

# Semantic and Pragmatic Language Development: Children Know ‘That’ Better

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## 1. Introduction

... “There were some boys and some girls, and suddenly one of them laughed out loud. Can you tell me who?” says the experimenter. “The girl!” retorts a 4-year-old child. This paper readdresses the issue of young English children’s misinterpretation and misuse of the definite determiner ‘the’ as ‘one of’, especially in such partitive contexts, where neither the speaker nor the listener know the identity of the referent and where an adult would use the indefinite article. Are children unaware of states of other’s minds and are Egocentric or do they not know what ‘the’, the most common word of English, means? Previously, the former was invoked as an explanation for children’s errors (Maratsos 1974, based on Piaget 1955), however given a recently proposed alternative, that children have problems with Uniqueness, a key component of the semantic definition of ‘the’ (Wexler 2005, based on Heim 1991), there are now two views that can be explicitly contrasted. The goal of this paper is to begin distinguishing the possible pragmatic and/or cognitive deficits on the children’s part, from the possible computational deficits of children’s as-yet-undeveloped linguistic semantic system.

## 2. Children’s overuse of ‘the’

Many studies address children’s acquisition of articles (e.g. Karmiloff-Smith (1979); Maratsos (1974, 1976); Warden (1976, 1981); Emslie & Stevenson (1980); Garton (1983); Pynte (1991)). It was noted that the indefinite article is correctly produced by children in the absence of a referent, and the definite article is correctly used in presence of a single salient referent. However many of these studies show that children incorrectly produce (and understand) the definite article to refer to a nonsalient, not-previously-identified referent from a group of several identical entities (i.e. a partitive context), regardless of whether they are visible objects or imagined characters from a verbally presented story. Consider one such story, used by both Karmiloff-Smith and Maratsos in their studies: “There’s lots of girls and boys and they were very noisy at night. A lady told them to be very quiet. She said: ‘If anyone makes any noise, they won’t get any breakfast tomorrow’. Then she went to bed. But do you know what happened? One of them started laughing! Who was laughing?” In such a context, adults would use the indefinite article in their reply, yet children up to age of about six years old insistently produce the definite article. On the other hand, some studies show that children’s overuse of the definite article in production is to some extent an artifact of the experimental design (e.g. Emslie & Stevenson 1980). To elucidate the situation, one should study children’s comprehension of articles, allowing children to demonstrate their preference for the interpretation of the definite determiner.

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### 3. Egocentrism

Egocentrism is one of Piaget's (1955) stages of a child's cognitive development, in which children in the preoperational stage (that ends by age six) show an inability to see any point of view other than their own. Egocentrism has been used to account for children's overuse of the definite determiner in production tasks. Correct use of 'the' necessitates the speaker to be aware of the listener's knowledge of the discourse context. If children can only take their own perspective and are ignoring or are unable to consider other people's point of view, then children may fixate on a referent, and consider it *unique*, and not tell their conversation partner about it explicitly, assuming their listener can read their mind. Children do not realize that the *salience* of the referent is not shared by their interlocutor.

A more recent proposal along the same lines concerns a module of human mind that is concerned with one's awareness of mental states of other people – Theory of Mind (TOM). Studies show that various aspects of TOM are acquired at different ages, from infant to kindergarten. Notably there is the 'first order' theory of mind, denoting a child's ability to understand that somebody else may have a belief that is different from the child's belief and crucially a belief that is false given the state of the world. Approximately 50% of 4-year-old children already have first order theory of mind, as measured by a number of false belief tasks (as reviewed in Call & Tomasello 1999). When children are about 5-7 years old (depending on the study and the relative complexity of the task), they acquire the 'second order' theory of mind, where they are now able to represent one person's beliefs about another person's beliefs (e.g. Sullivan, Zaitchik, & Tager-Flusberg (1994); Muris et al (1999); Astington, Pelletier, & Homer (2003)). For example, in a story used by Sullivan et al 1994, a little boy is led to believe by his mother that he would not be getting a puppy for his birthday only to find one in the basement. The child listening to this story must understand that the mother, since she still believes her son to be oblivious to the true nature of the present, believes that her son does not think he is getting a puppy, which is false given the state of the world in the story, yet true given the mother's beliefs. It is an interesting mental exercise (to be attempted later on in the paper) to figure out which level of theory of mind is required to interpret the definite determiner 'the'.

Note, that any proposal attributing the misuse of 'the' to children's cognitive immaturity must assume that children know the adult semantic definition of 'the', but children do not use 'the' in the adult way. In short, the Egocentrism/Theory of Mind account for children's misuse of 'the' suggests that children's mistakes are not linguistic, but are due to underdeveloped cognition or pragmatics.

One must however keep in mind that it has been shown that children's linguistic abilities do influence their awareness of other minds. Harris, de Rosnay and Pons (2005) in their review discuss that children with advanced language skills are better at the understanding of mental states, and children with deficient language abilities, such as deaf children born into non-signing families, lag in TOM, leading the researchers to conclude that TOM abilities are enhanced by children's conversations involving multiple perspectives on a given topic and references to other's mental states. In other words, Harris et al argue that it is the children's pragmatic enrichment that enhances their theory of mind. However work by de Villiers and de Villiers (2003) suggests that children's ability to embed propositions structurally, i.e. children's syntactic knowledge, is a precursor for TOM. Indeed, Hale & Tager-Flusberg (2003) demonstrate that training children on sentential complements, sentences of the kind "John said that Mary....", enhances TOM. 60 preschoolers, who failed a 1<sup>st</sup> order false belief and a sentential complement pretest, were randomly assigned to three groups, where over the course of two weeks they were trained on one of the following tasks: false belief, sentential complements, noun-describing relative clauses (e.g. "the dish that is broken"). Upon post tests, the group trained on relative clauses only improved on their knowledge of relative clauses, and not on TOM or complements. The group that was trained on TOM only improved on tests of TOM, but the group trained on sentential complements, in a sense a task of embedding and recursion, acquired the linguistic knowledge and significantly increased scores on a number of tasks of theory of mind. Thus it would not be entirely correct to say that theory of mind is independent from one's linguistic abilities, however there exist children that may do well on measures of language, yet do poorly on measures of TOM, e.g. some children on the autism spectrum disorder, but that discussion is for another paper.

## 4. Uniqueness

Wexler (2005) proposes that children's overuse of the definite article is a deficit in children's computational system of language, specifically due to the lack of a component of semantic definition of 'the' – Maximality/Uniqueness. This proposal is based on Heim's (1991) formal semantic definitions of articles as well as her observation that Egocentrism cannot explain children's overuse of 'the' in partitive contexts such as the 'one of the children is laughing' story (above) on one hand, and children's lack of overuse of 'the' in nonpartitive contexts without additional stipulations.

The formal semantic definition of the definite article contains a uniqueness presupposition – that there is exactly one referent in a given context set (for example one where there are several identical Xs that may be distinguished by various means, in order to make one X unique/salient). In plural cases, uniqueness generalizes to Maximality, that 'the objects' must refer to the entire set of objects in the context and not a subset. The formal definition for the indefinite article contains only an existence presupposition, without a context set, and may in fact be used in the absence of a referent.

Now suppose children are missing the Uniqueness presupposition from their definition of 'the': for them, the definite article simply means that there exists a referent in a context. Essentially, children's version of the definite article means 'one of' thing(s) in a context.

Adult's lexical entry for 'the' (based on Heim 1991)

Regardless of the utterance context (i), [the x] P expresses that proposition that is:

- true at an index i, if there is **exactly one x** at i, and it is P at i
- false at an index i, if there is exactly one x at i, and it is not P at i
- truth-valueless at an index i, if there isn't exactly one x at i.

Adult's lexical entry of 'a' (based on Heim 1991): A sentence of the form [a x] P expresses that proposition which is true if there is at least one individual which is both x and P, and false otherwise.

Children's lexical entry for 'the' (Wexler 2005)

Regardless of the utterance context (i), [the\* x] P expresses that proposition that is:

- true at an index i, if there is **an x** at i, and it is P at i
- false at an index i, if (i) there is an x at i, and there is no x such that x is P at i
- truth-valueless at an index i, if there is no x at i

Observe that in this proposal children are still able to differentiate the definite and indefinite articles, as 'a' has no context set. Observe also that children may be inconsistent with their use of the definite article, which would stem from what children chose the context set to be. Children may decide that the salient referent is in the entire context set, as there is no reason, semantically, to rule out the bigger set. Children may also pick the restricted, smaller set that only contains the salient referent.

This proposal suggests the overuse of 'the' to be a deficit of the underdeveloped computational system of language, especially in the semantic property of Uniqueness.

## 5. Uniqueness and Theory of Mind

It turns out that English language has a word that presents an excellent minimal contrast to the definite determiner - the definite determiner 'that'. The correct use of 'that' not only implicates uniqueness but also requires the speaker to be aware of the listener's mind. Consider three examples to illustrate the differences between 'a', 'the', and 'that'.

*A guy in my class is a genius* → Implies existence of a smart male person

*The guy in my class is a genius* → Implies there's a unique male in 'my class', e.g. among 10 females, and is infelicitous if there are several males in 'my class'

*That guy in my class is a genius* → Implies that the listener knows about a particular male person from previous discussions with speaker, and has no implications for number of males in 'my class'

Maclaran (1982) discusses the differences between ‘the’ and ‘that’, the key one being that while it is enough that the referent of the definite article is inferred, the referent referred to by ‘that’ must be given in the (extra)-linguistic context, it is not enough for it to be inferred. It seems that such nondemonstrative use of ‘that’ carries a number of presuppositions on the referent, which are minimally different from the definite article. ‘That’ carries a familiarity presupposition, such that both the speaker and the listener must be familiar with the referent, presumably from previous conversations. This familiarity is what makes the referent especially salient. ‘That’ also has a uniqueness presupposition, although effective not in the physical world, but in the metalinguistic knowledge space (context) shared by the speaker and the listener. Thus, while ‘the’ does not necessitate one to rely on TOM, but only on their knowledge of uniqueness and the context set, ‘that’ does not necessitate knowledge of uniqueness, but requires awareness of the context set shared by the speaker and the listener. When it comes to choosing appropriate context sets (the entire set vs the salient smaller set), ‘that’ also may differ from ‘the’. Children may know to choose the smaller, more salient and familiar set, upon hearing ‘that’ – leaving no room for uniqueness to play a role.

Thus it is now possible to formulate two hypotheses for children’s acquisition of ‘the’ and ‘that’.

1. If Egocentrism/deficient TOM, essentially an underdeveloped cognitive/pragmatic system, is to blame for children’s overuse of ‘the’, then no difference should be observed in comprehension of ‘the’ vs ‘that’. Both determiners require children to be aware of other people’s knowledge about referents in a given context, and that is precisely what children have a hard time doing.

2. If lack of Uniqueness, essentially an underdeveloped computational system of language, is to blame for children’s overuse of ‘the’, then we should see a difference between ‘the’ and ‘that’. While both determiners have the uniqueness presupposition that is hypothesized to be missing in child language, ‘that’ still has the familiarity presupposition that indicates high saliency of the referent, which should aid children in correct identification of the referent. In other words, computational deficit may not necessarily impede children’s use of ‘that’ for interpretation.

**6. This study: Method**

*6.1 Participants*

101 English-speaking children from Boston area daycares and afterschool programs, from all socioeconomic and ethnic backgrounds, participated in the study. Two MIT undergraduates (mean age 19) who did not know linguistics also participated as controls. Eight children were excluded from final analyses due to various testing issues (lack of audible input or lack of attention by the participant).

Group	Mean Age	Number	Minimum Age	Maximum Age
3s	3;7	12	3;2	3;11
4s	4;6	18	4;0	4;11
5s	5;5	13	5;0	5;10
6s	6;6	12	6;2	6;11
7s	7;8	12	7;1	7;11
8s	8;4	11	8;0	8;9
9s	9;6	11	9;1	9;11
10s	10;4	4	10;0	10;10
Adult	19	2	19	19
Total	6;10	95	3;2	19;0

Table 1. English-speaking participants



Figure 1. Experimental set-up

*6.2 Experimental setup*

An act-out paradigm was used, closely following Karmiloff-Smith’s (1979) experiment 15. Children’s comprehension of different articles, as illustrated by children’s actions is studied. Several objects are laid out in front of a child, here six fences, three balloons, three spoons, and three logs.

Significance of three vs six context sets will be explained later. A child is given two puppet actors, here Kanga and Froggy, and asked to follow the investigator's instructions: "Kanga, push a balloon" [break to allow for action] "and then Froggy, push a/the/that balloon." The first clause always contains the indefinite article, and is used to establish a salient referent out of a group of identical objects. The second clause asks subjects to act on the same object that was acted on in the first clause if 'the' and 'that' are used and interpreted in adult manner, or to act on any object if 'a' is used and interpreted in adult manner. Children were presented with exemplars of each condition 4 times in a randomized order. Two verbs were used for the act-out task: push and kiss.

It may be argued that the instruction phrase is not exactly a natural set up, since adults are more likely to say 'the same X', rather than simply 'the X'. However, our goal is to ask the participants to use minimal information and to see how they deal with it.

The dependent variable is the number of actions by children on the same object in both clauses. Observe that children are placed in the position of the listener, thus they have to evaluate their own knowledge about the context and the referents, and what the speaker's words are meant to imply.

### 6.3 Context size variable

The idea for investigating the possible effects of the size of the context set arose following a closer examination of Karmiloff-Smith's (1979) data from her experiment 15. 43 French children aged 4-9 years were tested on two conditions with 'a' or 'the' in second clause. There was only one presentation of each condition, but additional items were added ad hoc. The context set consisted of four objects.

Briefly going over her results (Table 2, where percentage of actions on the same object are shown), the indefinite article is mostly correctly interpreted to mean 'any' or 'a different one' depending on the age of the subjects. The definite article is differentiated from the indefinite article by all ages except 4, 5 and 7 year olds. Perfect knowledge of 'the', which would consist of 100% actions on the same object is not attained by any subjects, but is approximated by 6 and 9 year olds. Children are clearly presenting a deficit in comprehension and correct interpretation of the definite article.

	4;0-4;11	5;0-5;11	6;0-6;11	7;0-7;11	8;0-8;11	9;0-9;11
A	19%	10%	14%	42%	0%	0%
The	26%	30%	72%	42%	47%	81%

Table 2. Percentage 'same' responses by French children from Karmiloff-Smith, exp 15

If we consider the probabilities for children's performance given a context size of 4 objects and a single presentation of each condition, it becomes evident that younger children are performing at chance levels. Once one of 4 objects is made salient, there is a 75% chance of picking one of the other three objects, in a purely random manner. The chance for picking the same, salient object randomly is only 25%. It is important to note that these chance levels are only applicable in case there is only one presentation of each condition. Well, this is indeed the performance that French 4 and 5 year-olds are giving. They are picking about 80% different objects for 'a', and about 70% different object for 'the'.

Thus our goal was to pick two context sizes such that chance levels would be sufficiently different, yet the experimental set-up would still be manageable. There are two items for every determiner condition that have 3 elements of a set of objects, and two other items for every conditions that have 6 elements of a set of objects, giving us 33% vs 16% chance levels, respectively. Note that average chance levels over both determiner context conditions is 25%.

## 7. This study: Results

### 7.1 Overall results

Our results, summarized in Table 3, replicate those found previously for 'a' and 'the'. The indefinite article is correctly interpreted as 'any' by all age groups, remaining around 30% - very close to the average 25% chance levels. The definite article is differentiated from the indefinite article, but

proficiency is not yet fully attained even by the 10 year-old group. Our new result is that the determiner ‘that’ is differentiated from the definite article, with more children picking more same objects upon hearing ‘that’, at almost all ages. Proficiency with ‘that’ is attained by 9 year olds – earlier than with ‘the’. Over all subjects, there is significant difference between ‘the’ and ‘that’ ( $t(94) = 3.14, p = .002$ ). For further analysis, the children were divided into two roughly equal groups, the younger group (47 children, mean age 4;8, age range 3;2-6;5) and the older group (46 children, mean age 8;4, age range 6;6-10;10). Adults are excluded from further analyses.

Age	3s	4s	5s	6s	7s	8s	9s	10s	Adults	Young children	Old children
<b>A%</b>	21%	33%	23%	33%	42%	34%	34%	37%	62%	29%	35%
<b>The%</b>	39%	47%	46%	67%	54%	64%	75%	75%	100%	45%	66%
<b>That%</b>	42%	57%	67%	60%	60%	70%	95%	94%	100%	55%	74%

Table 3. Percentage ‘same’ responses by English-speaking children

A mixed repeated measures ANOVA was performed. Mauchly’s test of Sphericity for within subjects effects of determiner ( $\chi^2(2) = 10.05, p = .007$ ) and the interaction between determiner and context ( $\chi^2(2) = 7.03, p = .03$ ) come out significant, hence we must accept the hypothesis that the variances of the differences between the levels of variables are significantly different, and the assumption of sphericity has been violated. Therefore, degrees of freedom were corrected using the Huynh-Feldt estimates of sphericity ( $\epsilon = .993$  for determiner and  $\epsilon = 1$  for the interaction). For main effect of context, the assumption of sphericity is met. Results revealed a significant effect for determiner ( $F(1.98, 168.73) = 47.72, p < .0001$ ) and context ( $F(1,85) = 5.45, p = .001$ ), with determiner type by age being the only interaction approaching significance ( $F(13.89, 168.73) = 1.47, p = .128$ ).

Further independent samples t-tests between the younger and the older groups show the nature of the interaction between age and determiner: knowledge of the definite determiners increases over age (‘the’:  $t(91) = 3.23, p = .002$ ; ‘that’:  $t(91) = 2.68, p = .009$ ) however knowledge of the indefinite remains stable, as there is no significant difference between ages ( $t(91) = 1.09, p = .279$ ).

The nature of effect of determiner is shown by further paired samples t-tests where both younger and older children significantly differentiate ‘the’ and ‘that’ (Young:  $t(46) = 2.36, p = .022$ ; Old:  $t(45) = 2.06, p = .046$ ). All groups differentiate between the indefinite and the definite determiners (Young:  $t(46) = 3.54, p = .001$ ; Old:  $t(45) = 5.71, p < .0001$ ; overall:  $t(94) = 6.64, p < .0001$ )

It can be noted that all children differentiate between the indefinite and the definite articles. This in itself however cannot be taken as evidence for knowledge of Uniqueness, as the in/definite articles can be distinguished by context. The indefinite implies no context consideration. The definite determiners imply consideration of the context, and in case of “child’s the” there are two context possibilities: the entire set of objects can be considered, or alternatively only the object that was previously made salient can be taken as the context set.

Thus the results so far strongly suggest that English-speaking children in an act-out task are able to interpret ‘that’ to refer to an established salient referent better than they can interpret ‘the’. This difference in interpretation is not predicted by Egocentrism (pragmatic/cognitive deficit), but is predicted by Uniqueness (computational system of language deficit).

## 7.2 Random model in children’s performance

Table 4 summarizes the proportion of subjects performing in particular ways on determiners, i.e. picking the ‘same’ reference 0, 1, 2, 3, or 4 times, out of the 4 possible presentations. A random model of responses is derived by considering probabilities<sup>2</sup> given a context size and number of presentations.

Given that children are presented with each conditions 4 times, it is possible to derive the proportion of subjects that will produce from 0 to 4 out of 4 possible ‘same’ responses. Thus by pure chance, more subjects will show 0 and 1 ‘same’ responses. If such a pattern of responses is seen in the data, then subjects are guessing.

<sup>2</sup> Average of 3-item and 6-item contexts: e.g.  $P(\text{same}=4) = (1/4)^4$ ; e.g.  $P(\text{same}=0) = (3/4)^4$

Number 'same' responses	Random model:	A		That		The	
		Young	Old	Young	Old	Young	Old
Zero	0.32	0.38	0.20	0.15	0.04	0.15	0.04
One	0.42	0.21	0.39	0.15	0.20	0.30	0.15
Two	0.21	0.30	0.28	0.19	0.06	0.23	0.24
Three	0.05	0.09	0.09	0.34	0.13	0.21	0.24
Four	0.004	0.02	0.04	0.17	0.57	0.11	0.33

Table 4. Proportion of children giving 0, 1, 2, 3, or 4 'same' responses

Individual subject's performance on 'a' shows that the older group numbers are eerily reminiscent of the random response model, which is in fact the correct interpretation for 'a'. The younger group shows a preference for acting on two different objects. Perhaps this is evidence of an interpretation strategy. Individual subject's performance on 'the' shows that the younger group displays a random model pattern of responses. The older group shows less random model and more knowledge of 'the', however performance is not perfect. Individual subjects' performance on 'that' shows that a lot of children from the younger group are now moving away from the random model and showing some knowledge of 'that'. Older group shows firm knowledge – there is no room for random model.

Observe, that all proportions generally fit a unimodal distribution, suggesting children to be on a continuum of knowledge. If we saw bimodal distributions, it would suggest distinct populations within subjects, such that some children knew exactly what was going on, and the rest failing the task.

### 7.3 Analysis of children performing 'well'

We will define children as "performing well" on 'the' and 'that' when they perform the action by the two actors on the 'same' element of a set of objects 3 or 4 times per condition (i.e. at least 75% 'same' performance). Table 5 shows for each age and the two age groups the proportion of children performing well on 'the' and 'that'. It becomes immediately clear that almost twice as many children are performing better on 'the' than on 'that'. Table 6 shows the number of children who perform well on both 'the' and 'that', well only on 'that', well only on 'the', and poorly on both. The children who are performing well on both 'the' and 'that' tend to be older, while children performing poorly on both tend to be younger. It should be noted that children performing well on 'that' only are well distributed throughout the age ranges, while only 5 children perform better on 'the'.

	3s	4s	5s	6s	7s	8s	9s	10s	Young	Old
<b>The</b>	25%	39%	31%	58%	33%	46%	73%	75%	32%	57%
<b>That</b>	42%	50%	69%	42%	50%	64%	100%	100%	51%	70%

Table 5. Proportion of children performing well by age

Performance type	Number of children	Percentage of total children	Mean age (range)
<b>good on both</b>	36	38.7%	7;2 (3;2-10;2)
<b>good 'that' only</b>	20	21.5%	6;6 (3;9-10;10)
<b>good 'the' only</b>	5	5.4%	5;5 (3;2-6;6)
<b>bad on both</b>	32	34.4%	5;9 (3;3-8;6)

Table 6. Number of children for each performance type

### 7.4 Effect of context size on interpretation of articles

Recall that children were presented with either 3 or 6 elements of a set of identical objects. The ANOVA (above) showed a significant main effect of context, therefore a closer look is warranted. The first clause of instructions established a salient referent, and the second clause asked the child to act on either the same or a different referent. Thus the definite determiner phrases here are endophoric, i.e. the referent is identifiable from immediate linguistic context: if the first clause had 'a balloon', and

second clause had ‘the balloon’, an adult need not consider a physical context set to interpret the referent. At the same time, the phrase may also be interpreted exophorically, meaning the referent is identifiable on extralinguistic grounds or from the specific physical situation of the utterance. Since children are guessing referents due to their inconsistent knowledge of ‘the’, children may show different performance depending on the context set.

The Uniqueness account suggests that children will take either the endophoric unique discourse-determined context set of size one i.e. the established referent, in which case we may see the ‘same’ response. Alternatively, children may take the exophoric situation determined context set of size 3 or 6, depending on the trial, in which case they may respond according to a random model, with probabilities of responses determined by size of that set. Thus the uniqueness account predicts that more same responses will be given for a context size of 3 than context size 6 (see Table 7).

It is difficult to see what the Egocentrism account predicts. It seems that it does not predict a differential or random treatment of articles at all, so context size should not matter. Thus we expect to see little random responses, as children will be focusing on one object, and producing the same performance in both contexts. If kids pick a unique element for themselves, then the context selected is unique, and children may produce more ‘same’ responses than uniqueness account predicts.

We derive the random model of responses for each context size via probability performance levels (Table 7). Chance levels for action on the same object given two presentations for the 3 and for the 6 contexts are given in Table 8. When looking at the ‘visible values’, i.e. one and two responses out of two, it follows that by pure chance, more children are likely to act on the same referent when there are 3 elements of a set in front of them, than when there are 6 elements.

As expected, context size significantly affects performance on the indefinite article for all age groups. The indefinite indeed means ‘any one’ for children, as it does for adults. (Young:  $t(46) = 1.9$ ,  $p = .063$ ; Old:  $t(45) = 2.25$ ,  $p = .029$ ; Overall:  $t(94) = 3.05$ ,  $p = .003$ ).

While context size affects performance in younger children on ‘that’, indicating imperfect knowledge, there is no context influence in the older children, suggesting lack of doubt in referent choice guided by familiarity, and singular choice of context set (Young:  $t(46) = -1.9$ ,  $p = .062$ ; Old:  $t(45) = .256$ ,  $p = .799$ ; Overall:  $t(94) = -1.42$ ,  $p = .158$ ).

Context size significantly affects performance on the definite article for the younger children and overall, suggesting a choice of context set from two possibilities: the entire set of objects or the already-established referent. The older group’s performance is on its way to approaching significance, but clearly the older children have more knowledge of the Uniqueness requirement that leaves no room for doubt. (Young:  $t(46) = 2.65$ ,  $p = .011$ ; Old:  $t(45) = 1.57$ ,  $p = .124$ ; Overall:  $t(94) = 3.01$ ,  $p = .003$ ).

The above analyses show that children are sensitive to context set size, something that is not predicted by Egocentrism, but is expected on the Uniqueness account.

‘SAME’	3-ITEM	6-ITEM
zero	0.44	0.69
one	0.44	0.28
two	0.11	0.03

Table 7. Probability ‘same’ responses: random model for 3 vs 6 object context, given two presentations

	A		That		The	
	6	3	6	3	6	3
Old	27%	43%	75%	74%	61%	72%
Young	23%	35%	50%	62%	36%	56%

Table 8. Percentage ‘same’ responses as a function of context set

## 8. Discussion

### 8.1 General discussion

The results of this study strongly suggest that English-speaking children in an act-out task are able to interpret ‘that’ to refer to an established salient referent better than they can interpret ‘the’. The size of the context facing the children plays a significant role, with children being more likely to pick a previously established referent in a smaller context set, rather than in the bigger context set. This difference in interpretation and in contexts is not predicted by Egocentrism (pragmatic/cognitive deficit), but is predicted by Uniqueness (computational system of language deficit).

If one looks at the overall performance, there is not as big of a difference as one would like, however if one looks at the proportion of children performing well, then about twice as many younger children perform well on ‘that’, than on ‘the’. Younger children’s inconsistent performance may be due to the fact that lacking uniqueness, for ‘the’, children may pick the larger context of all elements, or may pick the smaller context of the established referent. For ‘that’ children may pick up on the familiarity presupposition, and pay closer attention to the salient, old information referent in the context and one that is familiar to both the child (as the listener) and the experimenter (as the speaker).

There may be a more simple explanation for the difference in results, namely that it is easier to auditorially perceive ‘that’ as ‘that’, whereas ‘the’ may be reduced to the same schwa sound as ‘a’ with a whiff of air preceding it, making comprehension harder. While this may be an issue, and something that is addressed by us in follow up experiments, this would not explain the effect of context size on children’s performance, nor explain the difference in performance between ‘a’ and ‘the’ for all ages.

8.2 Determiners and Theory of Mind – independent of each other?!

Let us recall sections 4 and 5 above and try to incorporate theory of mind with semantics. Determiners help listeners pick out referents, and may play key distinguishing roles in interpretations. The semantic definition of ‘the’ tells a person to pick the uniquely salient referent in the context set. ‘That’ on the other hand tells a person that the familiar uniquely salient referent is in the context set located in the information space shared by both the speaker and the listener. Observe that while the definition of ‘that’ explicitly refers to minds other than the listener, ‘the’ only needs a context set –if the context set is not clear, the listener may think about the hearer’s intentions, but that is optional.

Let us illustrate what we mean. Figure 2 shows the path of reasoning involved in 1<sup>st</sup> order vs 2<sup>nd</sup> order standard TOM tasks. For the 1<sup>st</sup> order TOM, the Ignorant person refers to the one who leaves the room and does not witness the Hider moving the object of interest from one place to another. For the 2<sup>nd</sup> order TOM, the Informed person is one who believes that the Knowledgeable person is not aware of the object of interest, although the Knowledgeable person actually is. (e.g. Perner & Wimmer 1985)

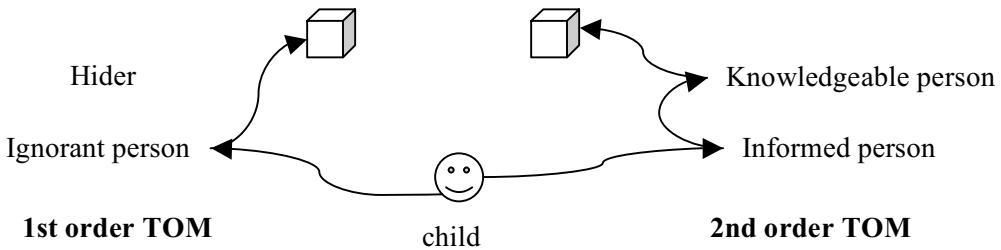


Figure 2. Schematic representation of reasoning involved in Theory of Mind

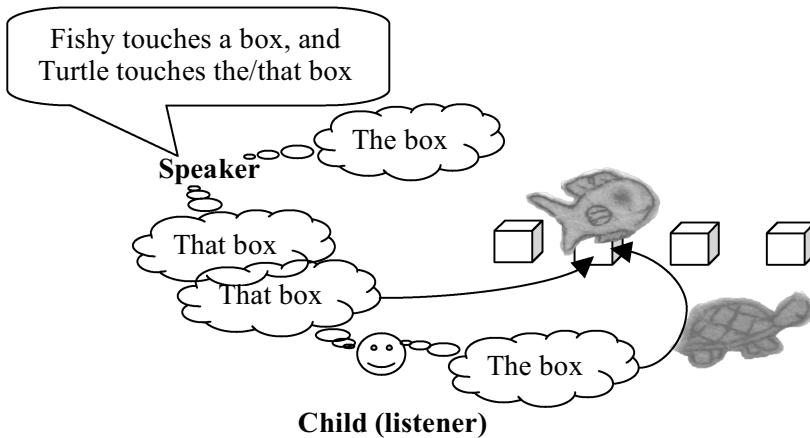


Figure 3. Schematic representation of reasoning in interpretation of determiners

Figure 3 illustrates in the same manner the reasoning involved in interpretation of the definite determiners ‘the’ and ‘that’. It is evident that while understanding ‘that’ involves the speaker and the listener sharing a mental space representing the salient unique referent and interfacing with the context, understanding of ‘the’ depends on the context set. In other words, children do not need to know anything about theory of mind to interpret ‘the’, no false belief is involved, and no necessary consideration of what the speaker has in mind; but children do need awareness of others’ minds for interpretation of ‘that’. Thus if children’s performance on determiners depended on theory of mind, then we would expect, if anything, children to do worse on ‘that’, that requires pragmatics. Yet section 7 makes a clear case that just the reverse is true.

### 8.3 Possible frequency accounts

A brief CHILDES (MacWhinney, 2000) search for adult input to children for determiners revealed an interesting picture. Input to Adam from the Brown corpus was analyzed for parents’ production of ‘the’ and ‘that’. Perhaps children’s mis/interpretations are driven by parental input?

There were 193 instances of ‘that’ as a complementizer (“there’s the truck *that* looks like that”), 258 as a determiner (“I think *that* one is too large...”), and 1025 as a demonstrative pronoun (“is *that* a lady?”), for a total of 1476 tokens. It is unclear how many of the 258 determiner uses are demonstrative with the referent present in the visible context, but these clearly constitute the majority, and the non-demonstrative uses, i.e. ones targeted in the present study, are in the minority.

‘The’ presents quite a different picture, with 3396 tokens. While a detailed analysis of ‘the’ is work in progress, it is likely that most utterances are exophoric, meaning the referent is identifiable on extralinguistic grounds and not by prior context, and definite, whereas the use targeted in the present study is endophoric, with referent being identifiable from immediate linguistic context.

Thus, on average, a child hears the definite determiner ‘the’ 13 times more than the demonstrative determiner ‘that’. While the exact issues remain to be worked out, a purely frequency account for the difference in acquisition of ‘the’ vs ‘that’ does not easily work.<sup>3</sup>

### 8.4 Evidence against maximality, or not

Munn, Miller and Schmitt (2006) argue that children do not in fact have problems with maximality – the plural version of uniqueness, thus arguing that children’s issues with ‘the’ cannot be due to uniqueness. Their experiment presents children with three frogs linearly sitting next to a house. The children are instructed to ‘give me the frog next to the house’, in which the adult response is the frog closest to the house, and to ‘give me the frogs next to the house’ where the adult response is the entire set of three frogs. Two control conditions consisted of the indefinite article ‘a’ or the plural ‘all’. 15 English speaking children of mean age 4;1 (age range 3;0-5;5) and 22 Spanish speaking children of mean age 4;3 (age range 3;2-4;11) do NOT pick the correct frog in the singular definite case (presumably picking a frog not directly next to the house 70% of the time) but DO pick the entire set of frogs in the plural definite case, thus indicating their lack of knowledge of uniqueness and their good knowledge of maximality. This presents a contradiction and leads the authors to conclude that children’s difficulties with ‘the’ are due to issues with picking the correct context and not the uniqueness/maximality presuppositions. Indeed, in both the singular definite and indefinite conditions, the children are more likely to pick the first frog in the line of frogs next to the house, i.e. the frog furthest from the house, and hardly ever picked the middle frog. Although Munn et al have a pretest for verifying knowledge of ‘next to’, it may be that children are not sure as the definition of the preposition. Alternatively, children are treating the entire set of frogs as being ‘next to’ the house, and then randomly selecting a frog, which happens to be the one most easily placed for grabbing, namely

<sup>3</sup> It is also possible that the reason for the observable differences in children’s interpretation are due to both determiners having a number of uses and meanings, but those of ‘that’, e.g. as determiner, demonstrative pronoun and a complementizer, being more mutually exclusive and thus easier to identify, than those of ‘the’ which are all enhancing the precision of reference of a noun phrase and used in singular, plural and generic cases, and thus are harder to mutually distinguish.

the one farthest from the house – presumably grabbing any of the other frogs may result in knocking over some of the other objects, which children may believe is not acceptable.

It is evident from Munn et al that children do not differentiate between ‘a’ and ‘the’ as they produced the same responses in both cases. This finding seems to go against the findings of this paper and a number of others where even the youngest children differentiated between ‘a’ and ‘the’. Also, given the present findings that children are susceptible to the effect of the context size, it would be interesting to see whether choice from six frogs vs choice from three frogs will make any difference.

It should be noted that Munn et al’s result that children correctly pick the maximal set for the plural definite determiner goes against an earlier finding by Karmiloff-Smith (1979) in her experiment 14. Children were presented with two parking lots containing a variety of cars and trucks, with 3 or 4 objects of type, e.g. closed cars, per lot. 4 and 5 year old children were shown to violate Maximality by picking the entire set upon hearing “the [optional adjective] cars” at an average rate of 20% and 50% respectively. Thus a bigger context size may indeed play a critical role in children’s performance.

We may also be picking up on a bigger issue<sup>4</sup> of the ambiguity of the definite noun phrases between kind readings and object readings (in Krifka 2004) where the former refers to the generic kind (e.g. the potato is cultivated in South America, meaning the species of potato) and the latter refers to a specific entity (e.g. the potato rolled out of a bag). Consider the following example that is closer to home. Imagine Mary is standing next to a shelf with many books, and is about to touch/take three of them. While “Mary is touching the books” is felicitous in this case, “Mary is taking down the books” is not, indicating an intricate relationship between a given predicate and the determiner. Perhaps the results of Munn et al are due to their using ‘give’, a predicate necessitating maximality. Clearly further studies of interaction between different predicates with determiners in the same children are necessary.

### *8.5 Predictions for further studies in populations with neurodevelopmental disorders*

The basic idea is that the Egocentrism account predicts there to be a correlation between a person’s theory of mind capabilities and their knowledge of definite determiners. The Uniqueness account on the other hand predicts that knowledge of the definite determiner may pattern alongside knowledge of other aspects of the computational system of language, thus predicting a correlation between, e.g., syntactic knowledge and knowledge of determiners. Alternatively, uniqueness predicts there to not be a correlation between TOM and determiner usage. There are a number of populations where these predictions can be tested, and these indeed are currently being investigated by us.

These are children with neurodevelopmental disorders, such as autism, Asperger syndrome (AS) and Specific Language Impairment (SLI), where we see a dissociation between linguistic abilities and theory of mind. Children with SLI show deficits specific to language, and have good TOM knowledge, at least on first order tasks, while children with autism show poor TOM and have variable language abilities (Colle, Baron-Cohen, Hill, 2006). Children with AS on the other hand, have no grammatical nor TOM impairments, yet have difficulties with pragmatic uses of language, e.g. interpretation of metaphors, or social situations, e.g. faux pas (Baron-Cohen et al 1999). Thus the Egocentrism view would predict that AS and autism will have difficulties with ‘the’, yet SLI would not; Uniqueness on the other hand predicts that AS would not have difficulties with determiners, SLI probably would, as would people with autism if they have grammatical deficits. Studies of determiners in people with neurodevelopmental disorders will further elucidate the true nature of typical children’s misinterpretation of the definite determiner.

## **9. Conclusions**

This study presents evidence that children are more likely to consider an established referent as salient when it is referred to with ‘that’ than with ‘the’, hence are more likely to make two puppet actors affect the same object. Difference in performance between ‘that’ and ‘the’ suggests that children are able to successfully use the familiarity presupposition in ‘that’, but are less able to use the

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<sup>4</sup> Many thanks to Kai von Fintel for suggesting this idea.

uniqueness presupposition in ‘the’. Such difference is not predicted on the Egocentrism account, so the present results argue against Egocentrism as an account for children’s acquisition of the definite determiner. Thus the study fails to disprove Wexler’s Uniqueness analysis.

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