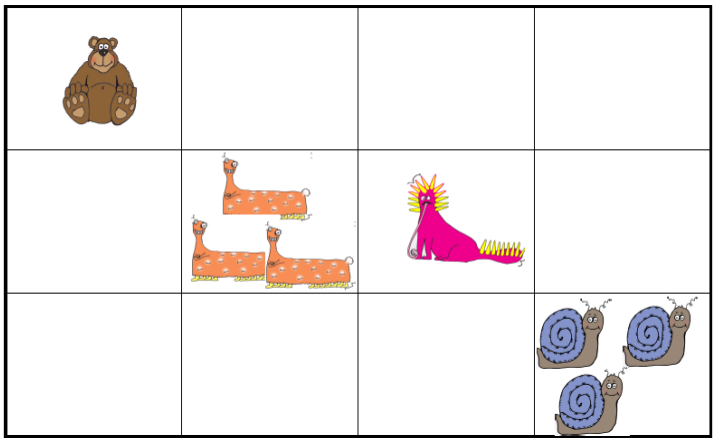

Figure 3. Example stimuli to test comprehension of definite and indefinite articles.

The above studies are broadly in line with over forty years of research (dating from Krauss & Glucksberg, 1969) which demonstrates that, right up until adolescence, children have real difficulty in producing appropriate referring expressions in context (Bahtiyar & Küntay, 2009; Deutsch & Pechmann, 1982; Dickson, 1982; Robinson & Robinson, 1985). We now consider what experiences might enable children to learn to use language more appropriately. In the following training studies, we assess how feedback of different kinds helps young children to accurately identify a target object that is located in an array of similar distracters.

Study 3: Training the production of referring expressions

In order to investigate the kinds of experiences that promote effective referential choice, we developed a training methodology based on naturalistic observations of communicative breakdown and repair. In brief, the child sits at a table with one adult, E2. Both have a sticker book with identical front covers. When they turn over the first page of their books it becomes apparent that a sticker is missing in the child's copy (as can be seen in figure 4).

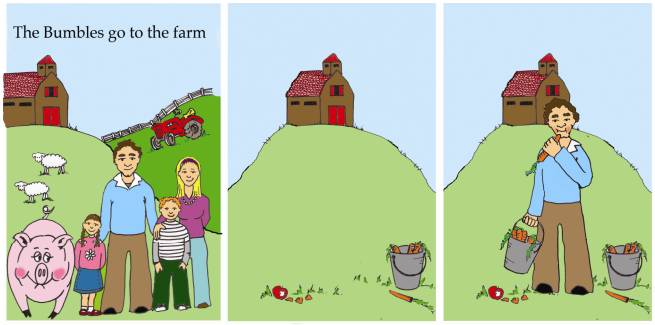

Figure 4. Sticker books used for training.

The child's task is to go to the other side of the room where another adult, E1, has a selection of stickers on the wall (as illustrated in Figure 4). The child thus needs to uniquely identify the target sticker bearing in mind the other stickers available.

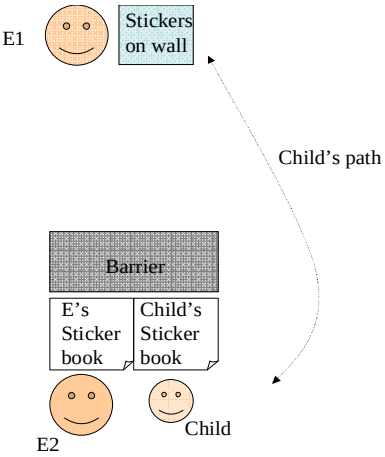

Figure 4. Set up for training studies.

In these studies children almost always do one of three things when first attempting to identify a sticker. They either **1) Point** to the sticker board and say "That one", **2) Name** the character (e.g., "The Daddy one") **3)** give a **Complex Description** by naming the character and a property of it (e.g., "The Daddy eating carrots"). We have been interested to establish what might enable children to inhibit pre-potent pointing responses and to use language to identify the sticker for E1.

In our first such study (Matthews, Lieven, & Tomasello, 2007), we pre- and post-tested 224 2-, 3- and 4-year-olds for their ability to request stickers from a dense array of similar alternatives. Between test sessions, children were assigned to a training condition in which they either 1) asked for 24 stickers from an adult and received feedback if their requests were ambiguous ('speaker' condition) 2) responded to 24 (sometimes ambiguous) adult requests for stickers (addressee condition) 3) observed one adult ask (sometimes ambiguously) another for 24 stickers (onlooker condition) or 4) heard 24 model descriptions of stickers (control for vocabulary and task familiarity). Children in all four conditions improved their referring strategies after training.

The speaker condition was the most effective. In this condition if a child requested a target by pointing at the array of stickers s/he was asked "***Which one?"*** and if s/he asked for a sticker ambiguously (e.g., saying "***I need the Daddy***") when there were two stickers that met this description), then the experimenter would explicitly ask which option the child had meant (e.g., "***Do you need the Daddy eating or the Daddy singing?***").

The second most helpful condition was the onlooker condition. This finding was somewhat surprising and demonstrates children's ability to learn by imitating other people's goal directed actions.

Study 4: Varying feedback and distracters

Study 3 raises questions as to what precisely children were learning and how. It is unclear whether the children were simply learning that they would get what they wanted faster if they produced longer descriptions of stickers (c.f. Whitehurst, Sonnenschein, & Ianfolla, 1981 who found that 5-year-olds confuse description length with informativity) However, if children were only learning to produce longer sentences without fully appreciating why they were required, it is not clear why the speaker condition was most effective. The children in this condition heard fewer adult descriptions of referents (i.e. fewer models of long utterances) than children in the other three conditions (since models were only heard as part of clarification requests that were contingent on the child's request type) and yet at post-test they produced the longest and most informative descriptions. It is possible that the speaker condition was nonetheless most effective because the feedback made children work hard to arrive at an adequate description. Alternatively, the advantage might have been motivational in nature.

In study 4, a follow up training study, we assessed (1) whether the learning in study 3 consisted of devising a simple strategy to produce the longest utterance possible and (2) whether different types of feedback are better for facilitating learning. 84 2- and 4-year-olds were tested for their ability to request 36 stickers from arrays that either did or did not contain similar distracters (as in Figure 5).

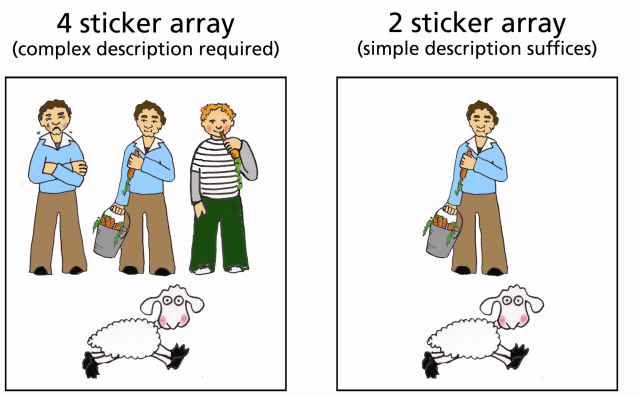

Figure 5. Example of sticker arrays used in study 4.

When children requested targets in an ambiguous manner, they received feedback either in the form of (1) **general** requests for more information or (2) **specific** questions about which of two options the child meant to refer to (as illustrated in table 4).

Table 4. Two types of feedback given in study 4

Child's response	Specific Feedback	General Feedback
Point	Do you need the daddy or the boy?	Who do you need?
Name	The daddy eating or the daddy dancing?	Which daddy?

We coded children's **first attempts** at reference (i.e. before feedback was received). Children of both ages were generally more likely to produce a complex description in the 4-sticker array condition than in the 2-sticker array condition, and this difference was larger from mid-way into training. The children were also more likely to produce complex descriptions in the specific feedback condition as compared to the general feedback condition and again this difference was more pronounced as training progressed.

This demonstrates that children as young as 2 ½ can learn to adapt referring expressions to the number of potential distracters there are in a given context – they are not simply as descriptive as possible at all times. It also appears that receiving specific, contrastive feedback (containing models of appropriate referring expressions) in the right motivational context is more helpful than experiencing a more arduous process of repair (general feedback). Importantly, specific feedback did not lead children to produce complex descriptions indiscriminately.

We suggest the learning process might work as follows. The child produced their most practiced referring strategy for the context as they understood it. The experimenter requested more information when she couldn't find the required sticker. The child kept clarifying (an early communicative ability) until s/he produced an expression that was successful in identifying the target and then remembered for subsequent trials that in such a context s/he needed to give a description of the same type (where 'same type' might mean 'name of character' or 'name of characters and what they are doing'. NB each target was unique).

An important question is how well this kind of learning would generalize. At the simplest level we might ask whether children would have learned that 'more distracters means you need to say more' or whether children would assess the similarity of distracters when choosing a referring expression (see Arnold & Griffin, 2007 for limits to adults' ability here). We address this question with a third training study.

Study 5: Testing the limits of learning

In this final study we trained and tested children by having them request stickers from a 4-sticker array that either had similar distracters (as in Figure 5) or dissimilar distracters (as in Figure 6). Children we always given specific feedback. We then tested for generalization by using 2- and 6- sticker-arrays that either did or did not have similar distracters.

Figure 6. Example 4-sticker array with dissimilar distracters.

Preliminary results indicate that children find it harder to learn when array size is held constant. When describing 4-sticker arrays in training, 2-year-olds tend to learn to name everything, whereas 4-year-olds tend to learn to describe everything with a complex description. Nonetheless, in the generalization test, 4-year-olds gave more complex descriptions when there were similar distracters and when the array size was greater. Two-year-olds also did this to an extent but only for the 2-sticker arrays. An additional interesting finding is that it would appear that when a referential situation gets really complex, some children, especially the younger ones, just give up and point. That is, pointing (the least informative response) sometimes became more likely when more information was required.

Discussion

These studies, taken together, suggest that referential communication is mastered in large part through the imitation of goal directed action and a good deal of trial and error. In such a way children come to be able to rapidly co-ordinate with others and to observe features of the environment that make the use of more informative referring expressions necessary. There is a limit to the level granularity at which these observations will be made. We suggest that much of this learning can be achieved with foundational but limited social cognitive skills: the desire to co-operate, the ability to engage in joint attention, to follow gaze, to understand communicative intentions and to imitate goal directed behavior. With such skills, infants are able to engage in communication in highly scaffolded environments. Doing so opens up a new world of experiences that make further learning possible. It is likely that time spent navigating the world of conversations is what eventually leads to meta-communicative insights, which allow adults to adapt their communicating strategies to ever more challenging situations.

References

Abbott, B. (2006). Definiteness and Indefiniteness. In L. R. Horn & G. L. Ward (Eds.), ***The handbook of pragmatics***. Oxford: Blackwell.

Allen, S. (2007). ***Interacting pragmatic influences on children's argument realization***. Mahwah, NJ: Erlbaum.

Arnold, J. E., & Griffin, Z. (2007). The effect of additional characters on choice of referring expression: Everyone counts. ***Journal of Memory & Language, 56***(4), 521-536.

Bahtiyar, S., & Küntay, A. C. (2009). Integration of communicative partner's visual perspective in patterns of referential requests. ***Journal of Child Language, 36***(03), 529-555.

Bates, E. (1976). ***Language and Context: The acquisition of pragmatics***. New York: Academic Press.

Brown, R. (1973). ***A first language: The early stages***. Cambridge, MA: Harvard University Press.

Bruner, J. (1983). ***Child's talk: Learning to use language.*** New York: Norton.

Campbell, A. L., Brooks, P., & Tomasello, M. (2000). Factors affecting young children's use of pronouns as referring expressions. ***J Speech Lang Hear Res, 43***(6), 1337-1349.

Clancy, P. (2003). The lexicon in interaction: Developmental origins of preferred argument structure in Korean. In J. Du Bois, L. Kumpf & W. Ashby (Eds.), ***Preferred Argument Structure: Grammar as architecture for function*** (pp. 81-108). Amsterdam: John Benjamins.

Deutsch, W., & Pechmann, T. (1982). Social interaction and the development of definite descriptions. ***Cognition, 11***, 159-184.

Dickson, W. P. (1982). Two decades of referential communication research: A review and meta-analysis. In C. J. Brainerd & M. Pressley (Eds.), ***Verbal processes in children***. New York: Springer

Gerken, L. (1996). Prosodic structure in young children's language production. ***Language, 72***(683-712).

Greenfield, P. M. (1979). Informativeness, presupposition and semantic choice in single word utterances. In E. Ochs & B. Schieffelin (Eds.), ***Developmental pragmatics.*** (pp. 159-166). New York: Academic Press.

Gundel, J., Hedberg, N., & Zacharski, R. (1993). Cognitive status and the form of referring expressions in discourse. ***Language, 69***, 274-307.

Hickmann, M., & Hendriks, H. (1999). Cohesion and anaphora in children's narratives: a comparison of English, French, German and Mandarin Chinese. ***Journal of Child Language, 26***, 419-452.

Karmiloff-Smith, A. (1979). ***A functional approach to child language.*** Cambridge, UK: Cambridge University Press.

Karmiloff-Smith, A. (1981). The grammatical marking of thematic structure in the development of language production. In W. Deutsch (Ed.), ***The child's construction of language.*** London: Academic Press.

Krauss, R. M., & Glucksberg, S. (1969). The development of communication competence as a function of age. ***Child Development, 40***, 255-266.

Küntay, A. C., & Özyürek, A. (2006). Learning to use demonstratives in conversation: what do language specific strategies in Turkish reveal? ***Journal of Child Language, 33***(02), 303-320.

Lambrecht, K. (1994). ***Information structure and sentence form. Topic, focus, and the mental representations of discourse referents.*** Cambridge: Cambridge University Press.

Maratsos, M. (1974). Preschool children's use of definite and indefinite articles. ***Child Development, 45***, 446-455.

Maratsos, M. (1976). ***The use of definite and indefinite reference in young children: An experimental study of semantic acquisition.*** Cambridge: Cambridge University Press.

Matthews, D. E., Behne, T., Lieven, E., & Tomasello, M. (in prep). Learning to point and vocalize between 9 and 12 months.

Matthews, D. E., Lieven, E., & Tomasello, M. (2007). How Toddlers and Preschoolers Learn to Uniquely Identify Referents for Others: A Training Study. ***Child Development, 78***(6), 1744-1759.

Matthews, D. E., Theakston, A., Lieven, E., & Tomasello, M. (2006). The effect of perceptual availability and prior discourse on young children's use of referring expressions. ***Applied Psycholinguistics, 27***, 403-422.

Peters, A. M. (2001). Filler syllables: what is their status in emerging grammar? ***Journal of Child Language, 28***(01), 229-242.

Robinson, E. J., & Robinson, W. P. (1985). Teaching children about verbal referential communication. ***International journal of behavioral development, 8***, 285-299.

Rozendaal, M. I., & Baker, A. E. (2008). A cross-linguistic investigation of the acquisition of the pragmatics of indefinite and definite reference in two-year-olds. ***Journal of Child Language, 35***(04), 773-807.

Thomas, M. (1989). The acquisition of English articles by first- second-language learners. ***Applied Psycholinguistics, 10***(335-355).

Tomasello, M., Carpenter, M., & Liszkowski, U. (2007). A new look at infant pointing. ***Child Development, 78***(3), 705-722.

Whitehurst, G., Sonnenschein, S., & Ianfolla, B. (1981). Learning to communicate from models: Children confuse length with information. ***Child Development, 52***, 507-513.