Children's ability to use speaker certainty in learning novel words

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One of the cues that children might use in learning words is the level of certainty that speakers demonstrate in their naming of a novel object. This study presented 52 4–5 year old Dutch children with a word-learning task in which two puppets each used the same label for a different novel object. In three conditions, puppets expressed their level of speaker certainty lexically (e.g. *'I know this is a mit'* vs. *'I think this is a mit'),* they used discourse means to convey certainty (e.g. *'I play with this a lot. Yes, a mit',* vs. *'I've never played with this. Well, a mit'*) or they combined the two. In all conditions, children were more likely to pick the object referred to by the more certain puppet as the referent of the new word, demonstrating that speaker certainty is a relevant cue in the word learning process.

Keywords: word learning strategies, speaker certainty, Theory of Mind

1. Introduction

1.1 The role of the interlocutor in word learning

Children acquire word meanings at a remarkable speed. How exactly children might be capable of this feat has been the topic of a good deal of literature. Much of previous work has focused on word learning strategies concerning the possible referents of words (e.g. constraints suggested by Markman 1994), although it is clear that children also need to focus on what the person labeling the objects might intend to pick out in the environment. Therefore, some of children's strategies in word learning might concern their interlocutor. One potentially relevant factor might be the reliability of the information source, as object labeling is not necessarily always accurate: A speaker might make a mistake or be unsure about a label (cf. Sabbagh & Baldwin 2001; Birch, Vauthier & Bloom 2008). To prevent the learning of incorrect word labels, the child then faces the task of determining

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who is a reliable source of information and who is not. Several studies have shown that children are better at learning from a source that was previously reliable than from a source that was unreliable and that they are more likely to trust the novel object labels of a speaker who previously labeled objects accurately than from a speaker who was inaccurate (cf. Birch et al. 2008; Scofield & Behrend 2008; Ganea, Koenig & Millett 2011). Most of the studies in this field have used experimental paradigms involving a reliable and an unreliable speaker, but Sabbagh & Baldwin (2001) considered differences in speaker reliability from one time to another (as the same speaker might be knowledgeable about one label but ignorant about another). Sabbagh & Baldwin (2001) thus conducted an experiment in which a single speaker was knowledgeable about the referent of the word in one condition, but ignorant in another. In the knowledgeable condition, the speaker said: "You know, I'd like to help my friend Birdie, and I know just which one's her blicket. It's this one." In the ignorant condition, however, the speaker said: "You know, I'd like to help my friend Birdie, but I don't know what a blicket is. Hmmm. Maybe, it's this one." (Sabbagh & Baldwin 2001: 1057). They found that children were more inclined to accept the novel word-object pairing when the speaker was knowledgeable. As taking into account the level of knowledge of a speaker may prevent children from making word learning errors, this focus on the interlocutor would seem to be a useful learning strategy.

1.2 Speaker certainty in a word learning context

Beliefs can be held with different levels of certainty, which a speaker can express using mental state verbs like *know* and *think.* As such, speakers have various linguistic means available to them to express their level of certainty. To understand these linguistic encodings of speaker certainty, a child must not only understand that another person can have different beliefs to her own, but also that these beliefs can be held with different levels of certainty (Moore, Pure & Furrow 1990). Understanding the difference between words like *know* and *think* is quite hard for children. These mental state verbs are generally not used before the end of the child's third year, and, even then, they are not well distinguished from one another in comprehension (Papafragou, Cassidy & Gleitman 2007). Around the age of four, however, children start to understand the differences between mental state verbs like *know* and *think*, as demonstrated in an experiment by Moore et al. (1990). In this experiment, children had to find a sweet which was hidden in either a blue box or a red box. To find it, the children had to listen to two puppets who used the words *know* and *think* in their directions to the child. For example, one puppet would say: "I think the sweet is in the blue box", whereas the other puppet would say: "I know the sweet is in the red box". The children were then asked to

find the sweet. If they fully understood the difference between *know* and *think*, they would look in the red box, as the puppet whose directions led to the red box was certain, whereas the other puppet was not. Moore et al. (1990) found that there were significant improvements in the performance on this task between the ages of three and four (coinciding with the development of Theory of Mind (ToM), the ability to understand that other people's beliefs may differ from your own), suggesting that this is when children develop an understanding of *know* and *think* and appreciate the differences in speaker certainty that they encode.

Previous research thus suggests that 4 year old children are not only capable of understanding speaker certainty, but that they can also use it to decide where to look for a hidden object (cf. also De Mulder 2011). As mentioned above, Sabbagh & Baldwin (2001) showed that children are also more likely to learn a word from a knowledgeable speaker than from an ignorant one. The present study aimed to investigate whether children will learn words from a certain speaker rather than from an uncertain speaker in a situation in which there is a direct contrast of speaker certainty. Since a speaker can show his certainty towards what he says in many different ways, a second aim was to investigate whether the way in which speaker certainty is conveyed would matter. In the current study, speaker certainty was manipulated both at the lexical level (using the mental state verbs *know* and *think*), but also at the discourse level. Imagine someone saying: "My keys are in my bag. I just put them there" and compare this with a doubtful "Mm… my keys are in my bag..". Clearly, there is a difference in certainty between these expressions, even though this certainty is not expressed using mental state verbs here. To assess to what extent this different encoding of speaker certainty influences children's word learning, three different conditions were compared: Speaker certainty was either conveyed using mental state verbs, through discourse or by a combination of the two. The procedure of the experiment was as follows: A child was presented with two puppets. Each puppet had an object in front of him, which the child had never seen before (they were made especially for the experiment). In one condition, Puppet A said: "I know this is a *mit*" and pointed to the object in front of him. Puppet B then said: "I think this is a *mit*" and pointed to the other object, the one that was in front of him. Two objects were thus labelled *mit*, but, whereas puppet A was certain about his naming, puppet B demonstrated uncertainty. The child was then asked to point at the *mit*. If she understands the difference in speaker certainty the puppets conveyed by using a particular mental state verb, the child should point to the object of puppet A, since he was the puppet that was certain about what he said. The other two conditions had a very similar set-up, but the ways of expressing speaker certainty differed somewhat (see Section 2.2).

The experimental paradigm used in the current study is thus very similar to earlier studies (cf. Moore et al. 1990; Birch et al. 2008; Scofield & Behrend 2008;

Ganea et al. 2011), however, the particular research question we aim to address (whether speaker certainty and the specific way in which it is conveyed plays a role in children's ability to learn new words), has not been addressed before. The results of this study should thus shed light on the extent to which speaker certainty (and the particular way in which it is encoded) has an effect on children's word learning.

2. Method

2.1 Participants

52 Dutch 4 and 5 year old children (range: 4;1–6;0) from one elementary school in the Netherlands participated in the experiment. Each child was assigned to one condition (see Table 1).

Table 1. Participants per condition

	N	Mean age	4 year olds (n)	5 year olds[a] (n)
Mental state verbs	18	5;1	7	11
Discourse	18	5;0	8	10
Combination	16	5;1	5	11

[a]One of the 5 year olds in the discourse condition was 6;0

Children started with two practice items in which two puppets named objects that the children knew (e.g. "This is a bike") with one of the puppets pointing to a bike and the other pointing to another object (one puppet was right on the first practice item, the other was right on the second practice item). The child was then asked to point to the bike. One 4 year old was not able to do this and was thus excluded (leaving 16 children in the combination condition).

2.2 Procedure

The children were tested individually in a separate room in their school. Each session lasted about twenty minutes and included the word learning task, a Theory of Mind task and a measure of general receptive vocabulary (described in the following sections). Two adults were present throughout: The experimenter and an assistant. Two different testing orders were administered to reduce unwanted order effects. After the testing, children were rewarded with a small toy.

Children were told that the puppets would name unfamiliar objects and that they had to listen carefully, because they would not have seen the objects before.

Each puppet had one novel object in front of him and gave it a label (a nonsense word, see the appendix for the stimuli). Each child received one of the three conditions (mental state verb, discourse or a combination). In the mental state verb condition, children were given the task portrayed in Figure 1:

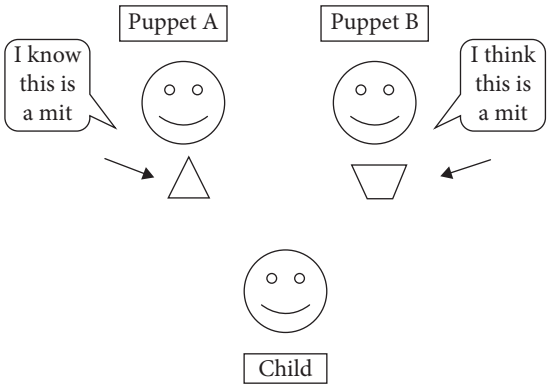

Figure 1. Procedure
Puppet 1: "I know this is a *mit*." *Points at the object in front of him.*
Puppet 2: "I think this is a *mit*." *Points at the object in front of him.*

The child was then asked to point at 'the *mit*'. In order to be successful, the child had to pick the object of the puppet that used the word *know*, because this was the puppet that had demonstrated a higher level of speaker certainty in his naming of the object.

In the discourse condition, speaker certainty was expressed through discourse in which the puppets talked about their familiarity with the object (no mental state verbs were used). The puppet that was very certain would thus tell the child: "I have seen this before. Look, this is how you pick it up (*picking up the object in front of him*). I have played with this a lot, because I have it at home, too. Yes, a *mit*." Following this, the uncertain puppet would tell the child that he had never seen the object in front of him before, did not know how to pick it up, and had never played with it, concluding with "Well… a *mit*". (There was no manipulation of intonation except for the natural differences in intonation that come with the expressions 'yes' and 'well…'.)

In the third, "combination"-condition, both discourse and mental state verbs were used. The procedure was almost identical to the second condition. The puppets first talked about their familiarity with the object. However, instead of concluding "Yes, a *mit*." or "Well… a *mit*", they concluded "I know this is a *mit*" or "I think this is a *mit*." In this condition, the puppets thus expressed their certainty in discourse as well as through mental state verbs.

Each child was given eight trials of this task (for an 8 point maximum score). The order in which the puppets spoke was varied, so that each puppet came first half of the time and last half of the time. Whether the first puppet who spoke was the certain or uncertain puppet was also counterbalanced so that test order would not influence the results. To make sure that the children were not just choosing the object that they liked the most, each child was asked to pick her favourite object out of every pair of novel objects. Since there was only one child for whom, in every trial, the object she chose was the same as the object that was her favourite, it was assumed that this was not a general tendency and that this case was likely to be a coincidence (analysing the results with the data from this child excluded did not change the findings). There was no pair of objects for which all children picked the same object as their favourite.

2.2.1 *Measuring Theory of Mind*

Aside from the word learning task, every child was also given a Theory of Mind test in order to determine whether the two tasks might be correlated. To measure Theory of Mind, a false belief task (Baron-Cohen, Leslie & Frith 1985) was conducted in which a story character initially places a marble in one container which is then moved to another container in the story character's absence. Two different versions of this task were conducted in which the child was asked two test questions that assessed her understanding of the story character's false belief regarding the location of the marble ("Where will the story character look for the marble?" followed by "Why will he look there?"). For each correct answer they received one point, so they could score a total of 4 points (2 questions x 2 trials). The explanations were judged to be correct if the response included something about the original location of the marble ("first it was in the box") or about the story character's belief about the marble ("he thinks it is in the box"). The children were also asked two control questions to make sure they had been paying attention and had remembered what had happened ("Where is the marble really?" and "Where was the marble first?"). All children answered these control questions correctly.

2.2.2 *Measuring vocabulary*

Receptive vocabulary was measured using the Peabody Picture Vocabulary Test III (Schlichting 2005). This task was a control task to make sure the child had no general vocabulary difficulties.

3. Results

3.1 Descriptive statistics

Table 2 shows the means, standard deviations and ranges of the tests.[1] It should be noted that the mean of the Theory of Mind test is only 2.13 with a high standard deviation (only half of the children passed this test).

Table 3 shows the mean results per condition.

Table 2. Overall means, standard deviations and ranges

	Mean	Standard deviation	Range
Age in months	61.08	6.46	49–72
PPVT-R	71.56	14.76	20–98
Theory of Mind	2.13	1.88	0–4 max = 4
Word learning	5.02	1.60	2–8 max = 8

Note: PPVT-R: Peabody Picture Vocabulary Test Raw score.

Table 3. Descriptives per condition

	Age (months)	Theory of Mind	Word Learning	PPVT-R
Mental state verbs	61.11	1.72	4.72	66.78
Discourse	60.44	2.44	4.72	72.39
Combination	61.75	2.25	5.69	76.00

Note: PPVTR: Peabody Picture Vocabulary Test Raw score.

3.2 Correlations

To find out if the performances on the different tests were correlated with each other and with the age of the child, correlations between these variables were investigated. Table 4 shows all the bivariate Pearson correlations.

Table 4. Correlations

	Age	PPVT-R	Theory of Mind
PPVT-R	.486**		
Theory of Mind	.368**	.268	
Word learning	.316*	.286*	.162
Mental state verb	.279	.294	.242
Discourse	.213	.063	.054
Combination	.435	.398	.181

Note * p<.05; ** p<.01

Table 4 shows significant positive correlations with age for all tests, that is, children get better across the board as they grow older. For the conditions of the word learning task separately no correlation was found, but this could be due to the small number of participants per condition (18, 18 and 16 respectively).

The word learning task also correlates weakly (r = .286) with the PPVT raw score, suggesting that current vocabulary is connected to the ability to learn new words. Again, no correlation with the conditions separately was found.

Remarkably, no correlation was found between Theory of Mind and performance on the word learning task. This is unexpected, as it was assumed that understanding speaker certainty (which is tested in the word learning task) is closely connected to understanding someone else's beliefs (which is tested in the ToM task). We will look into the relation between ToM and word learning in a bit more detail in Section 3.3.2.

3.3 Analyses

The goal of this study was to investigate whether children are able to use speaker certainty to learn new words. To see if children are capable of doing this, we need to know if they scored above chance level (i.e. a score higher than 4 out of 8) in the word learning task. As shown in Table 1, the mean in the word learning task was 5.02 (with results from all three conditions combined). A one sample t-test showed that this was significantly above chance level ($p<.001$). In the three conditions separately (means 4.72 for the mental verb condition, 4.72 for the discourse condition and 5.69 for the combined condition), the children also scored significantly above chance level ($p=.023$, $p=.044$ and $p<.001$ respectively), suggesting that 4 and 5 year old children are indeed capable of using speaker certainty in word learning. When the performance of 4 year olds (n = 20) and 5 year olds (n = 32) is considered separately, analyses show that both 4 year olds (mean score = 4.40) and 5 year olds (mean score = 5.41) score significantly above chance level ($p=.028$ and $p<.001$ respectively) and that the 5 year olds perform significantly better than the 4 year olds ($p<.001$). This finding thus suggests that the ability to use speaker certainty in word learning is still developing in the 4 year olds, however, due to the small sample size, differences between the 4 and 5 year olds are not investigated further in the additional analyses reported in the following sections.

3.3.1 *Means of expressing speaker certainty*

The second research question was whether children would perform differently according to how speaker certainty is conveyed (via mental state verbs, discourse or a combination). A one-way ANOVA analysis was used to investigate whether the children performed significantly differently in these three groups. It turned out

that there was no significant difference at the p <.05 level between the conditions ($F_{(2, 49)}$= 2.10, p=.13). These results suggest that the way in which speaker certainty is expressed does not influence 4 and 5 year old children's performance on the word learning task.

3.3.2 *ToM and word learning*

In Section 3.2 we showed that no correlation was found between ToM and word learning. To look into this relation in a bit more detail, the ToM score was also coded as pass/fail (with children with a score below 3 considered as failers (n = 26) and children with scores of 3 or higher considered passers (n = 26)). Analysis with this binary ToM division demonstrated that although ToM passers scored higher on the word learning task than failers (5.31 vs. 4.73), there was no statistically significant difference between the two groups.

4. Conclusion and discussion

Speaker certainty is the amount of certainty a speaker has towards the proposition he utters; he can be certain about it (know it) or uncertain (think it). Children begin to understand this speaker certainty at around the age of four, the same time at which they develop a Theory of Mind. This study investigated whether speaker certainty could be used as a strategy in the learning of new words. Other studies have already shown that children of 4 years old are able to use speaker certainty in an object finding task (Moore et al. 1990; De Mulder 2011) and that children are more willing to learn words from reliable rather than unreliable sources (Birch et al. 2008) and from knowledgeable rather than ignorant speakers (Sabbagh & Baldwin 2001). The present study combined these findings to formulate a new question: Are children more likely to learn a word from a certain speaker than from an uncertain speaker in a situation in which there is a direct contrast of speaker certainty? To answer this question, an experiment was conducted in which children had to follow the directions of a certain and an uncertain puppet to decide to which object a new word might refer. The results of this study showed that 4 and 5 year old children are indeed capable of doing this, as they scored significantly above chance level in their tendency to follow the certain puppet. Although the 5 year olds did not yet score at ceiling (with a score of 5.41 out of 8), they did score significantly higher than the 4 year olds suggesting that the ability to take into account speaker certainty in word learning is still developing in the age range tested in this study.

This study has thus shown that children also actively use strategies concerning their interlocutor (i.e. speaker certainty) to learn new words. This outcome

confirms the crucial role of the interlocutor in the child's learning of words. It also shows how children might prevent themselves from learning incorrect word labels: By focussing on certain instead of uncertain speakers, the chance of incorrectly mapping a novel label onto an object is significantly reduced.

However, one potential limitation of this study should be noted. Although we think that by pointing out a particular object in response to our request to "find the *mit*", children demonstrated that they associated that label with a particular novel object (and thus had learnt a new word in the sense that they had made a novel word-object pairing), it is not clear from this study to what extent children maintained the novel word/object association over time and thus whether they had truly learnt novel words in the course of the experiment. In future research, we aim to address this issue by assessing whether this kind of word-object link is still present after a time delay.

The second research question was about the different ways in which speaker certainty can be expressed. Do children perform differently depending on whether speaker certainty is conveyed via mental state verbs or through discourse? To answer this question, three conditions of the experiment were compared: One in which speaker certainty was expressed lexically through mental state verbs, one in which it was expressed through discourse, and one in which the two were combined. There were no significant differences in performance on the word learning task between these conditions. This means that children can use speaker certainty in learning words, regardless of how this certainty is conveyed exactly. It is enough for children when they get the impression of certainty, it does not have to be explicitly lexicalized as such.

One question still remains unanswered, however, as, unexpectedly, performance on the false belief task and the word learning task was not correlated. One explanation for this finding might be relatively simple: The fact that the ToM task only had a limited scale of 4 points may not have been enough for a meaningful correlation to show up. However, it may also be the case that children's understanding of speaker certainty is to some extent distinct from their understanding of false beliefs. In order to perform well on the word learning task employed in this study, children needed to understand that speakers can vary in the level of certainty with which they hold a certain belief and that this difference in certainty had a direct impact on how seriously their act of naming an object should be taken. False belief tasks, on the other hand, do not require children to understand differences in the strength of a particular belief (the story character in the false belief task has no reason to question her belief and thus has no reason to be uncertain about where to look for the object). Instead, they focus on children's understanding of people's behaviour given incorrect (as opposed to uncertain) beliefs about the world. Given the fact that this study did not find a correlation between these two

domains, it may be the case that the false belief task and the word learning task are tapping into different aspects of the child's cognitive development: Understanding of false beliefs and speaker certainty.

By showing that children are more likely to learn words from a certain speaker than from an uncertain speaker, this study confirms the crucial role of the interlocutor in the word learning process of a child. It shows that children do not only use cognitive abilities in establishing label-object links, but also social abilities: By considering the certainty of their interlocutor, the child prevents false label learning from occurring. Another relevant contribution of the study is that it has compared different ways of expressing speaker certainty, and found that children were equally capable of making use of different linguistic encodings of speaker certainty. In future research, we aim to extend these findings and investigate how important speaker certainty really is in the word learning process. For instance, if we cross speaker certainty with speaker likeability (e.g. a likeable uncertain speaker and a disliked certain speaker give different objects the same novel label) will children then only consider the speaker's certainty level in their mapping of a novel word to an object or will the affective value of the speaker also play a role? In this way, then, our current study not only demonstrates the importance of speaker certainty in word learning, but also paves the way for further investigation into what exactly is behind children's ability to learn novel words at such a remarkably high speed.

Note

1. In the analyses only the raw vocabulary score is taken into account, as using the standardized score would entail that age would be taken into account twice (it is already taken into account in determining the standardized score).

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Appendix

All stimuli are possible but non-existent monosyllabic words in Dutch:
mit
vlaar
kloef
glap
daks
guik
wop
hast

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