

Acquisition of Deontic and Epistemic Readings of *must* and *müssen**

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1. Introduction

This paper investigates the acquisition of deontic and epistemic readings of the English modal *must* and its German counterpart *müssen*. This paper proposes a syntactic analysis which assigns deontic and epistemic meanings in two structurally distinct positions. These positions are only divided by an adverb position which means that they are quite close in a phrase marker. This proposal has an impact on language acquisition. The hypothesis put forward here is that children perform poorly in deontic as well as epistemic instances when faced with comparing readings which are minimally distinct in structure.

This hypothesis is distinct from previous proposals made for the acquisition of deontic and epistemic readings of modals. Prior research and developmentalists, putting forward a Theory of Mind approach to the acquisition of modals, suggest that deontic readings are acquired first and epistemic readings do not emerge until later when children are cognitively mature enough to compute epistemic readings. This line of research proposes that deontic readings are easier for the cognitively less developed child since these readings do not require a Theory of Mind ability from the child. This means that the child does not need to be able to attribute false beliefs and differing mental states to people in order to compute deontic meanings. However, Theory of Mind capabilities are needed to be able to compute epistemic readings since these involve more abstract concepts.

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The Theory of Mind approach predicts children at around 3 to 4 years of age to perform significantly better on deontic tasks than epistemic tasks. Contrary to the Theory of Mind approach the hypothesis put forward in this paper predicts children to perform equally non-adult like in deontic as well as epistemic instances in cases of syntactically difficult environments.

This hypothesis was tested in an elicitation task with English and German children ranging in age from 3 to 5 years. The results of this study support the hypothesis put forward in this paper. The results also show that the Theory of Mind approach and other previous research have underestimated the role of the non-adult like syntactic system that children have partly by dividing deontic and epistemic instances into distinct acquisition tasks. This procedure does not force children to decide between closely competing structures thereby masking children's non-adult like syntactic abilities with modal verbs.

The remainder of this paper is structured in the following way. Section 2 introduces and discusses the different properties of English and German modal verbs, especially *must* and *müssen*. Section 3 summarizes and discusses previous research on the acquisition of modal verbs. Section 4 introduces and discusses the Theory of Mind approach and what prediction this kind of model makes for the experimental study presented in this paper. Section 5 lays out the theoretical assumptions made in this paper. Moreover the predictions of this model for the acquisition study are discussed. Finally, section 6 introduces the elicitation study and its results. This study was conducted in English and German to check the hypothesis put forward in this paper. Moreover, the results and its impact for further research is discussed in comparing the results crosslinguistically.

2. Properties of Modals

Both English and German belong to the category of languages that take the same set of devices to express modality by using modal auxiliaries. Modal auxiliaries in English include *may, might, must, can, could, need, have (got) to, will, would, shall, ought to and should*¹. In German, modal auxiliaries include *dürfen* 'to be allowed to', *sollen* 'have to', *müssen* 'must' and *können* 'can'. The set of English and German modals convey a broad cluster of meanings which are most commonly subsumed under deontic and epistemic modality. They play an important role in the domains of morality and law as well as in social conventions like expressions of politeness. Modal concepts are significant in theorizing and considering possible and hypothetical worlds. They influence planning, making predictions and expressing intentions and desires. Modal concepts reflect our ability to conceptualize parallel worlds.

¹ Taken from Greenbaum & Quirk (1990).

2.1 Semantic Properties

Deontic meaning involves notions of obligation, volition and permission. This kind of modality is concerned with the necessity or possibility of acts performed by morally responsible agents. The example in (1) represents a deontic interpretation of the modal *may*, more precisely one of permission.

- (1) You may go to the movies only after you have finished your homework.

Epistemic meaning involves the speaker's assumptions or judgments of possibilities or his conclusions about certain circumstances. Epistemic interpretations indicate the speaker's confidence or the lack of confidence in the truth of an expressed proposition. Understanding these kinds of structures means that the speaker is able to qualify propositions expressed, to judge their validity, truth or factuality. The example in (2) represents an epistemic interpretation of the modal *must*.

- (2) Mary must have missed the train.

In example (2) the only possible interpretation is an epistemic one, i.e. by all facts known to me, it must be the case that Mary has missed the train. The same interpretation holds for the equivalent examples in German.

- (3) Du darfst nur dann ins Kino gehen, wenn du deine Hausaufgaben gemacht hast.
you may only then to-the movies go if you your homework done have
"You may go to the movies only after you have finished your homework."
- (4) Maria muss den Zug verpasst haben.
Mary must the train missed have
"Mary must have missed the train."

Like the English example in (1), example (3) has a deontic interpretation, expressing permission. Sentence (4) has an epistemic interpretation like its English counterpart in (2), expressing a logical conclusion.

2.2 Syntactic Properties and Distribution

Modals in German can occur in a past tense construction (*musste*), they can have a German *Partizip* construction (*müssend*)², they have a distinct infinitival form (*müssen*), they show agreement properties (*muss, musst, müsst* etc.) and they can even function as full verbs like in (5) although the sentence is understood as containing an implicit verb, i.e. *I have to go to the bathroom*.

² Although native speakers do not agree on the acceptability of those constructions it is generally possible to have them. Some native speakers do not judge them as being perfectly good.

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(9) Who must eat a banana? \Rightarrow deontic

In English, (9) is clearly and exclusively deontic. An important issue is that the indefinite article *a* has to be used in English as well as in German to avoid confusion with the visible banana, i.e. the banana in *Bert's* hands, as opposed to another banana that *Piglet* is eating. By using the definite article only one reading would be permissible based on pragmatic regulations, namely *the banana* would only mean the one visible. Since a biased setting is not desirable, the indefinite article is used to be as neutral as possible. The question for the epistemic/*Piglet* reading is as given in (10).

(10) Who must *be eating* a banana? \Rightarrow epistemic

As opposed to the deontic version of the question, the progressive *be* and ending *-ing* are added to the structure in the epistemic version.

The context given in (8) applied to German, however, yields an ambiguous reading with respect to question structures⁵ since German does not have a present progressive tense.

(11) Wer muss 'ne Banane essen? \Rightarrow ambiguous
Who must a banana eat
"Who must eat a banana? AND Who must be eating a banana?"

The German sentence (11) is ambiguous between the deontic/*Cookie Monster* reading and the epistemic/*Piglet* reading. The phonologically reduced form of the indefinite article 'ne has to be used in German to avoid confusion with the cardinal number *one*. The indefinite article *a* in its non-reduced form (*eine*) is homophone with the cardinal number *one* (*eine*), which would refer to the visible banana in *Bert's* hands. Again, this is important to be able to maintain an 'as neutral as possible reading'.

2.2.2 Past Tense Differences in German and English

As mentioned in section 2.2 the past tense constructions of deontic and epistemic readings are also different in English and German. Again, the context in (8) is presupposed. The deontic version of the English question in the past tense is given in (12).

(12) Who was supposed to eat the banana? \Rightarrow deontic

participating characters and two of them, Bert and the Cookie Monster, are clearly visible, the third character must be Piglet.

⁵ Some German native speakers seem to prefer the deontic reading and classify the epistemic reading as being marginal. Since this preference does not influence the line of reasoning in this paper, I will not go in further details here.

This question form necessarily has to use a form other than *must* since *must* does not have a past tense form that conveys a deontic meaning. In order to be able to ask a deontic question in the past tense one has to resort to *be supposed to* as in (12) or *have to* as in (13).

(13) Who had to eat a banana? \Rightarrow deontic

Both questions, (12) and (13), yield the deontic/*Cookie Monster* reading. The epistemic/*Piglet* reading though can be constructed with *must* as in (14).

(14) Who must have eaten a banana? \Rightarrow epistemic

In German both readings, deontic and epistemic, can be composed with *müssen* in the past tense. The deontic question is given in (15) and the epistemic question is given in (16).

(15) Wer hat 'ne Banane essen müssen? \Rightarrow deontic
Who has a banana eat must
"Who had to eat a banana?"

(16) Wer muss 'ne Banane gegessen haben? \Rightarrow epistemic
Who must a banana eat has
"Who must have eaten a banana?"

In (15) we have a deontic/*Cookie Monster* reading, in (16) an epistemic/*Piglet* reading. The difference between English and German seems to be due to contrasting properties of modals since German modals behave like full verbs whereas in English modal verbs have the distribution of auxiliary verbs. Furthermore *must* has the odd property of not having a deontic past tense construction⁶. German *müssen* has no quirks like the English counterpart. It shares regular properties with other modal verbs.

The syntactic distribution observed so far has the implication that while in German modal verbs are base-generated within the VP system like other main verbs, modal verbs in English are base-generated higher in the IP system like other auxiliary verbs.

3. Previous Research on Acquisition of Modal Verbs

In this section an overview of literature on the acquisition of deontic and epistemic interpretations of modals is given. One can always approach the course of acquisition

⁶ Moreover, *must* in combination with negation also has the odd property of not conveying the semantic negation of the positive sentence. Compare i) and ii).

i) John must eat a banana.

ii) John must not eat a banana.

Modals in combination with negation is an interesting topic but it cannot be included in the current paper due to space limitations. Interestingly no acquisition study so far has looked at this interaction.

from two angles, observational and experimental. It is very important to examine insights gained from both perspectives in order to avoid the potential pitfall of looking only at a fragment of a whole puzzle. A more complete picture of the development of modals is certainly more desirable. A very well known fact, for example, is that production data always lags behind the competence of children⁷. Therefore both perspectives are needed to get the complete picture of what is going on in child speech. First I will give an overview of naturalistic data and later I will turn to experimental data.

3.1 Natural Production Data

In general, all studies on natural speech data taken together produce a quite consistent pattern of the early development of modals⁸. Shatz & Wilcox (1991), Hirst & Weil (1982) and Noveck et al. (1996) have good summaries of the assembled data on natural speech production of modals. The following summary can be reviewed in detail in their papers.

2 to 3 years: Kuczaj (1975), Kuczaj & Maratsos (1982) and Kuczaj & Maratsos (1983) assembled evidence that modals appear in child speech as early as 2;6 years of age. Although deontic concepts like those of permission were used quite frequently by young children, epistemic concepts of possibility did not appear frequently until around 3;3. Wells (1979) and Perkins (1983) yielded similar findings as those by Kuczaj.

It seems as if the growth in modal meanings is far more rapid than the change in syntactic contexts in which the modals appear. Kuczaj & Maratsos (1983) observed that children seem to be restricted in syntactic productivity at the onset of modal acquisition. Modals occurred earliest in declaratives and some months later in yes-no questions. This pattern with the observation made by Shatz et al. (1986) that confirms the early predominance of modals in declaratives. Later on more syntactic structures are used. Another consistent observation in all production data is the fact that deontic meanings of modals appear earlier in child language than epistemic readings.

3 to 4 years: The age between 3 and 4 seems to show a significant increase in the number of modals used to express different, predominantly deontic, meanings. The use of epistemic uses of modals is rarely attested in natural speech at this age but they do occur.

4 to 5 years: Around the age of 4;5 to 5 the use of notions of necessity and possibility, i.e. epistemic meanings, increase. Opposed to Kuczaj's findings, Wells (1985) observes that epistemic meanings are not produced very frequently yet during that period. However, the observed epistemic notions involve inference or certainty, Kuczaj's epistemic notions, on the other hand, involve possibilities. Wells' findings indicate that deontic meanings are in place by the age of 3;3. Epistemic meanings conveying certainty appeared later and with a lower frequency. And finally, epistemic meanings involving inferences appeared even later than those of certainty.

⁷ The same observation can be made in L2 acquisition.

⁸ Unfortunately, most of the studies, naturalistic and experimental, are restricted to English data.

3.2 Experimental Data

One of the earlier studies in the acquisition of modal verbs has been conducted by Hirst and Weil (1982). Their study contained two different elicitation tasks with children aged 3 to 6. One for deontic interpretations, the other for epistemic interpretations. In the deontic condition two teachers each gave one statement about what room a puppet should go to. These two statements were evaluated by the children, i.e. the children had to tell where the puppet would go. For example children had to choose between (i) *You must go to the green room* and (ii) *You may go to the red room*. The epistemic condition tested the propositions concerning the location of a peanut, i.e. the children had to choose where the peanut was. For example the children had to choose between (i) *The peanut should be under the box* and (ii) *The peanut must be under the cup*. In both tasks children had to choose between two utterances containing modals or the factive *is* of varying strength where the strength was supposed to decrease in the following order.

(17) *is* > *must* > *should* > *may*

The results show that the greater the difference in strength between the modals was, the earlier this difference was acquired. In other words the difference between *must* and *may* was acquired before the difference of *should* and *may*. Moreover their findings seem to suggest that epistemic interpretations are acquired earlier than deontic interpretations. Hirst and Weil themselves put forward that these results may have been influenced by performance factors rather than reflecting the competence of children. That might have been the case because the children had to evaluate some sort of authority of the two teachers issuing commands to a puppet as well as the puppet's compliance in the deontic task therefore making it more demanding overall.

A study conducted by Noveck et al. (1996) replicates parts of the Hirst & Weil (1982) study with 5-year-olds exclusively. Moreover they address the question as to whether feedback influences the performance of children on the relative force of modals. In a second task Noveck et al. aimed to determine the influence of logical reasoning to a greater extent than the original Hirst & Weil study. The results from the first task, the modified replication of the Hirst & Weil study, shows that even without feedback children obey the relative force hierarchy, i.e. removing the feedback does not seem to influence their performance. This seems to support Noveck et al.'s hypothesis that logic meaning is already present in 5-year-olds "[O]r at least an awareness of what is contextually appropriate for their use .." (Noveck et al. 1996: 641) and that relative force is not the only factor in the development of modals. Experiment 2 was a truth-value judgment task which included children aged 5 to 7 years. They presented two statements to the children, one true and one false statement. The two statements were uttered by two puppets (each puppet a different one). Then the children were asked to determine which one of the statements is correct, i.e. the children were asked *Which puppet is right?*. The two statements were presented in a context that determined that only one statement was logically correct, i.e. the children were told beforehand that only one puppet can be right. If children would solely rely on the relative force of modals, they were expected to agree with the statement containing the stronger modal even if this statement was established to

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be false. If on the other hand the children have an understanding of logical meaning they are expected to ignore relative force contrasts and rely on truth values. The results show that the relative force influence can be muted. The results from the second task shows that 5-year-olds employ the logically correct modal statement. Even if the two statements contained the same modal, the logically correct statement was chosen significantly more often. If relative force were the only influence, it would predict a chance responding. The results also show an increase in performance with age. 5-year-olds agree with some regularity with the logically correct statement (and not the more forceful modal), 7-year-olds systematically agree with the logically correct statement and 9-year-olds show an adult like performance on the task. This means that even the younger children do not consider relative force at the expense of logical considerations. Unfortunately this study did not include children under the age of 5. As we have seen in section 3.1 the emergence of the modal system is critical between the ages of around 3 years of age and 5 years. We will also see in the next section that this age is critical for the emergence of the Theory of Mind.

Interestingly, mental verbs seem to develop parallelly to what is known about the acquisition of modal verbs, cf. Moore et al. (1989) and Moore & Furrow (1989). Both, mental verbs and epistemic readings of modals can be linked to the development of metacognitive abilities which are impacted by the development of the Theory of Mind, cf. Miller (2004).

4. Theory of Mind

This section discusses the Theory of Mind (henceforth ToM) approach to the acquisition of deontic and epistemic readings and its implications and predictions for the acquisition study described in section 6. ToM approaches to the acquisition of modals, e.g. Papafragou (1998) and (2001), emphasize the importance of cognitive development of children. Prior to a certain developmental stage epistemic meanings are supposed to be harder to grasp as a model for the child as opposed to deontic meanings. This approach predicts that deontic meanings are acquired before epistemic readings since deontic meanings are cognitively less demanding for the child. However, I suggest that the ToM approach underestimates the syntactic demands which a child faces. If deontic meanings are earlier in place according to ToM, younger children should perform better and more stable on deontic readings in elicitation tasks than on epistemic tasks. This prediction is not borne out completely as the acquisition study in section 6 shows. Cognitive demands might well influence the early development of modals, however, as I show in subsequent sections, when children are faced with a difficult syntactic decision, they perform equally unstable on deontic as well as epistemic tasks. These results are not expected according to ToM.

4.1 Introduction to the Theory of Mind

An influential topic for cognitive developmentalists has been the Theory of Mind Hypothesis⁹. Essentially, the ToM supposes that the cognitive abilities of younger children are different from those of older children and adults. These different cognitive abilities are important for the acquisition of modal verbs. To be able to pass ToM tasks one needs the understanding that people have mental states, for example beliefs and desires, that can differ from one's own. To have a ToM also means that one has the ability to predict and explain people's behavior based on their, possibly false, belief states. Within the framework of ToM deontic readings are supposed to be easier for cognitive reasons since epistemic readings represent more abstract concepts than deontic readings, i.e. *It is messy here, you must clean up your room* (deontic) is less demanding on children's cognitive abilities than *Daddy must have left work earlier because he caught the 5 o'clock train* (epistemic). As we have seen in the preceding section children as young as 3;3 produce epistemic readings of modals although deontic readings are attested earlier and more frequent and stable in natural production data.

Papafragou (1998) defines this hypothesis as given in (18). However, this is not a complete definition that entails all implications.

- (18) On one of its central interpretations, this hypothesis entails that part of [the] human cognitive mechanism is the ability to know one's own mind as such, i.e. to reflect on one's mental contents and processes and to accommodate the results in a coherent commonsense theory about the mental world. (Papafragou 1998: 382)

In the prestage of the period described above the child's mind is a container that is nothing more than a storage place for representations of reality. These representations are taken to be accurate. They are directly induced by external stimuli and children are unable to produce representations that are not identical to reality. In a later stage when ToM kicks in, the mind starts to function as an active processing unit that forms and processes representations of reality and not only reality itself. By doing that this unit is also able to detect instances of false belief, different sources of evidence and to calculate possibilities.

Researches presupposing the Theory of Mind Hypothesis predict that children understand deontic interpretations of modals earlier than epistemic ones because they are limited cognitively from doing otherwise and are therefore constrained in acquiring these modal interpretations. The central question then is how do concepts of knowledge state and evidence arise?

According to Papafragou 'epistemic uses of modals mark operations on mental representations' (Papafragou 1998: 373). As mentioned earlier, the interpretation of epistemic modals is a reflection on the knowledge of a mental state. In other words the

⁹ For a more detailed exposition of the Theory of Mind Hypothesis see e.g. Wellman (1990).

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ability to differentiate between reality and hypothetical worlds and the **awareness** of doing so. In literature on child development this kind of reflection is rarely attributed to children under 4 years of age. Such a metacognitive ability presupposes a deduction on an abstract content of beliefs of speakers, i.e. of the type '*this is reality/a hypothetical world I am thinking about*', in order for them to arrive at a valid conclusion about a proposition.

Early structures involving volition and permission, i.e. *can, will* etc., seem to reflect the egocentricity which is also a feature attributed to children in a stage prior to the one needed for more abstract, i.e. epistemic, interpretations. This is supported by the observation that modals surface initially in first person usage, i.e. with self-reference, cf. Fletcher (1979). This subjectivity can be directly connected to the egocentricity issue.

There some debate about to which specific age period the different stages of ToM can be attributed to, cf. Papafragou (1998). The ability to contrast a belief or a dream against reality are attributed to children around 2;8, but 2-year-olds are not able yet to grasp desires and perceptions in an adult form. Desires are conceived as a drive towards objects and not as inner urges, and perceptions are conceived as awareness of objects, i.e. by visual contact and not as the knowledge of things still continuing to exist even when out of the visual range. At this stage children seem to establish causal links between the mind and the world. Even for 3-year-olds belief contents are taken to reflect the world directly and they are still incapable of recognizing that beliefs may have different sources. Finally between 4 and 5 years of age children seem to have established a representational model of mind. They are now able to conceive mental contents as representations distinct from reality. And since epistemic modality represents the ability to assess one's judgment of beliefs, and to consider the reliability of these judgments, it makes sense to believe that the developing ToM of children may influence the course of acquisition of modal interpretations. In other words, deontic meanings of modals do not require a fully fledged ToM from the child in order to understand them. To summarize, researchers such as Papafragou (1998) assume that ToM develops before language can map onto it.

Opposing developmentalists such as Papafragou (1998) are researchers stating that ToM is dependent on certain linguistic abilities, e.g. de Villiers and de Villiers (2000), de Villiers and Pyers (2002) and Miller (2001) and (2004). These accounts suggest that a specific syntactic structure, namely complementation, is necessary to be able to compute false beliefs, a component of ToM. This is so because complementation structures provide the representational structure for embedded propositions. Consider sentence (19).

(19) [_{mc} Mary thinks [_{ec} that the chocolate is in the box.]]

In example (19) the truth value of the matrix clause, *mc*, can be different from the truth value of the embedded clause, *ec*. In other words, it is not important whether the chocolate is actually in the box or not, Mary can still think that the chocolate is in the box even that belief is false.

The ability to compute a false belief within a ToM task is usually tested according to the blueprint given in (20).

(20) Displacement Task:

A puppet sees a toy hidden in location A and then leaves the scene. While the puppet is gone, the object is moved from location A to location B. The child is then asked where the puppet will look for the toy upon returning.

Question to the child: *Where does X think the toy is?*

For the situation described in (20) the correct adult response is that the puppet mistakenly thinks the toy is in location A since the puppet has a false belief about the toy's location, i.e. the puppet has no knowledge of the displacement. However, children of around 3;5 - 4;0 years of age and younger answer non-adult like by stating that the puppet thinks that the toy is in location B. As we can see from the question in (20) it involves complementation just as in example (19).

4.2 Predictions

If the Theory of Mind Hypothesis is right in assuming that ToM ability develops prior to language structures mapping onto it, children should have no problems with deontic tasks by the age of 4 since their cognitive abilities are capable of computing these. Children in that age range should however have problems with epistemic tasks since their cognitive capabilities are not developed enough yet.

According to the research of de Villiers et. al and Miller, children's non-adult like syntactic abilities could cause them to have trouble once they are faced with structures they have not acquired yet. This account claims the opposite of the Theory of Mind Hypothesis since certain language structures have to be in place before ToM maps onto that. The current paper supports this line of research. I propose that performance on both, deontic as well as epistemic, structures is impaired once the child is faced with a syntactic problem. Independent from a connection to ToM like de Villiers et al. and Miller's work, this prediction has not been examined in the literature on the acquisition of modals yet. This prediction however is supported by the experiment discussed in section 6. Before we can look at the actual experimental task we have to establish the theoretical assumptions underlying the current line of research and look at all structures that were tested in the experimental task.

5. Towards a Syntactic Approach of Deontic vs. Epistemic Readings

This section provides a syntactic approach to account for the difference between deontic and epistemic readings. I propose that there is not only a semantic difference between the two readings but moreover that the two different readings occupy two different structural positions. To my knowledge, a syntactic approach to these differences has not been explored in the literature yet. The claim in acquisition terms is that while ToM does partly influence the acquisition of modals the syntactic difficulties that the child faces must not be underestimated. When the child faces the acquisition of the two different

readings but these distinct readings are encoded in a syntactic structure which differs minimally, the child has more trouble in acquiring the two readings than in a situation where the two readings are encoded in syntactic structure which does not differ minimally. In the latter case the child has more success in detecting and acquiring the structure because there are more differences, e.g. two different lexical items in the case of the deontic past tense structure in English.

5.1 Two Syntactic Positions for Two Readings

As we have seen in the previous sections, linguists approach modal meanings on various levels: semantic, pragmatic and on the level of cognitive development of children. For example, the hypothesis that deontic meanings are the source of modal understanding does not seem to be confirmed as the findings of Hirst & Weil (1982) suggest¹⁰. Thus it seems plausible that the development of epistemic modals does not hinge on that of deontic ones¹¹. Of course they belong to the same set of linguistic devices used to express modality and therefore they are not two completely distinct concepts and linguistic items. The question now is, how do they differ and does that difference influence the order of acquisition? One possibility to account for the difference is to say that both meanings of modals, deontic and epistemic, have the same syntactic distribution but that children will still be able to recognize a difference. This argument is known as the Principle of Contrast¹². Children recognize a difference in meaning without necessarily knowing what those meanings are when they first encounter them. This awareness could alert the children to pay attention to those differences.

There are two problems with this account. First this principle by itself does not really do any explanatory work because it does not make any predictions about why deontic meaning would come in first, followed by epistemic meanings. The second problem is that there might well be a syntactic difference in the different meanings of modals. Up to now the syntactic aspect of the acquisition of modals has been neglected.

I approach deontic and epistemic readings from a syntactically based position, which has not been done before. First we have to establish that there is a structural difference between the two possible readings. Consider the context in (21) and the different interpretations in (22) and (23)¹³.

(21) *Peter* is ordered to go to the icebox every day to get the food out (deontic interpretation, because *Peter* is obliged to do that). He has small hands. But on the icebox only handprints from huge hands can be seen. Since *John* is the only other person in the house and he has very big hands, he must be the only one really

¹⁰ For a more thorough discussion of advantages and disadvantages of polysemous approaches vs. monosemous approaches see Papafragou (1997) and Papafragou (1998).

¹¹ For example, Papafragou (1998) emphasizes that the emergence of the modal system can be predicted solely on grounds different from a polysemous account.

¹² For a longer discussion of this topic see Shatz & Wilcox (1991).

¹³ Thanks to Tom Roeper and Jill de Villiers for English judgments.

going to the icebox (epistemic interpretation because of a conclusion based on handprints).

(22) He always must go to the icebox. \Rightarrow deontic

(23) He must always go to the icebox. \Rightarrow epistemic

Given the context in (21), example (22) has a deontic interpretation. *Peter* is the only person supposed to go to the icebox. Example (23) has an epistemic interpretation. *John* is the only person who is really going to the icebox. This interpretation is based on the evidence that only handprints from huge hands are on the icebox. Since *Peter* has small hands, *John* is the person whose handprints are on the icebox.

If we leave out the adverb *always* in sentences (22) and (23), the surface strings look identical. Moreover that structure then is ambiguous as we can see in the example in (24).

(24) He must go to the icebox. \Rightarrow ambiguous

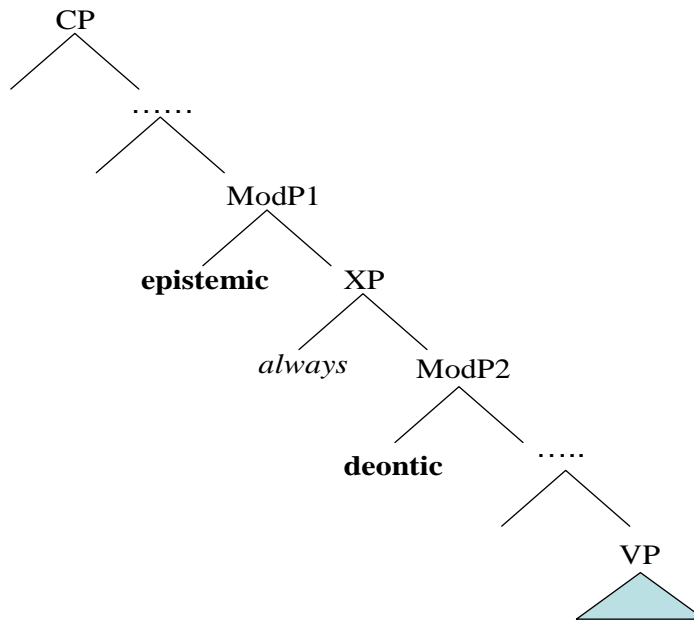
The difference between the possible epistemic example in (24) and the exclusively epistemic example in (10) is that (24) has a habitual reading and (10) has a situational reading, hence the present progressive. An example like the one in (10) would not be appropriate in the context of (21) since the situation is not currently ongoing. This difference is discussed in more detail in section 5.2.

As the data in (21) through (23) shows, deontic and epistemic readings may not have the same underlying structure. The crucial examples get disambiguated by an adverb. This observation leads to the assumption that the modal interpretation, i.e. the deontic or epistemic meaning, is assigned to modal auxiliaries within the I-system. Based on the examples in (22) and (23) I propose the structure in (25). There is reason to believe that there are two different modal positions within the IP system. One encodes deontic meaning, the other epistemic meaning. Based on (22) the deontic modal position is the lower one. Based on (23) the epistemic modal position is higher in the hierarchy given that the adverb position is fixed¹⁴.

¹⁴ This observation can only be made with *always*-type adverbs based on Cinque (1999) and not with any kind of adverbs. Of course, Cinque uses different examples and the original Cinque phrase marker involving modals is more complex since it proposes several distinct positions for the different interpretations of deontic cases. For simplicity's sake this complex structure is omitted here.

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(25) Two Modal Positions



Since German is a V2 language the deontic/epistemic interpretation is assigned a bit differently. As we have seen in example (11) in section 2.2.1 the German present tense question is ambiguous. Since German modals have properties of main verbs it is reasonable to assume that they are base-generated in VP, then they move to CP via the IP system. While passing through the IP system, the modal gets assigned either a deontic or an epistemic meaning in the respective positions exemplified in (25). The adverb *immer* (always) cannot disambiguate the structure as in English since always type adverbs have a fixed position within the IP system which is lower than the surface position of the verb, cf. Cinque (1999). This is exemplified in sentence (26). Since, in German, the modal occupies a position higher than the IP in the surface string, the adverb cannot intervene between the two positions yielding disambiguation as in the English cases.

(26) [_{CP}Er muss [_{IP}immer an den Gefrierschrank gehen.]] ⇒ ambiguous
 He must always to the icebox go
 “He must always go to the icebox AND He always must go to the icebox.”

For the German past tense deontic construction I assume that the modal meaning is checks off its feature at LF since the modal appears in the VP, as seen in (15) repeated here as (27). In other words, the modal moves to the ModP2 position at LF to get interpreted.

(27) Wer hat ‘ne Banane essen müssen? ⇒ deontic
 Who has a banana eat must
 “Who had to eat a banana?”

As we can see from the structure in (25), the distinction between the structural position for deontic versus the epistemic position is quite delicate. This subtle difference in positions is quite a challenge in acquisition terms. More so since the disambiguation for the English cases is quite rare, i.e. only *always* type adverbs. In German, pragmatic particles can support the disambiguation process as we can see in examples (28) and (29).

(28) Er muss wohl immer an den Gefrierschrank gehen. \Rightarrow epistemic

He must modal-particle always to the icebox go
“Indeed, it must be him who must always go to the icebox.”

(29) Er muss eigentlich immer an den Gefrierschrank gehen. \Rightarrow deontic

He must modal-particle always to the icebox go
“Necessarily, he always must go to the icebox.”

These modal particles, *wohl* in (28) and *eigentlich* in (29) have no lexical meaning and do not contribute anything to the propositional content of the sentence, cf. Bussmann (1996). This kind of disambiguation is more frequent in German than the disambiguation possibility for English.

To keep the acquisition task as syntactically minimal as possible these pragmatic helps were not included on purpose.

5.2 Implications and Predictions for Language Acquisition and Set Up of Task

In section 4.2 we have seen that the ToM approach predicts children to perform quite well on deontic cases at latest by the age of 3;5 and quite poor on epistemic cases possibly up until the age of 5;0. However, I propose that the non-adult like syntactic capabilities of children will cause them to have trouble in syntactically difficult situations, deontic as well as epistemic. This proposal does not claim that ToM does not play an important role in the acquisition of modals. Nevertheless the ToM approach underestimates the importance of syntax in the acquisition of modals.

This section points out and summarizes the cases for English and German that are crucial in the acquisition task that checked the hypothesis that children have trouble with deontic as well as epistemic cases in the case of a syntactically difficult environment.

5.2.1 Situational Conditions

As we have seen in section 2.2.1 the English present tense presents the child with the following minimal pair. As we can see the deontic form in (30) differs only minimally from the epistemic form in (31) making this a minimal but crucial distinction which needs to be acquired.

(30) Who must eat a banana? \Rightarrow deontic

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(31) Who must *be eating* a banana? ⇒ epistemic

In the situation described in (8) we can see that both possibilities, deontic/*Piglet* and epistemic/*Cookie Monster*, are present in one and the same story. This is an important departure from previous experiments which divided deontic readings and epistemic readings into separate tasks. However, in order to be able to check my hypothesis that children have trouble in syntactically difficult situations, it is crucial that both syntactic structures are an option to the child in one and the same task. This way the child is forced to consider all characters, i.e. structures, and if the child is indeed having trouble in the area of syntax we expect the child to perform poorly no matter whether the question is a deontic one or an epistemic one.

The hypothesis here is that opposed to the minimal difference in the present tense, the deontic/epistemic distinction in the past tense in English is easier to acquire for children because it does not involve a syntactically minimal pair but different lexical items. This is exemplified in examples (12) through (14) repeated here for convenience.

(32) Who was supposed to eat the banana? ⇒ deontic

(33) Who had to eat a banana? ⇒ deontic

(34) Who must have eaten a banana? ⇒ epistemic

As we can see, the child can acquire the difference between deontic and epistemic readings in the past via different lexical items.

For German there is a minimal pair in past tense constructions. Again, I hypothesize that children have difficulties acquiring these structures since they are minimal. And as in the English example, both possibilities, deontic/*Piglet* and epistemic/*Cookie Monster*, are options in one and the same story.

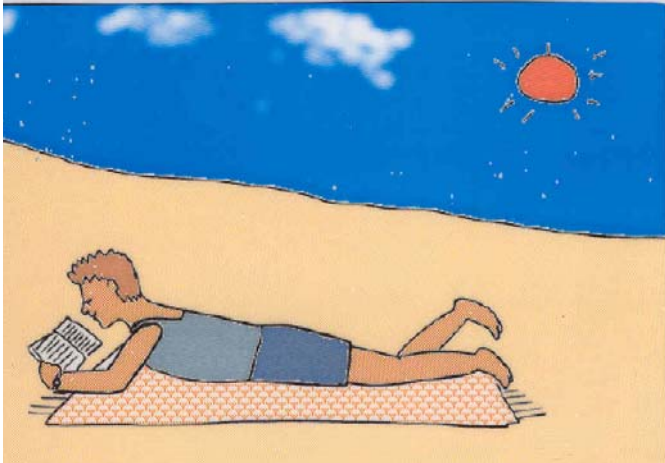
(35) Wer hat 'ne Banane essen müssen? ⇒ deontic
Who has a banana eat must
"Who had to eat a banana?"

(36) Wer muss 'ne Banane gegessen haben? ⇒ epistemic
Who must a banana eat has
"Who must have eaten a banana?"

On the other hand the difficulty that English children face for the present tense is not a problem in German since the structure of (31) is not present in English, i.e. there is no present progressive in German. As we have seen in section 2.2.1 the German present tense is ambiguous between the deontic and the epistemic reading¹⁵.

¹⁵ Of course the acquisition of an ambiguous structure presents a different kind of complexity. This aspect has not been tested yet and I will not test this acquisition in the current paper.

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Picture 2: See this man? He likes to lie on the beach and read.



Picture 3: See this man? He owns this bakery and people love his cakes.

Question: Who must bake a lot of cakes?

The question that follows the pictures is ambiguous, i.e. ‘the daddy’ (deontic) and ‘the baker’ (epistemic) are correct answers to this question. The same holds for German, both answers, deontic and epistemic, are correct adult responses. As opposed to the Banana story situation in example (8) and the questions in (30) through (37) the example in 0 is not situational but habitual. This difference is reflected in the fact that the progressive present tense epistemic question cannot be asked here, i.e. Who must be baking a lot of cakes?.

To make difference between situational and habitual easy to grasp for the children the situational examples were presented in an animated video story format and the situational examples were presented in non-animated still picture format to the children.

6. Acquisition Study

6.1 The English Study

For the English study the following conditions were tested. According to my hypothesis children should have trouble when pitting example (30) the deontic/*Piglet* reading against (31) the epistemic/*Cookie Monster* reading. Since the number of tokens was limited, the children already had two trial days each, only question (30) was asked. If the child mistakenly answered with the epistemic character we know that she is misinterpreting the question with the epistemic meaning since children had to point to a character of their choice. Furthermore a neutral setting and a biased setting was introduced into the task. The Banana story that we have seen in previous sections had all three participating characters visible at all times. This setting was considered a neutral setting. In the biased setting the children were biased towards the non-adult epistemic interpretation by having the character representing the epistemic reading be present exclusively in the last frame. For the Banana story this would have meant to have *Piglet* alone in the last frame when the story ended. This biased setting was introduced to check whether children would fall for the lure of the immediate present and thereby being influenced towards an epistemic reading.

Furthermore past tense constructions with *must* were checked. As we have seen in the previous section it is predicted that children do not have a problem interpreting this structure since it does not compete with another minimally different structure. This is not expected under the ToM approach since this reading is epistemic.

The last condition that was tested in English were the ambiguous habitual conditions described in the previous section.

6.1.1 Procedure

Subjects: 28 children from 3 to 5 years. A control group of 6 adults. The children were not all monolingual but it was made sure that their English abilities met standard English abilities expected at this age. All children were considered to be developing normally and were not language impaired or had any perceptual impairment, for example hearing loss. Since a pilot study did not show any difference in performance of male and female children a balance in sex was not required.

Task: After a warm-up session, where the characters and the tasks were introduced, the children saw stories on a laptop from a CD ROM but without sound. While showing the video the experimenters told the corresponding story live¹⁶. Before each story a picture of the characters that were involved in the particular story were laid on the table before the child. After the story the child was asked either a deontic or an epistemic question.

¹⁶ We tried to have native speakers of English as experimenters but this was not possible for the whole experiment. Thanks to Jill de Villiers' students Marissa Fond and Kathy D'Amato for helping us out.

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In a second task the children saw a sequence of three pictures with a corresponding description of the content of these pictures. This task was used for the ambiguous questions exclusively. This condition included one picture compatible with a deontic reading, one picture compatible with an epistemic reading and one picture that functioned as a distractor. The 3 pictures were changed for sequence for each child. Afterwards the children were asked an ambiguous question, i.e. two answers, deontic and epistemic, were possible and correct answers.

Throughout the stories *have to* was used. As observations in Papafragou (1998) show, children perform better with items that are more colloquial to them. Therefore, the more colloquial form *have to* is used for English. The question that followed the stories, however, contains *must*. This replacement should not pose a problem for the task. On the contrary, possible effects from ‘the lure of the immediate present’ can be reduced. This is so because *is* and *have to* are farther apart than *is* and *must* in the relative force hierarchy.

Token: 8 stories per day (2 neutral present tense, 2 biased present tense, 2 past tense and 2 ambiguous). With 2 test days it made up a total of 16 stories per child. The token were evenly distributed and there were distractors included that were not related to the structure.

6.1.2 Results and Discussion

Table 1: 3-year-olds

	Correct	Wrong	Total
Deontic	16 (47%)	18 (53%)	34
Epistemic	21 (87%)	3 (13%)	24
	Deontic	Epistemic	
Ambiguous	18 (82%)	4 (18%)	22

Table 2: 4-year-olds

	Correct	Wrong	Total
Deontic	13 (33%)	26 (67%)	39
Epistemic	18 (86%)	3 (14%)	21
	Deontic	Epistemic	
Ambiguous	13 (57%)	10 (43%)	23

Table 3: 5-year-olds

	Correct	Wrong	Total
Deontic	13 (32%)	28 (68%)	41
Epistemic	23 (92%)	2 (8%)	25
	Deontic	Epistemic	
Ambiguous	12 (41%)	17 (59%)	29

As we can see in Table 1 through Table 3 children do have trouble in answering the deontic question. This confirms the prediction that when there is a competing syntactic structure children do have problems because of their non-adult like syntactic abilities. If the ToM approach were correct children should have performed that much better on this task. As we can see there is no significant improvement in performance within the age groups. As for the difference within the deontic task in the neutral versus the biased condition it was observable there was no significant difference between the two subconditions for the 3-year-olds. For the 4 and 5-year olds there was an effect observable. These age groups did indeed fall for the biased setting since the results show a slight above chance response for the non-adult epistemic reading as opposed to the neutral setting¹⁷.

Moreover as we can see in Table 1 through Table 3 children of all age groups performed quite well on the past tense epistemic condition which did not compete with a minimally different syntactic structure. This finding is expected under the hypothesis put forward in the previous section. However, this result is not expected under a ToM approach. If the ToM were correct at least the younger age groups should have performed significantly worse in the epistemic task. As we can see there is no significant increase in performance within the age groups.

Finally the habitual ambiguous condition in which both, deontic and epistemic, were correct adult responses we can see that 3-year-olds prefer deontic readings, 4-year-olds have no preference for either reading and 5-year-olds have a slight preference for epistemic readings. This finding is compatible with the current hypothesis as well as the ToM approach. Children do indeed seem to start out with deontic readings and then develop a better understanding of epistemic readings.

Summarizing these findings I conclude that the ToM approach might well play its part in the acquisition of deontic and epistemic readings as the habitual ambiguous condition shows. However, research so far has underestimated the role of children's non-adult like syntactic abilities. This underestimation might have also been caused by the fact that experimental tasks so far have separated deontic from epistemic tasks thereby not forcing children to choose between two closely related syntactic structures.

¹⁷ In the interest of space limitations only the most important results are given here. Please contact the author for specific details.

6.2 The German Study

For the German study the following conditions were tested. According to my hypothesis German children should have trouble in past tense constructions pitting example (35) against (36) which is a syntactic minimal pair. Both question types, i.e. (35) and (36) were asked. Moreover the biased and neutral subcondition was maintained just as described in section 6.1 for the English study.

For German there are two ambiguous conditions, the present tense situational condition in the video task, i.e. example (37), and the present tense habitual condition in the picture task.

6.2.1 Procedure

Subjects: 26 children from 3 to 5 years. A control group of 5 adults. The children were monolingual. All children were considered to be developing normally and were not language impaired or had any perceptual impairment, for example hearing loss. Since all previous studies did not show any difference in performance of male and female children a balance in sex was not required.

Task: After a warm-up session, where the characters and the tasks were introduced, the children saw stories on a laptop from a CD ROM but without sound. While showing the video the experimenter told the corresponding story live. Before each story a picture of the characters, that were involved in the particular story, were laid on the table before the child. After the story the child was asked either a deontic or an epistemic question in the past tense condition or an ambiguous question in the present tense conditions.

In a second task the children saw a sequence of three pictures with a corresponding description of the content of these pictures. This task was used for the ambiguous questions exclusively. This condition included one picture compatible with a deontic reading, one picture compatible with an epistemic reading and one picture that functioned as a distractor. The 3 pictures were changed for sequence for each child. Afterwards the children were asked an ambiguous question, i.e. two answers (deontic and epistemic) were possible and correct answers.

Token: 8 stories per day. Day 1: 1 neutral present tense, 2 biased present tense, 3 past tense and 2 ambiguous. Day 2: 2 neutral present tense, 1 biased present tense, 3 past tense and 2 ambiguous. The questions for the past tense condition were evenly distributed for deontic and epistemic token. The various token were evenly distributed and there were distractors included that were not related to the structure.

6.2.2 Results and Discussion

Table 4: 3-year-olds

	Correct	Wrong	Total
Deontic	16 (67%)	8 (33%)	24
Epistemic	12 (50%)	12 (50%)	24
	Deontic	Epistemic	
Ambiguous (situational)	36 (80%)	9 (20%)	45
Ambiguous (habitual)	22 (69%)	10 (31%)	32

Table 5: 4-year-olds

	Correct	Wrong	Total
Deontic	14 (58%)	10 (42%)	24
Epistemic	6 (25%)	18 (75%)	24
	Deontic	Epistemic	
Ambiguous (situational)	28 (58%)	20 (42%)	48
Ambiguous (habitual)	16 (48%)	17 (52%)	33

Table 6: 5-year-olds

	Correct	Wrong	Total
Deontic	18 (60%)	12 (40%)	30
Epistemic	8 (27%)	22 (73%)	30
	Deontic	Epistemic	
Ambiguous (situational)	36 (75%)	12 (25%)	48
Ambiguous (habitual)	6 (19%)	26 (81%)	32

As we can see in Table 3 through Table 6 children did have trouble with the past tense condition as predicted. Children of all age groups performed equally on the deontic conditions, i.e. no increase in performance was detectable. However as we can see in Table 3 3-year-olds performed better on the epistemic condition than the older age groups but these responses are by chance responses as the numbers show. The 4 and 5-year-olds performed better on the deontic than the epistemic condition. This finding is compatible

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with the current hypothesis as well as partly with the ToM approach. However, under the ToM approach we would have expected the children of all age groups to perform significantly better in the deontic condition which is not the case here. An explanation for the worse performance in the epistemic conditions of 4 and 5-year-olds could be that they start to realize that there is indeed an epistemic reading but that they still mistakenly assign a non-adult deontic structure to the sentence.

This explanation is supported by the fact that the numbers for the ambiguous condition show an increase in epistemic readings when we compare the 3, 4 and 5-year-olds. Again, this finding is compatible with the current hypothesis as well as the ToM approach.

Furthermore there was no difference detectable for any age group for the biased versus the neutral subcondition in the situational ambiguous condition in any of the age groups.

6.3 Comparing the English and the German Study

As predicted in section 5.2 English and German children exhibited problems with deontic as well as epistemic readings when these structures were syntactically closely related, i.e. minimally different. This means that English children indeed showed trouble in the present tense (deontic) versus the present progressive (epistemic) condition. Furthermore, as predicted even the youngest English children did not have trouble in the past tense condition although it was an epistemic condition since this structure was syntactically not competing with closely related structures. As predicted, German children had trouble in the past tense condition no matter whether it was deontic or epistemic since these structures are a syntactic minimal pair.

For English as well as German children it was observable that in the habitual ambiguous condition, children seem to start out with a preference for deontic readings and acquire more epistemic readings later as the preference for epistemic readings in the 5-year-olds in both languages shows.

An additional interesting conclusion can be drawn by comparing English and German children with regard to the biased and neutral settings. As we have seen the biased subcondition does have an effect on the older English age groups. However it does not effect any of the German age groups. The biased setting does have an impact exactly in the case where children are having difficulties syntactically, i.e. the English children. It does not have an effect when there is no syntactically precarious situation to begin with, i.e. no trouble for the German children.

These results support the hypothesis that children's non-adult like syntactic abilities in deontic as well as epistemic readings has a quite important impact on their performance. These findings combined show that the ToM approach as well as previous studies have underestimated the role of syntax in children's acquisition of modals. Furthermore these findings support researchers like de Villiers et al. and Miller in their

view that certain syntactic structures might be necessary for a Theory of Mind to develop in the first place.

7. Conclusion

This paper has put forward a syntactic approach to deontic and epistemic readings of modals such as *must* and *müssen* by proposing that deontic and epistemic readings are assigned to modals in two distinct syntactic positions. This analysis supports a monosemous semantic approach to modals over a polysemous approach since a polysemous approach would most likely map both readings onto one syntactic position. The two distinct syntactic positions for the two meanings also have an impact on how children's acquisition of these meanings might be guided. The difference in syntactic positions is quite subtle and therefore it is expected that the acquisition of this difference is quite complicated. This proposal however does not predict which of the two readings emerges first. The Theory of Mind predicts that a deontic meaning emerges first. The Theory of Mind is no doubt a part of the acquisition of modals. Nonetheless its importance in the acquisition of modals might have been overestimated.

The experimental part of this paper put forward the hypothesis that although the Theory of Mind has a part in the path of acquisition of modals the syntactic influence must not be underestimated. The Theory of Mind approach as well as previous experimental studies underestimated the impact that a non-adult like syntactic grammar has on the acquisition of modals.

The hypothesis put forward in this paper predicted that if children are put in a situation where they have to compare two minimally distinct syntactic structures their performance is equally impaired in deontic as well as epistemic instances. This prediction was borne out by the English as well as the German data. A subpart of the data in both languages also confirms previous studies that showed that if children are not in a syntactically minimal environment, deontic readings emerge prior to epistemic readings.

This study investigated only a subpart of modals in English and German. More studies including more modals are certainly desirable to complete the picture. However, the general hypothesis should be transferable to other modals and languages.

References

- Bussmann, H. (1996). *Routledge Dictionary of Language and Linguistics*. London: Routledge.
- Choi, S. (1995). The Development of Epistemic Sentence-ending Modal Forms and Functions in Korean Children. In: J. Bybee and S. Fleischman (Eds.), *Modality in Grammar and Discourse*. Amsterdam: Benjamins, 165-204.
- Cinque, G. (1999). *Adverbs and Functional Heads*. Oxford: OUP.
- Coates, J. (1987). The acquisition of the meanings of modality in children aged eight and twelve. In: *Journal of Child Language* 15 (2), 425-434.

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- de Villiers, J. G. and de Villiers, P. A.. (2000). Linguistic Determinism and the Understanding of False Beliefs. In: P. Mitchell and K. Riggs (eds), *Children's Reasoning and the Mind*. Hove: Psychology Press, 191–228.
- de Villiers, J.G. and Pyers, J.E. (2002). Complements to Cognition: a Longitudinal Study of the Relationship Between Complex Syntax and False-belief-understanding. *Cognitive Development* 17, 1037–1060.
- Greenbaum, S. & R. Quirk. (1990). *A Student's Grammar of the English Language*. Harlow: Longman.
- Hirst, W. & J. Weil. (1982). Acquisition of Epistemic and Deontic Meaning of Modals. In: *Journal of Child Language* 9(3), 659-666.
- Kuczaj, S.A. & M.P. Maratsos. (1975). What children can say before they will. In: *MPQ* 21, 89-111.
- Kuczaj, S.A. & M.P. Maratsos. (1983). Initial verbs of yes-no questions: A different kind of general grammatical category. In: *Developmental Psychology* 19, 440-444.
- Miller, C. A. (2001). False Belief Understanding in Children with Specific Language Impairment. In: *Journal of Communication Disorders*, 34, 73–86.
- Miller, C.A. (2004). False Belief and Sentence Complement Performance in Children with Specific Language Impairment. In: *International Journal of Language & Communication Disorders* 39(2), 191-213.
- Moore, C., D. Bryant & D. Furrow. (1989). Mental terms and the development of certainty. In: *Child Development* 60, 167-171.
- Moore, C. & J. Davidge. (1989). The development of mental terms: Semantics or pragmatics?. In: *Journal of Child Language* 16, 633-641.
- Noveck, I. A., S. Ho & M. Sera. (1996). Children's Understanding of Epistemic Modals. In: *Journal of Child Language* 23(3), 621-643.
- Papafragou, A. (1997). Inference and word meaning: The case of modal auxiliaries. In: *Lingua* 105, 1-47.
- Papafragou, A. (1998). The Acquisition of Modality: Implications for Theories on Semantic Representation. In: *Mind & Language* 13(3). 370-399.
- Papafragou, A. (2001). Linking Early Linguistic and Conceptual Capacities: The Role of Theory of Mind. In: A.Cienki, B. Luka & M.Smith (eds) *Conceptual and Discourse Factors in Linguistic Structure*. Stanford: CSLI Publications, 169 -184.
- Palmer, R. F.. (1998). *Mood and Modality*. Cambridge: CUP.
- Perkins, M. (1983). *Modal Expressions in English*. London: Frances Pinter.
- Roberts, I. (1985). Agreement Parameters And The Development Of English Modal Auxiliaries. In: *NLLT* 3(1), 21-58.
- Shatz, M., Billman D. & Yaniv, I. (1986). *Early occurrences of auxiliaries in children's speech*. Unpublished manuscript. University of Michigan, Ann Arbor.
- Shatz, M. & S. A. Wilcox. (1991). Constraints on the Acquisition of English Modals. In: S. A. Gelman & J. P. Byrnes (Eds.). *Perspectives on Language and Thought: Interrelations in Development*. Cambridge: CUP, 319-353.
- Wellman, H. (1990). *The Child's Theory of Mind*. Cambridge: MIT Press.
- Wells, G. (1979). Learning and Using the Auxiliary Verb in English. In: V. Lee (Ed.) *Cognitive Development: Language And Thinking from Birth to Adolescence*. London: Croom Helm.

Appendix A – Situational Condition

Questions are not given after the stories since they differed for German versus English and they were pseudorandomized for each child. Each question type is compatible with each story.

1. Banana

We can see a house and within the milky window we can see Piglets shadow eating a banana. In front of the house we can see Bert and Cookie Monster. Look, there is Cookie Monster and there is Bert. Bert tells Cookie Monster: “You eat too many cookies and not enough fruit and vegetables. That's not healthy. So, you really have to eat a banana.” Throughout the story all three characters are visible.

2. Tires

We can see a house and in front of the house there are Eey-ore, Piglet and a car. Look, there are Eey-ore and Piglet. Eey-ore tells Piglet: “Our car has a flat tire. So, before we go to Tigger's house I'll buy a present for him. But you really have to change the tire.” (New scene) Eey-ore and Piglet are gone but Mickey Mouse's big ears are visible behind the car. Note that only the ears are visible not the whole puppet. Uh, look!

3. Dishes

Kitchen scene is set up. The kitchen looks messy. Look, there is Ernie and there is Elmo. Ernie tells Elmo: “Look at the mess you made. This is terrible. You really have to wash the dishes before Bert comes home.” (New scene) Ernie and Elmo are gone. Through a window we can see a pair of blue arms washing dishes. Oh, look.

NOTE: Elmo is red, Cookie Monster is blue!

4. Spinach

Kitchen scene is set up. Winnie the Pooh is behind the stove. Tigger sits at a table. Look, there is Tigger and there is Winnie the Pooh. And here comes Eey-ore. Tigger says: “Can I go outside and play with Eey-ore?” Winnie the Pooh says: “Sure, but first you have to eat all your spinach. We can hear a phone ringing. Winnie the Pooh says: “Oh, the telephone.” Winnie the Pooh leaves. Tigger says: “I really don't like spinach.” Fade out and fade in. Winnie the Pooh enters the scene. Now, Winnie the Pooh is back. He says: “Oh, the spinach is all gone. Good, Tigger, now you can go outside.” Oh, look at Eey-ore! We can see that Eey-ore face is smudged with spinach.

5. Shelving

Grocery store scene set up. Look, there is Bert and there is Ernie. Ernie works for Bert in the grocery store. See the cash register and all the shelves. Bert says: “Look at all these cans on the floor. The customers can't walk through here and they can't push their shopping carts down the aisle. Behind one of the shelves we can see a pair of red hands piling up cans. Note that only the hands are visible not the whole puppet. They'll get angry and complain. You really have to put the cans on the shelf.” “Okay,” says Ernie, “I'll do it right away.”

6. Ball

There are no props at all. We can see Ernie and Cookie Monster. Bert comes in with a ball. Look, there is Cookie Monster and there is Ernie. Ernie says: “Cookie Monster, do you want to play ball?” “Yeah, sure,” says Cookie Monster. “Well, first I have to get a ball. Because without a ball we can't play.”

7. Banana Buying/ Birthday Cake

Kitchen scene is set up. Look, there is Minnie Mouse. She wants to bake a banana cake for Mickey Mouse because it is his birthday. She reads the recipe and says: “Let's see: I need flour, I have flour. I need a banana, ... oh no, I don't have any bananas. I'd better go to the grocery store because I have to buy a banana.” (New scene) Minnie Mouse is gone. A grocery store from outside and through a milky window we can see shadows moving. The shadows can clearly be

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identified as Bert and Winnie the Pooh. Winnie the Pooh is behind the cash register and Bert has a banana in his hands. Look, here is the grocery store. See the sign for Stop & Shop? We can hear a bing from the cash register.

8. Trumpet

Kitchen scene is set up. In the rightmost corner of the scene there is a wall with a milky window. Look there are Winnie the Pooh and Eey-ore. Winnie the Pooh tells Eey-ore: "Eey-ore, you have to play your trumpet because your concert is tomorrow." Look, there is Piglet. He says: "Yey, I just got a trumpet." Piglet vanishes behind the wall then reappears as a shadow in the milky window with the trumpet at his mouth. We can hear trumpet sounds. Winnie the Pooh and Eey-ore are still in the kitchen.

9. Jam

Kitchen scene is set up. Look, there is Elmo and there is Ernie. Ernie says: "Hmm, I really want toast with jam for breakfast." "Me too", says Elmo. "But look, the jar is empty." Ernie says: "Oh no, what should we do?" Elmo says: "Well, we have to buy some jam. So let's go to the grocery store." (New scene) A grocery store. Look, there they are in the grocery store. Ernie says: "Oh no, Elmo. There is no jam left. The store is all sold out." Elmo says: "Well, what should we do? Should we have toast with honey instead?" Ernie says: "That's okay with me. So let's go home." (New scene) Back in the kitchen. Bert sits at a table having a toast with jam in his hand. And now they're back at home. "Oh", says Elmo, "Look, what Bert has for breakfast!"

10. Drinking

Kitchen scene is set up. We can see Mickey Mouse with a basket full of groceries. Look, there is Mickey Mouse. Oh, he has some groceries. Mickey Mouse says: "I am so thirsty. I really have to drink something. But first I should bring in the rest of the groceries." (New scene) A house. In front of the house we can see a car and Mickey Mouse. In a milky window of the house we can see the shadow of Bert with a bottle at his mouth. Look, there he is at the car with the rest of the groceries.

11. Sandbox

A house. In front of the house we can see a sandbox. Look, there are Cookie Monster and Ernie in the sandbox. Cookie Monster says: "I don't really want to play anymore. I'm kind of tired. I guess I'll go inside and take a nap." "Okay," says Ernie, "That's fine." Cookie Monster says: "I cleaned up last time. So, could you clean up this time?" "Okay then," says Ernie. And Cookie Monster goes inside. Fade out, fade in. Same set up. In front of the house we can see Cookie Monster's shoes. Ernie has finished cleaning up. Look, Ernie put away all the toys. And now he is ready to go inside. Bert enters the scene. But look, there is Bert and he says: "Ernie, don't go inside with your sandy shoes. I cleaned the whole house this morning and if you go inside with your sandy shoes it'll get all dirty. So, you really have to take off your shoes. Look, somebody already did it."

12. Apple-picking

We can see a tree with a lot of red apples. Look, there is Piglet and there is Winnie the Pooh. And Winnie the Pooh says: "I'll get some honey, but you really have to pick apples so that we'll have enough food for the winter." Piglet says: "Okay." Winnie the Pooh leaves the scene. Piglet tries to reach the apples, but he realizes that he is too small. He says: "I think I'd better get a ladder." Piglet leaves the scene. Fade out, fade in. A basket with apples is under the tree and the feet and parts of Bert's face are visible in the tree. Look, I think there is someone up in the tree. I think I can see a foot and a face.

Appendix B – Ambiguous Condition¹⁸

1. Burgers

Picture 1: See this little boy? He is so skinny his mother is trying to get him to eat more. So she says he can't go out until he finishes all these burgers. Phew!

Picture 2: See this guy? He is so big he can hardly fit through the door of McDonald's. I guess he eats plenty.

Picture 3: See this man? He is trying to catch a fish.

Who must eat a lot of burgers?

2. Heavy

Picture 1: See this man? He is eating some corn.

Picture 2: See this man (*man has weights in his hands*)? He's got lots of muscles! I guess he works out in the gym.

Picture 3: This boy can't go and play today because his family is moving, and he has the job of moving all these big boxes.

Who must lift a lot of heavy things?

3. Bake

Picture 1: See this man? His little girl is having a birthday party tomorrow and she says that every kid has to have his own special cake and her dad has to bake them all.

Picture 2: See this man? He likes to lie on the beach and read.

Picture 3: See this man? He owns this bakery and people love his cakes.

Who must bake a lot of cakes?

4. Ice-Cream

Picture 1: See this woman? She works in the ice-cream store – what a nice job – YUM! She tries every flavor and loves them!

Picture 2: This woman can't remember which of these boxes has vanilla ice cream in it, so she's gonna have to try them all.

Picture 3: See this woman? She is having a nice nap.

Who must taste a lot of ice cream?

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