# Using speaker certainty in word learning

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**Abstract**

To learn the meanings of words, children need to use strategies. Some of these strategies may not concern the possible referents of the word, but the person uttering the word to them. This study proposed a possible strategy: the use of speaker certainty. Speaker certainty is the amount of certainty someone has towards the proposition he is uttering (does he know it is true or just think it is true?). It has already been shown that 4 year old children are able to use speaker certainty in tasks where they have to use directions to find a hidden sticker (Moore et al., 1990, De Mulder, 2011). It also has been shown that children are able to use Theory of Mind in word learning (Happé & Loth, 2002). The present study combines these two facts to investigate a new question: are children able to use speaker certainty in word learning? An experiment in which puppets labeled an unknown object with more or less certainty showed that 4 and 5 year old children performed significantly above chance level in picking the more certain one, and thereby learning a new word. The study also investigated which manners of expressing speaker certainty in language children can use to learn new words. This was done by comparing conditions in which speaker certainty was expressed in different manners (through mental state verbs, in discourse, and in by combining the two). The results showed that there were no significant differences between the conditions, so there are several ways of expressing certainty that children can understand, and use to learn new words .

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## 1. Introduction

### *1.1 The acquisition of words*

How do children acquire language? While adults usually have a hard time learning a foreign language, children are able to acquire the complex system of language at a remarkable speed. The gap between children's knowledge of language and their little experience with it, is not yet fully understood, and is referred to as "the projection problem" or "the logical problem of language acquisition". This problem was first posed (in this form) by Noam Chomsky (Fromkin, V.A., Curtiss, S., Hayes, B.P., Hyams, N., Keating, P.A., Koopman, H., Munro, P., Sportiche, D., Stabler, E.P., Steriade, D., Stowel, T., Szabolcsi, A., 2000). He also suggested a solution to it: the a priori existence of "Universal Grammar". Universal Grammar is innate to all humans, consisting of language universals that allow us to acquire the grammar of any human language (Fromkin et al., 2000). While linguists are still debating about the existence of Universal Grammar, it is still not clear how a child's knowledge of word and sentence meaning could be explained.

Word meanings are conventional. That means that there is no natural connection between a word's meaning and its form, and that this connection is merely a convention (Brillenburg Wurth & Rigney, 2006). Word meanings can therefore not be innate. Still, like grammar, words are acquired at a remarkable speed. By the age of six, children have acquired 9.000 – 14.000 words (Markman, 1994). But if word meanings are not innate, how do children know which sound to connect to which meaning? The philosopher Quine pointed out an important problem in the learning of words. He calls this the "Gavagai problem" (Quine, 1960 in: ). This problem is actually about the problems of translating (how do you know how to translate a word exactly), but accounts for language acquisition as well (how do you know what a word's meaning is exactly)?

The "Gavagai problem" works as follows: imagine you go to a foreign country, where people speak a foreign language you know nothing about. You meet a native speaker and, when a white rabbit passes by, this speaker says "Gavagai". You will probably assume that this sound, "gavagai", is a word and means something like "rabbit". However, you cannot know

for sure. “Gavagai” could also refer to many other things, for example to “animal” or “white”. Of course, it could be the case that at the next moment, a grey rabbit passes by and the native speaker repeats “gavagai”. The possible meaning “white” is then ruled out. Still, there remain many possible meanings (like animal, rodent, rabbit) . This “Gavagai-problem” is also found in the language acquisition of a child. How does a child know that when its mother points to a picture of a cow, saying “cow”, she means cow? Why not, for instance, “animal”, “black-and-white”, “eating grass”, etc.? Quine (1960) has pointed out that it would be impossible, even for an adult, to rule out all possible meanings of a word they hear.

To still be able to learn so many words so fast, children would need strategies and principles to help them pick the right meaning for a word. Linguists have tried to find out what kind of strategies these could be. Clark (1987), for example, proposed “the principle of lexical contrast”, which states that every two words contrast in meaning. An implication of this, is that a word can only have one referent or meaning, and a certain meaning has only one word belonging to it. If children indeed used this principle, they would map the meaning of a word they have never heard before to an object they do not know, rather than to an object they do know – because this last object already has a label. Of course, this can lead to some problems. In the Gavagai problem, we saw that multiple words in fact can refer to one referent – “white”, “animal”, or “rabbit” are all possible words to somehow refer to this rabbit - so the principle of lexical contrast is not entirely correct. However, it can still be a useful assumption to make when learning a new word, since in most cases, it will work. Imagine a child that sees a picture of a dog and a cat. He already knows what a dog is and that it is called “dog”, but he has never seen a cat before and never heard the word before. When his mother says “cat”, the child will probably assume that this is the label of the animal he does not know yet – since the dog is already called “dog”. This is an example in which the principle of lexical contrast can help to decide which meaning belongs to a word. Related to this is the “mutual exclusivity assumption”, which states that every object only has one label (Markman, 1994). Other strategies for mapping meanings to words have also been proposed, for example the “whole object assumption”, which states that “a novel label is likely to refer to a whole object and not to its parts” (Markman, 1994 : 155).

However, it is possible that children, in word learning, do not only make assumptions about the objects that are referred to, but also assumptions about the person that is saying the words to them. More precisely, assumptions about the *beliefs* that this person (the speaker) has. Davidson (1974) pointed out that meaning and beliefs are closely connected. Belief, in this case, does not mean faith, but beliefs about the world. Such beliefs are attitudes towards a proposition.

A proposition is the content of a declarative sentence, like "the grass is green" or "it will rain". You can have certain attitudes towards this proposition: the proposition can be known, thought, believed, guessed, assumed, etcetera. A belief can thus be something like "knowing that the grass is green" or "assuming it will rain".

What is, then, the relation between the beliefs of a speaker and the meaning of a word, and in what way can children use these beliefs to learn new words? To understand this, we need to take a little detour and first explain something about Theory of Mind.

*1.2 Theory of Mind*

Young children are mostly unaware of the fact that other people can have beliefs that differ from their own. Not until around the age of four do they start to become aware of the fact that other people's feelings and thoughts can differ from their owns. At this time they also begin to understand that someone else's beliefs may in fact be false beliefs (beliefs that are not consistent with the state of affairs in the world). This can be shown in a typical false belief task. This was conducted by Wimmer & Perner (1983) for the first time. A well-known version of the false belief task is the "Sally-Anne task". This was first conducted by Baron-Cohen, Leslie, A.M. and Frith, U. (1985).

In the Sally-Anne task, children are presented with a story involving two characters (Sally and Anne). There are also a bag and a box. Sally has a marble and she puts the marble in the bag. Then Sally leaves for a walk. While Sally is gone, Anne takes the marble out of the bag and puts it into the box. Sally returns and the child is asked where Sally will look for the marble. The right answer here is "the bag", because Sally cannot know that Anne has moved the marble. She was not there to see it, but the child was, and therefore has a different mental

representation of the situation than Sally does. Sally must still think that the marble is in the bag, even though it is in fact in the box. However, children younger than four years often answer "the box", when they are asked where Sally will look for the marble. They know the marble is in the box, and do not understand that another person (in this case Sally) has a different mental representation of the situation. However, when children grow older and develop further, they begin to answer "the bag" to the question (which is the right answer). When they give the right answer, they understand that Sally has a different belief than they have. And when children understand that other people have their own minds with their own feelings, thoughts and beliefs (beliefs that may be either true or false, and may differ from those of the child), they are said to have a "Theory of Mind".

Having a Theory of Mind (ToM) thus means being able to understand that other people's beliefs may differ from your own. The question is now: how is this connected to language, and to learning the meaning of words?

*1.3 Mental state verbs and speaker certainty*

When a child is about four, he starts to understand that other persons may have false beliefs. However, beliefs may not only be completely wrong or completely right. They can also be held with different amounts of certainty. A person can be very sure about something, or very unsure, and everything in between. Someone can "know" his key is in his bag, or only "think" his key is in his bag. These are the beliefs, the attitudes towards a proposition, that were mentioned before. As one can see, there are differences in the amount of certainty the "believer" can have. For example when he "knows", he is certain, when he "thinks", he is not certain.

Words like "know" and "think" are called mental state verbs. These are verbs that express a mental state (an attitude towards a belief, like "know", "think", "guess", "assume", etc.). This is where we can see the connection between beliefs and language. Words like "know" and "think" are words (and therefore linguistic ways) to express beliefs. So to understand these mental state verbs, a child must not only understand that another person can have different

beliefs than he does, but also that these beliefs can be held with different degrees of certainty (Moore, C., Pure, K & Furrow, D., 1990).

Words like "know" and "think" are quite hard to learn for children. Most of the time, these words are not used before the end of a child's third year, and until a child is four, the words are not well distinguished from one another in comprehension (Papafragou, A., Cassidy, K & Gleitman, L.R., 2007). Moore et al. (1990) also found that children start to understand the differences between mental state verbs like "know" and "think" at around the age of four (so approximately at the same time they develop a Theory of Mind). They conducted an experiment in which the children had to find a hidden candy, which was hidden in either a blue box or a red box. To find the candy, the children had to use directions that were given by puppets. The puppets would use the words "know" and "think" to guide the child. For example, a puppet would say: "I think it is in the blue box", and the other one: "I know the it is in the red box". The children were then asked to find the candy. If they fully understood the difference between "know" and "think", they would look in the red box. This is because the puppet whose directions led to the red box was sure, and the other puppet was not. Moore et al. (1990) found that four year old children were capable of doing this. In fact, there were significant improvements between the ages of three and four, which suggests that children develop understanding of "know" and "think" between these ages. Moore et al. (1990) also investigated the children's understanding of the word "guess" and it turned out that 4 year old children could did not understand the difference between "think" and "guess".

The difference between "know" and "think", is, as said earlier, a difference in certainty. If you "know" something you are sure, and if you "think" something, you are not entirely sure. The amount of certainty one has about something, will from now on be called "speaker certainty" (because a person (speaker) says something about how sure (certain) he is). Moore et al. (1990) thus found that children understood differences in speaker certainty conveyed lexically by the age of four.

Moore et al. (1990) also showed that the results in this hidden candy task had a strong correlation with the results of some Theory of Mind false belief tasks they conducted. Before interpreting their results, they wanted to make sure that the results in the hidden candy tasks really said something about speaker certainty, and not about a lexical difference between "know" and "think". To do this, they also conducted hidden candy task with some other linguistic expressions of certainty: modal terms like "must"/"may"/"could" and "probably"/"possibly"/"maybe". The puppets would then say for example: "It must be in the red box" or "Maybe it is in the blue box." The results of this study resembled the results from the study with mental state verbs, and had correlations with the ToM false belief tasks as well. Speaker certainty seems thus to be strongly connected to Theory of Mind. Since speaker certainty is, like Theory of Mind, about understanding someone else's beliefs, this is no surprise.

*1.4 Using speaker certainty in a word learning context*

We now know that children develop a Theory of Mind at the age of four and that they are able to understand lexically conveyed speaker certainty at the age of four. The ability of children to acquire thousands of new words at a remarkable speed was mentioned earlier. It was suggested that the strategies children use, could not only be strategies about the referents of the new words (like the lexical contrast principle and the whole object assumption), but also strategies concerning the speaker that utters the new words. More precisely, about the amount of certainty a speaker has: the speaker certainty.

It has already been shown that children are capable of understanding speaker certainty at the age of four. In fact, they can even use this speaker certainty, to decide where to look for a hidden sticker (Moore et al., 1990, De Mulder, 2011). It may well be the case that this speaker certainty can also be used to decide other things. For instance, to decide what the meaning of a word is. This idea is not completely new. Happé & Loth (2002) suggested ToM could be used to learn new words. They showed that children were able to track a speaker's intentions, which would help them to learn a new word. They conducted an experiment in which they put false belief tasks into a word learning context. The task they conducted was much like a Sally-Anne task. The scenario Happé & Loth (2002) used is shown below:

*True belief scenario*

Puppet X puts object A in a box. Puppet X leaves the scene. Puppet Y enters with object B. Puppet X returns. Puppet Y takes object A out of the box and puts object B into the box. Puppet X names the contents: "Do you want to see the modi? There is a modi in this box! Let's see the modi!"

*False belief scenario*

Puppet X puts object A in a box. Puppet X leaves the scene. Puppet Y enters with object B. Puppet Y takes object A out of the box and puts object B into the box. Puppet X returns and names the contents: "Do you want to see the modi? There is a modi in this box! Let's see the modi!"

The child either sees the true belief scenario (in which puppet X returns, therefore sees what happens, and has a true belief about the contents of the box) or the false belief scenario (in which puppet X does not return, does not see what happens and thus has a false belief about the contents of the box) At the end of the scenario, the child is asked to point to "the modi". He has to choose between object A and object B. In the true belief condition, "modi" refers to object B, because puppet X knows that object B is in the box. In the false belief condition, however, "modi" refers to object A, because puppet X believes object A is still in the box. The child knows better than this, since it has seen that now object B is in the box. However, if it has a Theory of Mind, the child will understand that puppet X has a false belief, and it will choose object A as the modi. This experiment is a word learning task, because children were asked to match a new label with a new object. In this example, they learn the word "modi"

It turns out that the understanding of beliefs – which is related to Theory of Mind - can be used to learn new words. In fact, Happé & Loth (2002) showed that children scored significantly better on this word learning task than on false belief tasks in which no new word was learned (like in the ordinary Sally-Anne task). They suggested that word learning context is a privileged context for Theory of Mind, which means that children are able to pass Theory of Mind tasks which help them to learn new words earlier than Theory of Mind tasks which do not help them to learn new words.

We have now seen that children can use speaker certainty (to find an object, see Moore et al. (1990) and De Mulder (2011)) and that children can use their understanding of false beliefs – thus Theory of Mind - to learn new words.
Since speaker certainty is closely connected to ToM, we can combine these two results and ask the question: are children able to use speaker certainty to learn new words?
With this study, I want to answer this question.

Children's use of a speaker's intentions to help them learn a new word will be investigated. To do this, an experiment will be conducted in which children need to make use of the difference between "know" and "think" to learn a new word. The scenario is as follows: a child is presented with two puppets. Each puppet has an object in front of him, that the child has never seen before. Puppet A says: "I know this is a mit." and points to the object in front of him. Puppet B then says: "I think this is a mit." and points to the other object, the one that is in front of hím. Two objects are now labeled as a "mit", but one with much certainty, and one with less certainty. The child will be asked to point at "the mit". If it understood the difference between "know" and "think", that is, the speaker certainty of the puppets, it will point to the object of puppet A, since that was the puppet that was sure.

This task is much like the sticker finding task of Moore et al. (1990). However, instead of finding a sticker, the children have to pick an object as the referent of a new word, which makes it a word learning task. The research question to be answered with this experiment is: "Are children able to use speaker certainty to learn a new word?". To answer this question, I will investigate whether children will score significantly above chance level in this word learning task. This will show if the children are able to use speaker certainty in word learning at all. I expect that they will be able to do this, because they can also use speaker certainty in other context. In addition, I will compare the results of this study to the results of De Mulder (2011), who conducted a sticker finding task similar to Moore et al (1990). The comparison will show whether children are able to use speaker certainty more easily in a word learning context, than in another context (a sticker finding task). If it is indeed easier in a word learning context, then perhaps Happé & Loth (2002) were right about word learning being a privileged context for Theory of Mind. In that case it does not only apply to false belief tasks

but also to speaker certainty. This could mean that word learning mechanisms can influence the development of other mechanisms (Theory of Mind and speaker certainty) and thus is a are very important mechanisms of a child.

A second research question to be answered in this study is about different ways of expressing speaker certainty in language that can be used by children to learn new words. The mental state verbs "know" and "think" are clear examples of linguistic expressions of speaker certainty, but there are other ways as well. Moore et al. (1990) tested children's understanding of modal adverbs like "probably" and "maybe", which can also be indicators of speaker certainty, in a hidden cany task (where the puppets gave directions like "Probably it is in the blue box" or "Maybe it is in the red box."). It turned out that children's understanding of these words was much like their understanding of mental state verbs. Children thus are able to determine speaker certainty by other cues than mental state verbs. However, are these other cues limited to modal adverbs? Or do children understand speaker certainty when it is not explicitly said, but in only expressed in discourse? By "certainty in discourse" I mean a way to express certainty in a linguistic manner, without using words that directly refer to this certainty (like "know", or "probably"). This can for example be done by talking about one's familiarity with something; this gives the *impression* that one knows a lot about it (so one has a high degree of certainty), but one does not explicitly say that one knows it. To investigate the importance of the use of mental state verbs in expressing speaker certainty, I ask the following research question: Do children perform equally well (or better) when speaker certainty is expressed in discourse only, than when it is expressed through mental state verbs? To answer this research question, three different conditions of the experiment mentioned earlier will be compared. In the first condition, the puppets will use the mental state verbs "know" and "think" to express their certainty. They will thus say: "I know this is a mit" or "I think this is a mit.". In the second condition, the amount of certainty will be expressed in discourse (the puppets will mention their familiarity with the object). In the third condition, the puppets will express their certainty in both discourse and through mental state verbs. For a more complete explanation of the different conditions, see the *Method* section.

Since Moore et al. (1990) showed that children are able to understand other kinds of certainty as well as certainty expressed by mental state verbs, it is expected that the children are capable of understanding speaker certainty all conditions and are able to use this certainty to learn new words. However, it is expected that children in the third condition will perform best, since these children will have two sources of information: discourse *and* a mental state verb.

The results of this study will answer some important questions. We already know that children are able to use speaker certainty. We also know that children are able to use Theory of Mind in word learning. However, we know nothing yet about the combination of these facts: are children able to use speaker certainty to learn new words? This study will answer this question by conducting an experiment in which the children have to use speaker certainty to decide what object is the referent of a word. If they score above chance level on this experiment, they are capable of using speaker certainty in word learning. Also, the word learning context will be compared to a sticker finding context (from De Mulder, 2011) to see if word learning is a privileged context for using speaker certainty. This would add to the suggestion of Happé & Loth (2002) that word learning is a privileged context for Theory of Mind use. The second research question will for the first time show to what extent speaker certainty can be understood by children and used to learn new words. This will be investigated by comparing three different conditions of the experiment, in which three different manners of expressing speaker certainty are used.

## 2. Method

### *2.1 Participants*

52 Dutch children in the age range from 4;1 to 6;0 participated in the experiment. They were all from the same elementary school, but had different teachers (there were three groups). The children were assigned to three conditions. Condition 1 (the mental state verb condition) had 18 children with a mean age of 5;1. Condition 2 (the discourse condition) had 17 children with a mean age of 5;0 and condition 3 (the "both"-condition) also had 17 children, who had a mean age of 5;1.

Not all children had Dutch as their (only) native language. None of the children scored remarkably low on the vocabulary test (The lowest score on this test was 74, which was not more than two standard deviations away from the mean, 102, which was the exclusion criteria). The vocabulary test therefore gave no reason to expect that the children would perform poorly on the experiment. Only one child was excluded from data analysis because she didn't pass the practice items (which was another criteria for exclusion). In the practice items, the puppets named objects that the children knew. To let the children get used to puppets that did not not agree with each other, the puppets both said the same thing, for instance "This is a bike". One of them would actually point to a bike, but the other one would point to another object. The child was then asked to point to the bike. One child was not able to do this, which left 16 children for condition 3.

### *2.2 Procedure*

Children were tested in a separate room in their school. Each session lasted about twenty minutes and included three different tests. Two adults were present: the experimenter and an assistant. There were two different testing orders, to reduce unwanted effects of order. After the testing, children were rewarded with an eraser.

#### *2.2.1 Measuring vocabulary*

The vocabulary of every child was measured with the Dutch version of the Peabody Picture Vocabulary Test III, produced by Schlichting (2005). This is a standardized picture matching test which measures the current vocabulary of a child, relative to his age. If a child scores 100

points on the standardized score (called the WBQ score, where age is taken into account), it means he has exactly the vocabulary a child is expected to have at his age. The raw score, which indicates the number of items the child answered correctly, was also calculated. This test was conducted to see if there was a correlation between the size of a child's vocabulary and his ability to learn new words. Also, it was used as a pretest to see if there were children with an extremely small vocabulary (more than two standard deviations below the mean).

*2.2.2 Measuring Theory of Mind*

Every child was also administered a Theory of Mind test. This was because to find out if there were correlations with the word learning task, in which the children had to use speaker certainty. Since speaker certainty is connected to ToM, I expected to find a strong correlation. The false belief location test was replicated from De Mulder (2011) It is an adaptation of the Sally-Anne test (mentioned in the *Introduction* section). In this version of the test, there are two Playmobil puppets. One of them (Paul) has a marble. He takes the marble and puts it into a blue box. When the puppet goes away, the other one (Laura) takes the marble out of the blue box and puts it in a red box. Paul returns, and the child is asked where Paul will look for the marble, the blue box or the red box? A second question asks the child for an explanation: why will Paul look there? A child can receive two points if he answers correctly: one point for the right location, one for the explanation. The explanations were seen as correct if they said something about the original location of the marble ("First it was…") or about Paul's belief about the marble ("He thinks it is…"). Since the test was conducted twice (the second time, the roles and boxes were switched), with some time in between (in which the Picture Peabody Vocabulary test was conducted), the children could score 4 points in total. The children were only given these points if they also answered the control questions correctly, which were given to them to make sure they paid attention and remembered what happened. These two control questions were: "Where is the marble really?" and "Where was the marble first?". In fact, all children answered these questions correctly.

(A full script of the test can be found in the appendix.)

*2.2.3 Measuring the learning of words*

To measure the use of speaker certainty in word learning, an experiment in which two puppets named nonsense objects was developed. The children were told that the puppets would name these objects and that they had to listen carefully, because they would not have seen the objects before. Each puppet had one object in front of him and gave it a label (a nonsense word). The experiment had a between-subjects design with three different conditions (mental state verb, discourse and a combination).
In the first condition, this was done as follows:

> Puppet 1: "Ik weet dat dit een mit is." (I know this is a mit) *Points at the object in front of him*.
> Puppet 2: "Ik denk dat dit een mit is." (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 was more certain.

The second condition was the discourse condition. Again, two puppets were used and they both had one object in front of them. In this condition speaker certainty was expressed in discourse and no mental state verbs were used. Instead, the puppets talked about their familiarity with the object. This was done as follows:

> The puppet that was very certain told the child: "I have seen this before. Look, this is how you pick it up."(he then picked up the object in front of him) "I have played with this a lot, because I have it at home, too. Yes, a mit."
> The other puppet, which was not certain, then said 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. He concluded "Well… a mit?" (A full script of the conditions can be found in the appendix .)

There was no manipulation of intonation except for the natural differences in intonation that come with the expressions "yes" and "well…".

In the third condition, both discourse and mental state verbs were used. The procedure was almost the same as in 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 expressed their certainty in discourse as well as through mental state verbs. The expectation was that children would perform best on this condition, because it gives them the most information (both from discourse and mental state verbs).

Each child was given eight trials of this task (which allowed them to score 8 points in total on word learning), in which the order of the puppets and that of the sentences were of course varied. As for a control question, the children were asked to pick their favourite object out of every pair of novel objects. This was done to make sure that in the experiment, the children picked the object that they thought matched the word, and not just always the object they liked most. Since there was only one child for whom, in every trial, the object he chose was the same as the object that was his favorite, it was assumed that this was no general tendency and this case could also be a coincidence . There was no pair of objects where all children picked the same object as their favorite.

A full script of the three conditions and the list of nonsense words can be found in the appendix.

## 3 Results

### *3.1 Descriptive statistics*

Table 1 shows the means, standard deviations and ranges of the tests. 51 children participated in the experiment.

| | Mean | Standard deviation | Range |
|---|---|---|---|
| Age in months | 61.08 | 6.46 | 49-72 |
| PPVT-S | 102.27 | 13.96 | 74 -138 |
| PPVT-R | 71.56 | 14.76 | 20 - 98 |
| Theory of Mind | 2.13 | 1.88 | 0 - 4 |
| Word learning | 5.02 | 1.60 | 2 – 8 |
| know-think | 4.72 | 1.23 | 4 – 8 |
| discourse | 4.72 | 1.41 | 3 – 8 |
| combination | 5.69 | 2.02 | 2 – 8 |

Table 1. Means, standard deviations and ranges.

Note: PPVT-S is Picture Peabody Vocabulary Test Standardized score. PPVT-R is the Picture Peabody Vocabulary Test Raw score. Theory of Mind refers to the false belief location change task.

The mean standardized score on the Peabody Picture Vocabulary Test (the PPVT-S) is 102.27, which means that the children in this study scored somewhat above average (which is 100). The PPVT-S will be excluded from further analysis, because otherwise age will be taken into account twice (it is already taken into account in determining the standardized score). The PPVT-R, the raw score that indicates the number of correct answers, is the score that will be used in further analyses.

To see if children are capable at all of learning new words when using speaker certainty, we need to know if they scored above chance level. To score above chance level in the word

learning task, a child had to score higher than 4 (since 8 was the maximum score and children had two possible answer options). As shown in table 1, the mean in the word learning task was 5.02. A one sample t-test showed that this was significantly above chance level with $p<0.001$. Also in the three conditions separately, the children scored significantly above chance level.

*3.2 Correlations*

To find out if the performances on the different tests are connected to each other and to the age of the child, we will look at correlations. Table 2 shows all the bivariate Pearson correlations.

| | Age | PPVT-R | Theory of Mind |
|---|---|---|---|
| PPVT-R | .486** | | |
| Theory of Mind | .368** | .268 | |
| Word learning | .316* | .286* | .162 |
| know-think | .279 | .294 | .242 |
| discourse | .213 | .063 | .054 |
| combination | .435 | .398 | .181 |

Table 2. Correlations

*. correlation is significant at the 0.05 level. **. correlation is significant at the 0.01 level.

The table shows significant positive correlations with age for all tests, which means that children get better at every test when they grow older. This was already known for the PPVT and the Theory of Mind tests, but turns out to be true for the word learning task as well (however this correlation is weaker than the others). This is however not true for the conditions of the word learning task separately. However, this could be due to the small number of participants per condition.

The word learning tasks also weakly correlates with the PPVT raw score. This probably means that 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 ToM and word learning. This goes against the expectations, because 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). (Possible explanations for this are given in the *Conclusion and discussion* section)

### *3.3 Analysis*

The goal of this research was to investigate whether children are able to use speaker certainty to learn a new word. We already saw that the children are able to do this, because they scored significantly above chance level. The next step is to find out whether children can use speaker certainty more easily in word learning than in other contexts. To find this out, I will compare the data of my experiment with that of De Mulder (2011). Both studies investigated 4-and 5 year olds' understanding of "know" and "think" (so, speaker certainty). De Mulder's (2011) experiment was not in a word learning context (but in a sticker finding task), but this study was.

#### *3.3.1 "Know" and "think" in different contexts*

The results of this study and those of De Mulder (2011) were compared by using a one-way ANOVA. Only the children of the first condition could be included, since this was the only condition where the mental state verbs "know" and "think" were all the information the children had. 18 children were tested on this condition. Since the dataset of De Mulder (2011) was much larger, a random sample of 18 children was taken out of the set (while making sure there was no significant age difference). The descriptive statistics of these 18 children can be found in table 3.

| | Mean | Standard deviation | Range |
|---|---|---|---|
| Age in months | 56.83 | 2.73 | 50 – 59 |
| Know-think | 1.83 | .71 | 0 – 3 |

Table 3. Descriptive statistics of sample from the sticker finding task De Mulder (2011). The maximum score on the know-think test was 3.

To score the "know" vs. "think" task, De Mulder (2011) used a three point scale while this study used an eight point scale. Both were transformed into a 24 point scale to facilitate comparison. Table 4 shows the results of a one-way ANOVA between both datasets.

| | Sum of squares | df | Mean square | F | Sig. |
|---|---|---|---|---|---|
| Between groups | 2.25 | 1 | 2.25 | .1 | .76 |
| Within groups | 774.50 | 34 | 22.78 | | |
| Total | 776.75 | 35 | | | |

Table 4: One-way ANOVA: comparing the understanding of know vs. think in and outside a word learning context

Table 4 shows that there is no significant difference between the two datasets. That means that the children performed equally well in both experiments on the understanding of "know" and "think", independently of the nature of the task. Word learning thus seems not to be a privileged context for theory of mind. However, note that the number of participants is rather small and both the experiment and experimenters were different, which makes a fair comparison hard to make.

*3.3.2 The importance of mental state verbs in speaker certainty*

The second research question was about different ways to express speaker certainty. Is it equally useful to express the certainty in mental state verbs as in discourse, as in combining the two?

The experiment included three different conditions: a condition where certainty was expressed only through mental state verbs, a condition where certainty was expressed through discourse (the familiarity with an object), and a condition where certainty was expressed through discourse and mental state verbs. A one-way ANOVA analysis was used to investigate whether the children performed significantly differently in these three groups. The results are shown in table 5.

| | Sum of squares | df | Mean square | F | Sig. |
|---|---|---|---|---|---|
| Between groups | 10.32 | 2 | 5.16 | 2.10 | ,13 |
| Within groups | 120.66 | 49 | 2.46 | | |
| Total | 130.98 | 51 | | | |

Table 5: One-way ANOVA: comparing three conditions (mental state verb, discourse and discourse with mental state verb)

There were no hypotheses about the differences between the mental state verb condition and the discourse condition, but it was expected that the scores in the "both condition" would differ from the other. In that condition, children have two sources of information instead of one. The means of the three conditions were shown in table 1 and were respectively 4.72, 4.72 and 5.69. Although condition 3, the "both condition", does have the highest mean, it turns out that there are no significant differences between the groups. Children of 4 and 5 year old turn out to be equally capable of understanding speaker certainty expressed through mental state verbs, as well as understanding speaker certainty expressed in discourse, as

understanding speaker certainty expressed through both.
A post-hoc analysis showed that all three conditions differ equally from each other. That means that the difference between the first and second condition is the same as the difference between the first and third or second and third. The third condition, in which the children were given speaker certainty expressed in discourse *and* through mental state verbs does not stand out, while it was expected that it would. Apparently, having two different sources of information is in this case not more useful than having just one.

An extra ANCOVA analysis was conducted where the covariates age, sex, PPVT score (raw) and ToM score were added. None of these had a significant influence and the overall outcome still remained insignificant.
To find out if the ToM score really did not influence the word learning score, the ToM scores were also classified as pass/fail (were 2 or more was passing, 1 or 0 was failing). The word learning scores of the ToM pass group were then compared with the word learning scores of the ToM fail group in a one-way ANOVA analysis. The difference between these groups was unsignificant with $p = 0.266$, so the ToM score did not influence the word learning score.

## 4. Conclusion and discussion

Growing up, children are able to acquire the meanings of thousands of words at remarkable speed. We do not know how they are capable of doing this, since every word has many possible meanings that cannot be ruled out, as originally pointed out by Quine (1960). To learn the meanings of words, children need to have certain strategies that help them pick the right meaning of a word. Such strategies may concern the possible referents (for instance, assuming that the word refers to a whole object and not to its parts (Markman, 1994)), but may also concern the speaker that is uttering the words.

This study proposed the possibility that use of speaker certainty was such a strategy for learning new words. Speaker certainty is the amount of certainty a speaker has towards the proposition he utters. For instance, he can "know" something (very sure), but can also just "think" something (not so sure). Children begin to understand this speaker certainty at around the age of four, the same time at which they develop a Theory of Mind: the understanding that other people's thoughts and beliefs may differ from their own.

Other studies have already shown that children of 4 years old are able to use speaker certainty in a sticker finding task (Moore et al., 1990, De Mulder, 2011) and that they are able to use Theory of Mind to learn new words (Happé & Loth, 2002). This study combined these two facts to formulate a new question: are children able to use speaker certainty to learn new words? To answer this question, an experiment was conducted in which children had to follow directions of two puppets to decide to what referent a new word refers. One puppet was sure and said he "knows this is an X" about an object, while the other one was less sure and says "the thinks this is an X" about another object. The child was asked to pick "the X" and if the child picked the object that the puppet was sure about, it had used speaker certainty to learn a new word.

The results of this study showed that 4 and 5 year old children are indeed capable of doing this; they scored significantly above chance level. As a next step, the word learning context was compared to another context (the sticker finding task of De Mulder, 2011) to see if word

learning is a privileged context for speaker certainty. It turned out that there was no significant difference between the contexts. Children are equally capable of using speaker certainty to find a hidden sticker, as to learn a new word. This is quite remarkable, since one could expect children to be more motivated to find a sticker, than to learn a new word. This is either, or motivation does not play a role in the use of speaker certainty.

The second research question was about the different ways to express speaker certainty in language. Do children perform equally well (or better) when speaker certainty is expressed in discourse only, than when it is expressed through mental state verbs?
To answer this question, three conditions of the experiment were compared. In the first condition, speaker certainty was expressed through mental state verbs. In the second condition, it was expressed in discourse. In the third condition, it was expressed in both. There were no significant differences between the conditions. This means that children understand speaker certainty in all kind of ways. The use of speaker certainty in word learning is not limited to the use of mental state verbs or other specific words. It is enough for children when they get the impression of certainty, it does not have to be explicitly said. Children are thus very well capable of tracking a speaker's intentions, if it helps them to learn a new word.

For future research, it can be useful to investigate even more ways of expressing speaker certainty. We now know that it can be expressed in discourse. However, what are the limits of this discourse? Is there a way to formulate this discourse that makes the children score even better in a discourse condition than in a mental state verb condition? Or is it possible to formulate poorly, so that children do not understand the speaker certainty anymore? This study showed that children can understand different ways of expressing speaker certainty and use them to learn new words, but we do not know the limits of these ways yet.

There is one question still left unanswered. In this study, ToM false beliefs and using speaker certainty in word learning were uncorrelated. This was against expectation, so what could be the reason for this? There are two possible explanations. The first is that speaker certainty and false belief are two very different aspects of theory of mind, which are simply not connected. This is not very plausible, because other scholars' data (Moore et al. (1990) and

De Mulder (2011)) do show high correlations between these. However, it could also be the case that the dataset of this study was too small to show significant results and correlations. Perhaps if the same tests are conducted with more participants, or when more different ToM tasks are conducted, the results will be slightly different.

This study has shown two important things: that children of 4 and 5 year old are able to use speaker certainty to learn new words, and that they can understand speaker certainty not only when it is expressed through mental state verbs, but also when it is expressed in discourse. However, future research can tell us more about these subjects. For example about other ways to formulate speaker certainty in discourse. Also, it would be interesting to know whether children use speaker certainty to learn new words not only in an experimental setting, but also in everyday life. We know now they are capable of doing it, but it remains a question whether using speaker certainty is really one of the strategies they use in everyday life lo learn the enormous amount of word meanings that they do.

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## Appendix

**1. Theory of Mind false belief procedure**

**2. Word learning procedure**

**3. List of Dutch nonsense words used in word learning task**

*1. Theory of Mind false belief test procedure – location change (this procedure was taken from De Mulder (2011))*

E: Experimenter, A: Assistant

Materials: 2 Playmobil puppets , marble, red box, blue box

E: Look, this story is about a boy, Paul.

A [points at Paul]

E: and a girl Laura.

A[points at Laura]

E: Paul has a marble and the wants to put it away for a while, so he puts it in the red box.

A [moves Paul to the red box and puts the marble in the red box].

E: Now Paul has to go to the bathroom, look, there he goes.

A [moves Paul away, under the table].

E: Now look what Laura is doing! She is taking the marble out of the red box.

A [moves marble to the red box and takes the marble out]

E: and she puts it into the blue box!

A [moves Laura to the blue box and puts the marble in it]

E: Look, there is Paul again.

A [moves Paul back]

E [asks test questions] :

Test question 1: Where will Paul look first for the marble?
Test question 2: Why will Paul look there first?
Control question 1: OK, and to make sure you paid attention: where is the marble really?
Control question 2: And where was the marble first?

*2. Word learning procedure*

E: experimenter, A: assistant
Materials: Pig (puppet), Frog (puppet), novel objects

E: "Look, here are Pig and Frog. Pig and Frog are going to tell you how these objects are called. You have to listen carefully, because you have not seen these things before. After they tell you, I will ask you to point at one of the objects."

*Condition 1:*

A [as Frog]: "I know this is a mit." [points at object in front of him]

A [as Pig]: "I think this is a mit." [points at object in front of him]

E: "Which one is the mit? Point at the mit."

*Condition 2:*

A [as Frog]: “I have seen this before. Look, this is how you pick it up.”
[picks up the object in front of him]
“I have played with this a lot, because I have it at home, too. Yes, a mit.”

A [as Pig]: “I have never seen this before. How do I pick it up?”
[picks up the object in front of him]
“I have never played with this, because I don’t have it at home. Well… a mit?”

E: “Which one is the mit? Point at the mit.”

*Condition 3:*

A [as Frog]: “I have seen this before. Look, this is how you pick it up.”
[picks up the object in front of him]
“I have played with this a lot, because I have it at home, too. I know this is a mit.”

A [as Pig]: “I have never seen this before. How do I pick it up?”
[picks up the object in front of him]
“I have never played with this before, because I don’t have it at home. I think this is a mit.”

E: “Which one is the mit? Point at the mit.”

*3. List of used Dutch nonsense words:*

mit
vlaar
kloef
glap
daks
guik
wop
hast