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Interrelationships between Theory of Mind and language development: A longitudinal study of Dutch-speaking kindergartners

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ABSTRACT

Research on the relationship between language acquisition and Theory of Mind (ToM) has been largely confined to English-speaking populations and has yielded conflicting results regarding which domains of language are most relevant. The current study assessed 101 *Dutch*-speaking kindergartners on ToM and various potentially relevant domains of language (general and mental vocabulary, sentence comprehension and sentential complementation understanding). Results show a bidirectional relationship between ToM and both vocabulary measures and a unidirectional relationship from sentence comprehension to ToM. Sentence comprehension was the best ToM predictor out of the language measures. No evidence was found for a relationship between ToM and sentential complementation understanding, likely due to the use of a novel, and potentially purer, sentential complementation measure. Comprehension of language at the sentential level is thus fundamental for explicit ToM development. Finding this result in a Dutch-speaking population suggests that similar outcomes from previous studies can be generalised more broadly.

1. Introduction

Being able to communicate with others and being able to understand what is going on in other people's minds (Theory of Mind, ToM) are two fundamental aspects of the child's socio-cognitive development. Although there are specific disorders in the domain of language development (e.g. Specific Language Impairment; Conti-Ramsden & Durkin, 2011) and in the ability to understand other people's mental states (Autism Spectrum Disorders (ASD); Baron-Cohen, Leslie, & Frith, 1985), which indicates that these domains are dissociable, it is likely that the development of language and ToM is intimately related. After all, being able to communicate with others provides you with a unique means of understanding what is going on in their mental world and an understanding of what is going on in other people's mental worlds makes it easier to understand what it is that someone might be trying to communicate to you. The current study has two major aims: (1) to investigate how specific components of language and the explicit false belief understanding component of ToM are developmentally interrelated; (2) to contribute data from a non-English-speaking population to the current body of knowledge in this domain. This study thus considers how various aspects of language and ToM are related in *Dutch*-speaking four- to five-year olds, so that it can be assessed whether the results that have been obtained for previous studies

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investigating this issue only apply to English-speaking children or whether they can also be generalised to other linguistic populations.

1.1. Interrelations between language and ToM development

Although the relationship between language and ToM, particularly the false belief understanding component of the latter, has been the topic of many previous studies, there is still debate regarding the question whether specific components of language are required for *explicit* false belief understanding[1] to develop (most notably the understanding of sentential complementation constructions) or whether the linguistic system as a whole needs to have a certain level of complexity for it to scaffold the development of explicit false belief understanding (see, for instance, Astington & Baird, 2005; Milligan, Astington, & Dack, 2007; San Juan & Astington, 2012; a recent meta-analysis of studies investigating this issue is provided by Farrar, Benigno, Tompkins, & Gage, 2017). Astington and Jenkins (1999), for example, argue in favour of what Farrar et al. (2017) refer to as the 'general language hypothesis': the child has to have a linguistic system that can handle a certain level of representational complexity before false belief understanding is possible. On this view, understanding that other people's mental states can differ from your own (and from reality) requires the child to be able to separate the child's own representation of reality and those of others. The linguistic system is then thought to serve as the representational means that allows the child to organise and separate these different layers of representation and thus be able to process them effectively.

However, other studies have argued that the linguistic system should not be considered as a unitary whole in this respect. Instead, specific aspects of language have been suggested to be of particular relevance in the development of explicit false belief understanding. For instance, based on their findings with Nicaraguan signers, Pyers and Senghas (2009) suggest that acquisition of vocabulary, specifically mental state terms, is important, as they provide labels for entities that are not directly observable (e.g. mental state verbs like *know* and *believe*). In line with the idea that lexical ability is important for understanding of false beliefs to develop, Low (2010) demonstrates that three- and four-year old children's scores on a standardised general vocabulary task are significantly correlated with their performance on explicit ToM tasks. Furthermore, an intervention study by Gola (2012) demonstrates that repeated exposure to mental state verbs enhanced three- and four-year-old children's ToM performance. Finally, a recent meta-analysis by Devine and Hughes (2018) also suggests that mother's earlier mental state talk is robustly linked to children's later false belief understanding, again underscoring the importance of exposure to mental state terms for ToM development.

In contrast to this suggestion that the acquisition of (particular aspects of) vocabulary is crucial for ToM development, de Villiers and colleagues (de Villiers, 2005, 2007; de Villiers & de Villiers, 2014; de Villiers & Pyers, 2002) argue in favour of the 'sentential complementation hypothesis'. In their view the acquisition of tensed sentential complementation constructions with a realis complement (i.e. a complex sentence that has a tensed subordinate clause as its grammatical object that can be judged for its truth against reality, see 1 and 2), is fundamental in the development of false belief understanding.

1) Maxi thinks [that the chocolate is in the blue cupboard]
2) John says [that the keys are in the drawer]

Both mental state verbs like *think*, as in 1, and communication verbs like *say*, as in 2, can occur in tensed sentential complementation constructions with a realis complement. In these constructions it is possible that the truth conditions of the subordinate sentence ('the chocolate is in the blue cupboard') and the matrix sentence ('Maxi thinks that the chocolate is in the blue cupboard') have different values (e.g. the subordinate sentence can be false whilst the matrix sentence can be true). According to de Villiers (2005), mastery of this kind of sentential complementation construction bootstraps false belief understanding in the following way: at some point in development the child notices the surface syntactic similarity of communication verbs (like *say*) and mental state verbs such as *think*. On being exposed to overt evidence that a communication verb can take false complements (e.g. someone claims 'John says the keys are in the drawer' in a situation in which the child knows that the keys are not in the drawer), the child is in a position to realise that if it is possible to *say* something false, it may also be possible to *think* something false. At this point in development, the child is capable of dealing with the fact that the embedded proposition encodes the content of someone's mind and that the truth of the embedded proposition can thus only be evaluated with respect to this person's mind, even if this is not in line with reality. In this way then, understanding of the syntactic and truth conditional properties of tensed sentential complementation constructions with a realis complement provides the child with a developmental 'breakthrough' in her understanding of false beliefs that occurs sometime in the fourth or fifth year of life.

In support of this idea, a longitudinal study by Farrant, Maybery, and Fletcher (2012) found that earlier sentential complementation understanding predicted later false belief understanding. Intervention studies by Lohmann and Tomasello (2003) for German-speaking children, Hale and Tager-Flusberg (2003) for English-speaking children and Shuliang, Yanjie, and Sabbagh (2014) for Mandarin-speaking children have also demonstrated that training three- to five-year-old children on sentential complementation constructions enhances their performance on false belief tasks. These findings from individual studies on typically developing

[1] Although *implicit* false belief understanding may already be present at a very early age (see Baillargeon, Scott, & He, 2010, for a review), the current study focuses on the development of explicit false belief understanding, as linguistic development has been suggested to have its primary influence on this aspect of ToM development (see, for instance, Apperly, 2010; Low, Apperly, Butterfill, & Rakoczy, 2016; San Juan & Astington, 2012, for further discussion of this issue).

children were supported by a meta-analysis by Milligan et al. (2007), as they found evidence for a unique role for sentential complementation understanding in predicting false belief understanding. Finally, in their investigation of atypically developing populations, Durrleman and Franck (2015) and Durrleman et al. (2016) provide evidence to suggest that children with ASD use their understanding of sentential complementation constructions (especially those with verbs of communication like *say*) as a cognitive tool to be able to figure out solutions to ToM tasks, even if these tasks are nonverbal in nature. Paynter and Peterson (2013) also report a link between sentential complementation understanding and false belief understanding in children with ASD in their training study (see Fontana, Adenzato, Penso, Enrici, & Ardito, 2018, for a more extensive review of studies assessing the relationship between sentential complementation constructions and false belief understanding in clinical and non-clinical populations).

Although there are thus many studies that suggest that understanding of sentential complementation constructions is required for explicit false belief understanding, there is also quite a body of research that does not find this link for typically developing children. Indeed, although the study by Durrleman et al. (2016) finds a correlation between children with ASD's performance on nonverbal ToM tasks and their understanding of sentential complementation constructions, this correlation was not found for the typically developing control group in this study (and the same applies to Paynter & Peterson, 2013, although Durrleman & Franck, 2015, do report a correlation between the two domains for their typically developing participants). There is, in fact, quite a body of research that supports the general language hypothesis: multiple studies have found that general linguistic ability (consisting of both syntactic and semantic aspects of language) is most closely related to ToM ability and that sentential complementation understanding does not independently contribute to ToM development once general language ability is taken into account (e.g. Cheung et al., 2004; Tardif, So, & Kaciroti, 2007, for Cantonese and Ruffman, Slade, Rowlandson, Rumsey, & Garnham, 2003, for English). Furthermore, although the recent meta-analysis by Farrar et al. (2017) does find evidence for an independent relationship between false belief and sentential complementation understanding for children with atypical development, the two domains were not exclusively related for typically developing children. Instead, this meta-analysis found the general language hypothesis to be more strongly supported than the sentential complementation hypothesis for typically developing children.

Furthermore, studies that do find a link between sentential complementation understanding and ToM have demonstrated that not all types of sentential complementation construction are equal in this respect. Perner, Sprung, Zauner, and Haider (2003), for instance, suggest that there is no specific relation between the sentential complementation construction itself and false belief understanding in German two- to four-year-olds. Although in German *want that* occurs with the same grammatical construction as *think that* and *say that* (e.g. 'Mutter will, dass Andreas ins Bett geht' [Mum wants that Andy goes to bed]), German children were found to understand sentences with *want that* much earlier in development than constructions with *think that* or *say that*. As only understanding of the latter constructions was found to be related to explicit false belief understanding, this finding suggests that only specific kinds of sentential complementation constructions are relevant to ToM development. This suggestion is supported by findings from Cantonese and Mandarin, as these languages also use the same linguistic construction to express desire and belief, but children demonstrate earlier understanding of desire than belief (Tardif & Wellman, 2000). This developmental difference suggests that understanding the syntax of the sentential complementation construction is not enough for explicit false belief understanding to develop and thus goes against a purely syntax-based version of the sentential complementation hypothesis. It should be noted, though, that these particular findings do not actually go against the sentential complementation hypothesis as conceptualised by de Villiers and her colleagues, as sentential complementation constructions with desire verbs do not have realis complements even if they can be tensed in some languages (see, for example, the claims made in de Villiers & de Villiers, 2014). However, this counter-argument cannot be made for the findings reported in Brandt, Buttelmann, Lieven, and Tomasello (2016), as this study found that although understanding of third person sentential complementation constructions (e.g. 'the cow thinks the sticker is in the red box') was related to four-year-old children's understanding of their own previous false beliefs, there was no such relation between understanding of first person sentential complementation constructions (e.g. 'I think the sticker is in the red box') and false belief understanding. This dissociation in performance would not be expected if it is the tensed sentential complementation construction with a realis complement in and of itself that is relevant in enabling explicit false belief reasoning to be possible.

Given these conflicting findings regarding the relationship between false belief and sentential complementation understanding, it is not currently clear whether an understanding of tensed realis sentential complementation constructions is in fact required for false belief understanding to develop. In addition, the nature of the task that is traditionally used to assess understanding of sentential complementation constructions also makes an evaluation of the sentential complementation hypothesis problematic. Ruffman et al. (2003) argue that the assessment of sentential complements and false beliefs is confounded in the traditional sentential complementation task. In a typical version of this task, children are told stories in which the protagonist is described as making a mistake, telling a lie or having a false belief, and they are then asked a question about the matrix sentence (e.g. 'He thought he found his ring, but it was really a bottle cap. What did he think?'; de Villiers & Pyers, 2002). Although false belief understanding may not strictly be necessary to answer the question correctly (given that the child only has to repeat the thought verbatim), the story does not make much sense if you have no concept of false beliefs already in place. As Ruffman et al. (2003) point out, without false belief understanding the child has no basis for reconstructing what the character thinks and hence may find it hard to remember a mistaken proposition. An incorrect answer may thus not primarily be a reflection of the child's inability to process sentential complementation constructions as such, but instead may reflect their lack of understanding of the story at the conceptual level. Using a communication verb (e.g. *say*) instead of a mental state verb like *think* in this test set-up does not solve the problem, as use of the communication verb entails that the protagonist is lying, which similarly requires some understanding of the nature of false beliefs. Also note that even if the statement is construed as a mistake instead of a lie, it still seems likely that the child has to have at least some appreciation of the notion that thoughts can be incorrect in order to make sense of the story. Furthermore, many of the items that tend to be used in these tasks are more in line with the protagonist lying than simply making a mistake, e.g. the child is asked 'what did she say she was

cutting?' in a situation in which a girl tells her father she is cutting paper, when in reality she is cutting her own hair (example from Hale & Tager-Flusberg, 2003). Thus, although a number of studies have demonstrated an important role for sentential complementation in the development of false belief understanding, it is not entirely clear to what extent this claim will be upheld if a purer task of sentential complementation understanding (i.e. a task that does not confound an understanding of sentential complements and false beliefs) is employed. Indeed, although Ng, Cheung, and Xiao (2010) do not investigate to what extent this particular confound affects the relationship, their findings do suggest that the nature of the information that is provided in the sentential complementation task affects whether a relationship between false belief and sentential complementation understanding is observed. For instance, when a story character's desire is made explicit in the sentential complementation task (presumably prompting children to focus more on mental states), a positive correlation between false belief and sentential complementation is reported, but no correlation between these domains was found when this was not the case. This finding thus suggests that sentential complementation tasks that implicitly prime children to contemplate the protagonists' mental states might not be suitable for assessing whether there is a relationship between false belief and sentential complementation understanding. The current study therefore employs a novel task of sentential complementation understanding that aims to assess children's mastery of tensed sentential complementation constructions with a realis complement in a context that does not require the understanding of (false) beliefs, mistakes or lies.

Whereas the studies discussed above have all suggested that (some component of) linguistic ability is crucial for ToM development, the reverse effect, ToM influencing linguistic development, has also been demonstrated. For instance, bidirectional links between ToM and language (i.e. earlier ToM predicting later language and earlier language predicting later ToM) have been found in various longitudinal studies (e.g. De Mulder, 2015; Slade & Ruffman, 2005). Similarly, Milligan et al. (2007) found evidence for a bidirectional relationship in their meta-analysis of the relation between language ability and false belief understanding (although the size of the effect was greater from language to ToM than the reverse). Furthermore, Papafragou (2001) and Papafragou and Li (2001) argue that the acquisition of evidential markers (the linguistic encoding of information source, like the hearsay marker *allegedly* in English) is constrained by the development of ToM. In addition to these studies in typically developing populations, studies considering the development of ToM and mental state terms in autistic children also suggest that ToM might influence linguistic development. Autistic individuals' ToM deficit is presumed to be at the basis of the difficulties autistic children experience in acquiring mental state terms (cf. Kazak, Collis, & Lewis, 1997; Tager-Flusberg, 1992; Ziatas, Durkin, & Pratt, 1998). Although there is thus considerable evidence to suggest that linguistic development has an important role to play in the development of false belief understanding, the possibility that the relationship might be bidirectional, both as regards general linguistic competence and competence in the domains of language that have been specifically linked to false belief understanding, has received less attention, even though an understanding of other people's minds is likely also relevant in coming to understand what others might be trying to communicate to you. The current study therefore aims to add to previous literature by investigating potential bidirectional links between false belief understanding and various aspects of linguistic development as well as unidirectional links from language to ToM.

1.2. ToM and language: relationships in non-English speaking populations

Although the above discussion of previous studies does mention a number of studies that have investigated the relationship between language and ToM in languages other than English, by far the most of the studies on this topic have only included English-speaking children. To our knowledge, there is currently no longitudinal study that has considered false belief understanding and the various different aspects of language that have been considered to be relevant in a population that does not speak English. Note, for instance, that the meta-analysis that was conducted by Milligan et al. (2007) included 100 studies, but only those that assessed English-speaking children. Furthermore, the recent meta-analysis by Farrar et al. (2017) for typically developing children does include languages other than English, but only incorporates one study on French-speaking children (Durrleman & Franck, 2015), one study on Korean-speaking children (Farrar, Lee, Cho, Tamargo, & Seung, 2013) and four studies on Cantonese-speaking children (Cheung, 2006; Cheung et al., 2004; Cheung, Chen, & Yeung, 2009; Tardif et al., 2007). None of these studies are longitudinal and most only assess general language ability and sentential complementation understanding and do not consider mental state term understanding separately. To our knowledge, the only longitudinal studies that have considered the relationship between ToM and language in non-English-speaking children are Schneider, Lockl, and Fernandez (2005) and De Mulder (2015). However, the former study, investigating German participants, only considered effects of language on ToM (and not vice versa, thereby excluding the possible presence of bidirectional relationships) and limited the language assessment to a general language ability measure (which was found to predict later ToM). The latter study, investigating Dutch-speaking children, focused specifically on the effect of ToM on the development of mental state term and indirect request understanding (with earlier ToM predicting later performance on both). Longitudinal studies that consider multiple relevant aspects of language ability in non-English speaking children are thus lacking. This entails that it is currently unclear to what extent the developmental links that have been proposed to exist between ToM and language are specific to English-speaking children or whether they can be generalised to other linguistic populations and thus reflect more general aspects of human cognitive development. Indeed, previous research by Perner et al. (2003) already makes clear that cross-linguistic differences in the grammatical realisation of sentential complementation constructions matter for how the relationship between understanding of these constructions and explicit false belief understanding can be characterised. Studies with children from other linguistic backgrounds that employ similar tasks as have been used in previous work on English-speaking children are thus crucial in order to determine the universality of previous findings.

The current study assesses children that speak Dutch, a language that has not been investigated previously with this specific focus.

Dutch and English are similar in their realisation of sentential complementation constructions (for instance, they both display sequence of tense, see Matsuo, 2006, and example sentence 3), but there are some differences as well. Although the complementiser can be omitted in English (see 3a), this is not acceptable in Dutch (3b) and, like German (see the above discussion of Perner et al., 2003), Dutch can also use tensed sentential complementation constructions for desire verbs, whereas this is not acceptable in English (see example 4).

3a) John said (that) Bill was happy
3b) Jan zei *(dat) Bill gelukkig was
4a) *John wants that Bill is happy
4b) Jan wil dat Bill gelukkig is

We have no specific reason to believe that Dutch children will differ markedly in their acquisition of sentential complementation constructions as compared to children acquiring English. After all, previous research has suggested that English and German children have similar ages of acquisition for the tensed realis sentential complementation construction (sometime in the fourth or fifth year of life, see Perner et al., 2003 for German and de Villiers & Pyers, 2002, for English) even though there are some differences in the realisation of these constructions in the two languages. Given that German and Dutch are fairly comparable in this respect, it seems plausible to assume that the acquisition of tensed sentential complementation constructions in Dutch children will proceed along similar lines. Instead, the primary reason for investigating Dutch was to assess whether the findings reported in the literature regarding the relationship between ToM and linguistic development are the result of general human cognitive maturation or whether specific aspects of a language or culture might affect this developmental trajectory. It is possible, for instance, that sentential complementation constructions are required for false belief understanding regardless of the specific way they are encoded in a particular language (e.g. whether the occurrence of a complementiser is obligatory or not or whether they only occur with mental state and communication verbs or can be used with a wider selection of verb types), but it may also be the case that there is something special about these constructions in English (or how they are used in English-speaking cultures) that has prompted many studies to suggest that this construction is a prerequisite for false belief understanding. We thus seek to determine whether the generalisations regarding cognitive development that are made on the basis of findings for English-speaking children can be legitimately extended to children acquiring other languages. In this sense, then, we do not have any reason to believe that Dutch is of more interest than other languages that have not previously been studied from this point of view before, but including Dutch-speaking children does fulfil the goal of investigating the issues that have been discussed above in a sample that does not speak English.

1.3. Aims of the study

Despite many studies considering the nature of the relationship between language and ToM, there is still debate on whether it is the representational complexity of the linguistic system as a whole that is of most importance or whether only particular aspects of linguistic development are crucial. The first major aim of the current study is to address these questions by longitudinally considering false belief understanding and performance on those areas of language that have been claimed to be particularly relevant to ToM development (i.e. general language comprehension and vocabulary, sentential complementation and understanding of mental state terms) between the ages of four and five (crucial ages for the development of ToM; Wellman, Cross, & Watson, 2001). In order to deal with the methodological issues that have been raised regarding the use of the sentential complementation task, a novel task was developed for the purpose of this study that assesses understanding of sentential complementation constructions using stimuli that do not presuppose an understanding of false beliefs, lies or mistakes (see Section 2 for more information on this task). With this set-up, consisting of assessments of multiple dimensions of the four- to-five year old's linguistic ability in relation to her capacity to explicitly reason about others' mental states, the conflicting findings in the literature regarding how language development is related to false belief understanding can be addressed over time and in one and the same participant group.

The second major aim of the current study is to consider to what extent previous findings regarding the nature of the relationship between language and ToM in English-speaking children can be generalised to children acquiring a language other than English. By considering the performance of non-English-speaking children on many different components of language in relation to ToM in a longitudinal design, this study thus goes beyond the scope of previous studies in its assessment of developmental links between ToM and language.

2. Method

2.1. Participants

101 Dutch-speaking children[2] (47 boys and 54 girls) between the ages of 4;0 and 4;11 (M = 4;6) at the first time of testing participated in the study. The children were recruited from four different primary schools in The Netherlands. Most of the children

[2] Note that the same children participated in the study reported in De Mulder (2015). The main focus of this study was on the development of mental state term and indirect request understanding over time and how ToM might influence this development. The regression analysis reported for the relationship between ToM development and mental state term understanding was also reported in De Mulder (2015), but the other analyses are specific to the current study.

came from lower middle class or middle class families.

2.2. Procedure

After parental consent had been obtained, children were tested individually in a separate room in their school building in the presence of two experimenters. Each child was tested in two waves that were separated by eight months. Each wave consisted of three sessions separated by at least a day and at most a week between each session. Each session lasted approximately 30 min; total testing time for each testing wave was around 1.5 h per child. Some additional tests were conducted that are not reported in this study; total testing time per session for the tests reported here was approximately 25 min. Each child received one of twelve possible testing orders, so that test order effects were minimised. Children received stickers in return for their participation. The second wave followed the same procedure as the first wave.

2.2.1. Assessing Theory of Mind

Three different types of false belief task were used: appearance-reality (Flavell, Flavell, & Green, 1983; Gopnik & Astington, 1988), location change (Wimmer & Perner, 1983) and unexpected contents (Perner, Leekam, & Wimmer, 1987). Two versions of each of the three false belief tasks were presented at each wave (i.e. in each wave children received six false belief tasks). The location change tasks required the child to appreciate that a character that had not seen a particular object being displaced would falsely believe that the object was still in its original location. Children were asked to predict where the character would look for the object (prediction question) and to explain why the character would look there (explanation question). Children also had to answer two control questions (pertaining to the initial and final locations of the object) correctly in order to score points on this task. The appearance-reality tasks assessed whether the child understood that a deceptive object (e.g. a candle that looked like a cake) would initially be considered to be one thing (a cake) by anyone who had not observed the object closely.[3] This understanding was probed by asking the child about her initial belief regarding the identity of the object (self-belief question) and the initial belief of a naïve observer of the object (other-belief question). Again, two control questions were asked (regarding the true and the deceptive nature of the object) to determine whether the child really understood the nature of the deceptive object. In the unexpected contents tasks, children were shown familiar containers (e.g. a pencil box) and shown that they contained something unexpected (e.g. a piece of string). Three false belief questions (a self-belief question probing the child's initial belief regarding the contents of the container, an other-belief question probing the beliefs of a naïve observer and an explanation-question requiring the child to explain her answer to the other-belief question) and a control question (regarding the true contents of the box) were then put to the child.

Across all ToM tests, children could receive a maximum of 14 points (1 point for each ToM question, points were only awarded if control questions that were part of that particular ToM task were answered correctly, otherwise the child received zero points for that task). In comparison to other studies, this range is relatively broad. It should be noted that none of the ToM test questions included mental state terms. All ToM questions either referred to concrete behaviour (e.g. “Where will she look for her ball?” in the location change task) or used the communication verb *say* instead of the mental state verb *think* (e.g. “What did you say this was when you first saw it?” in the appearance–reality task). Performance on the ToM tasks did thus not hinge on understanding of mental state terms as such.

2.2.2. Assessing linguistic ability

Children received four different language tests, assessing general and mental vocabulary, understanding of sentential complements and general sentence comprehension. General vocabulary was measured using a standardised vocabulary test (the Peabody Picture Vocabulary Test III (PPVT); Schlichting, 2005) which required the child to listen to a word and point to a picture that the word refers to. Although various different aspects of mental state term understanding could have been assessed, the focus of the current study was on epistemic mental state terms, as previous research has suggested that these terms play a prominent role in the development of false belief understanding (e.g. Gola, 2012; Pyers & Senghas, 2009). Children's understanding of the difference in speaker certainty entailed by various mental state verbs, modal auxiliaries and modal adverbs was thus assessed. Children were required to choose a box that contained a hidden sticker on the basis of contrastive use of mental state terms by two puppets. In order to be successful on this task, children had to choose the box denoted by the mental state term that conveyed greater speaker certainty over the term that conveyed lesser speaker certainty. In the mental state verb task, the Dutch verbs *weten* (know), *denken* (think) and *raden* (guess) were used (see 5). Each contrast (i.e. know vs. think, know vs. guess and think vs. guess) was presented three times, allowing the child to score nine points in total. In the modal auxiliary task, *moet* (must) and *kan* (may) were used (see 6) and in the modal adverbs task, *zeker* (definitely) and *misschien* (maybe) were used (see 7). The contrasts in both modal tasks were presented four times, allowing the child to score a maximum of four points on each of the modal tasks. A total of 17 points could thus be scored by the child in the mental state term understanding tasks.

[3] Different deceptive objects (and containers in the unexpected contents task) were used in the first and the second wave, so that children would not remember the true nature of the object (or the unexpected content of a container) they had seen in the first wave.

5) Ik weet/denk/raad dat de sticker in de rode doos ligt
I know/think/guess[4] the sticker is in the red box
6) De sticker moet/kan in de blauwe doos liggen
The sticker must/might be in the blue box
7) De sticker ligt zeker/misschien in de rode doos
The sticker is definitely/maybe in the red box

We devised a novel test of sentential complementation understanding. In this test, children listened to six stories involving two characters, Jan and Karin, talking about three objects (the characters and objects were displayed in an accompanying picture). In each story, one of the characters would always say something about one of the objects; the other character would then say something about the remaining two objects. At the end of the story, a puppet asked the child about the first character's utterance. An example can be found in 8:

8) [child sees a picture of Jan and Karin sitting next to a teddy bear, a doll and a book]
It's Karin's birthday and Karin is showing Jan the presents she got. Jan says that Karin got a teddy bear for her birthday. Karin then says that she also got a doll and a book.
Puppet: That went a bit fast. They both said something, but what did JAN say Karin got?

Correctly responding “a teddy bear” instead of “a teddy bear, a doll and a book” or “a doll and a book” shows understanding of the sentential complementation construction. The question is properly interpreted as relating to the content of the embedded clause in the relevant sentence and not as either a general question for clarification regarding the presents that Karin received for her birthday, or as a partial representation of the sentence uttered by Karin. That is, the child demonstrates she realises the question to be answered is ‘what did Jan say Karin got?’ and not ‘what did Karin [get]?’ and that she has correctly parsed the sentential complementation construction in the sentence uttered by Karin as ‘Karin then says that she also got a doll and a book’ and not as ‘Karin got a doll and a book’ (which would give rise to the answer “a doll and a book”). Importantly, none of the utterances in the story are false. All three of the objects are Karin's birthday presents; Jan just chooses to comment on a subset of them. The child thus does not have to take into account mistakes, false beliefs or lies; she only has to remember and repeat verbatim what objects a particular character talked about. Note though, that there is still a subtle distinction between the matrix sentence and the sentential complement: ‘Jan says Karin got a teddy bear for her birthday’ is clearly true, but ‘Karin got a teddy bear for her birthday’, does not provide a full representation of reality (in which Karin received various other presents). This novel version of the task thus does retain a certain distinction between the state of affairs in reality vs. the state of affairs according to the subordinate sentence without requiring any understanding of false beliefs or lies at the conceptual level.

Note that this sets the current study apart from the small number of other studies that we are aware of that have not (only) relied on the use of false complements in their assessment of the acquisition of tensed realis sentential complementation constructions. Lewis, Lidz, and Hacquard (2012), for instance, investigated whether knowledge of the truth of a statement vs. ignorance regarding the statement's truth value would influence performance in a set-up with either one speaker (Experiment 1) or two speakers (Experiment 2). In this task, children thus either knew that a certain statement was right or wrong with respect to reality or they did not know its truth value until after they had evaluated the statement (at which point it became clear whether the speaker was right or wrong in Experiment 1 or which of the two speakers was right in Experiment 2). Although children's performance did differ depending on whether they knew the true state of affairs or not (performance was best when children were assessing a speaker's true belief), it is important to note that the set-up of this study entailed that there was a clear ‘fact of the matter’. That is, children may not actually know at the point in time when they have to answer a question whether a certain statement is, in fact, true or false, but the set-up was such that it had to be one way or the other and this was relevant for full understanding of the set-up. The underlying premise of the task thus only really makes sense if the child has some understanding of mistakes or lies, which was what we wanted to avoid in our novel task. Similarly, although Lohmann and Tomasello's (2003) training study (also mentioned in the Introduction above) found that exposing children to sentential complements that were not explicitly framed as being true or false enhanced false belief understanding, the task that they used to actually assess sentential complementation understanding was the standard task involving false sentential complements. Lohman and Tomasello's study is interesting in that it demonstrates that exposure to sentential complements is one factor that helps children understand false beliefs, but the (true) sentential complements that are used in the training component of the study all involve use of mental state terminology, so it is not clear whether it was this aspect of this form of training that was the ‘active ingredient’ that helped children understand false beliefs better or whether it was the exposure to the syntactic construction in and of itself that was responsible for the training effect. At any rate, it should be noted that this study does not use a novel task for assessing sentential complementation understanding itself, but that it also uses the task that we feel is not fully sufficient. Finally, de Villiers, Hobbs, and Hollebrandse (2014) also address the relevance of truth contrasts between the embedded clause and the matrix sentence in their study, but the specific task that they use investigates understanding of second order embeddings (e.g. children are asked ‘What did Billy tell Jane?’ following the information that ‘Billy tells Jane that Mom said that comic books are stupid’) and focuses on an older age range (5- to 6-year olds), so this task could not be used for our purposes either. We thus recognise the previous efforts that have been engaged in in attempts to disentangle understanding of falsity from understanding of sentential complementation constructions as such, but, to our knowledge, there are no previous studies that investigate

[4] Note that in Dutch the verb *raden* is not used as a modulation of an assertion like the English verb *guess* can be; use of *raden* entails that the speaker is providing an actual guess regarding the location of the sticker.

the understanding of tensed realis sentential complementation constructions in 4-year-olds in situations that do not at least potentially presuppose some understanding of false beliefs, mistakes or lies. Our novel task thus aims to provide insight regarding this particular issue and thereby is informative regarding the question whether understanding of the syntax of tensed realis sentential complementation constructions in itself is a predictor of false belief understanding.

A potential drawback of our novel task is that children might not be able to remember which object was commented on by which character and thus just respond randomly. In order to ensure that random responding would not lead to points on the task, four control stories were added that had the same memory load as the test stories but did not contain sentential complementation constructions (see 9). Children were required to provide correct answers on at least three out of four of these questions in order to be awarded points for the sentential complementation task under the assumption that it would be unlikely for children to get three out of four questions correct if they were responding randomly (note that children were not given specific answer options, so they could answer with the correct object, 'a starfish', but any combination of the objects mentioned in the story or answers such as 'don't know' were also possible). If this criterion was attained, children could score six points on the sentential complementation task.

9) [child sees a picture of Jan and Karin, standing next to a crab, a starfish and a shell]
Jan and Karin are at the beach. They're looking for things they can take home with them. Karin found a starfish. And Jan found a crab and a shell.
Puppet: Wait a minute. They both found something, but what did KARIN find?

General sentence comprehension was tested by giving children an abbreviated version of the Reynell test for language comprehension (Van Eldik, Schlichting, Lutje Spelberg, van der Meulen, & van der Meulen, 1995). This standardised test is suitable for children from 1;3 to 6;3 years old. It requires the child to manipulate various objects that are in front of her in ways specified by the verbal instructions provided by the experimenter. Given the long duration of the whole test (approximately 45 min per child), only parts 8, 9 and 11 of the test were conducted (consisting of 34 items in total) as these were deemed to provide the best assessment of four- to five year old children's language abilities at the sentential level (the PPVT test already provided information regarding children's abilities at the lexical level). These parts of the Reynell test do not have specific names, but they are described in the manual in the following ways. Part 8 assesses 'non-standard couplings of two objects through a preposition and the understanding of passive forms', such as *put the chair in the box* (in which a small chair has to be placed in a small box given various other objects and possible locations) and *the dog is being bitten by the rabbit*. Part 9 assesses children's 'recognition of properties of objects and understanding of number, question words and prepositions', such as *put all the white buttons in the cup* (in which the child has to put all and only the white buttons in a toy cup given a set of black and white buttons). Part 11 tests children's understanding of 'two or more concepts (e.g. question words, colour, superlative forms, pronouns, prepositions and double negatives) in a concrete situation', such as *which pigs are farthest away from the farmer?* (given a group of pigs that are close to the farmer and pigs that are farther away). The test items thus included a range of constructions consisting of, for example, passives (e.g. *the horse is being bitten by the dog*), prepositions (e.g. *put a small pig next to the black pig*), negation (e.g. *which button is not in the cup?*) and the diminutive form (e.g. *show me the smallest button*).

3. Results

3.1. Descriptive statistics

Table 1 shows the means, standard deviations and ranges of the various tasks and the participants' ages at the first and second wave. Mean scores on all the ToM and language measures increased over time. Paired-sample *t*-tests demonstrate that this increase is significant for all measures (all *p*'s ≤ .006) and that the effect sizes are generally large (with all but one of the η^2 values exceeding .14;

Table 1
Means, standard deviations (SD) and ranges of all the ToM and language tests at the 1st and 2nd wave.

Measure	Subtest	Wave 1			Wave 2			*p*-value wave 1 vs. 2	eta-squared
		Mean	SD	Range	Mean	SD	Range		
Age (months)	N/A	54	3.29	48–59	62	3.28	55–68		
ToM	Appearance-reality	1.58	1.47	0–4	2.44	1.56	0–4	< .001	.20
	Location change	2.41	1.61	0–4	3.14	1.33	0–4	< .001	.20
	Unexpected contents	2.47	2.24	0–6	3.44	2.40	0–6	< .001	.15
	ToM sum score	6.46	4.34	0–14	9.01	4.27	0–14	< .001	.34
Language	Vocabulary	66.18	13.78	26–98	76.12	13.31	48–115	< .001	.45
	Mental vocabulary	10.31	2.40	5–16	11.15	2.69	6–17	.006	.07
	SC	2.01	2.36	0–6	3.05	2.46	0–6	< .001	.17
	Reynell	21.52	6.61	3–32	24.13	4.19	12–33	< .001	.28

Note: SC: sentential complementation task; maximum scores: appearance-reality and location change = 4; unexpected contents = 6; ToM sum = 14; vocabulary maximum = 204 (for adults); mental vocabulary = 17; sentential complementation = 6; Reynell = 34.

only the development in the domain of mental language comprehension is in the medium range with an η^2 value of .07; Cohen, 1988). In the eight months between the first and the second time of testing, children's understanding of false beliefs, sentential complementation constructions, mental vocabulary, general vocabulary and sentence comprehension thus showed significant development.

3.2. Correlations

Table 2 provides the full correlation matrix for all measures in wave 1 and 2 and Table 3 gives an overview of the partial correlations between all the measures controlling for age.

Table 2
Full correlation matrix between all measures in wave 1 and 2.

	Age	AR1	UC1	LC1	ToM1	Vocab1	Rey1	SC1	MVocab1	AR2	UC2	LC2	ToM2	Vocab2	Rey2	SC2
AR1	.24*															
UC1	.31**	.59***														
LC1	.27**	.43***	.45***													
ToM1	.34***	.80***	.88***	.75***												
Vocab1	.38***	.46***	.46***	.59***	.61***											
Rey1	.38***	.53***	.55***	.55***	.67***	.70***										
SC1	.24*	.31**	.37***	.34***	.42***	.44***	.40***									
MVocab1	.11	.35***	.15	.21*	.27**	.27**	.34***	.11								
AR2	.34***	.38***	.50***	.55***	.59***	.47***	.61***	.22*	.30**							
UC2	.17	.38***	.49***	.46***	.55***	.48***	.52***	.22*	.29**	.64***						
LC2	.12	.23*	.28**	.52***	.41***	.44***	.39***	.07	.23*	.32***	.34***					
ToM2	.26**	.42***	.54***	.62***	.65***	.58***	.63***	.23*	.34***	.82***	.90***	.62***				
Vocab2	.34***	.49***	.54***	.48***	.62***	.67***	.71***	.54***	.29**	.46***	.53***	.34***	.57***			
Rey2	.29**	.44***	.46***	.51***	.57***	.65***	.78***	.35***	.34***	.49***	.50***	.41***	.59***	.68***		
SC2	.21*	.31**	.28**	.35***	.38***	.41***	.52***	.53***	.14	.31**	.25**	.14	.30**	.40***	.42***	
MVocab2	.22*	.37***	.26**	.19	.33***	.29**	.42***	.24*	.32***	.33***	.32***	.02	.30**	.42***	.32***	.30**

Note: AR: appearance-reality; UC: unexpected contents; LC: location change; ToM: Theory of Mind total score; Vocab: vocabulary; Rey: Reynell; SC: sentential complementation; MVocab: mental vocabulary; 1 relates to the measurement at wave 1, 2 relates to wave 2.

* $p \leq .05$.
** $p \leq .01$.
*** $p \leq .001$.

Table 3
Partial correlations between measures in wave 1 and 2 controlling for age.

	ToM1	Vocab1	Rey1	SC1	MVocab1	ToM2	Vocab2	Rey2	SC2
Vocab1	.55***								
Rey1	.62***	.65***							
SC1	.37***	.39***	.34***						
MVocab1	.25**	.25**	.33***	.09					
ToM2	.62***	.53***	.60***	.18	.33***				
Vocab2	.57***	.62***	.67***	.50***	.27**	.53***			
Rey2	.53***	.61***	.76***	.30**	.32***	.55***	.65***		
SC2	.34***	.37***	.49***	.51***	.12	.26**	.35***	.38***	
MVocab2	.28**	.23*	.37***	.20*	.30**	.26**	.37***	.27**	.27**

Note: ToM: Theory of Mind total score; Vocab: vocabulary; Rey: Reynell; SC: sentential complementation; MVocab: mental vocabulary; 1 relates to the measurement at wave 1, 2 relates to wave 2.

* $p \leq .05$.
** $p \leq .01$.
*** $p \leq .001$.

As is to be expected, there are significant correlations between age and the dependent variables in the test battery (wave 2 performance on ToM and language), and correlations between the various ToM components are medium to large in size. Furthermore, correlations between the different language measures demonstrate that although some of the correlations between the language components are relatively large, they are not so high that they should be considered inseparable (given that the values are all clearly below .80, multicollinearity is not a problem for the regression analyses reported in the following section; Field, 2005).

In order to determine the developmental relationship between ToM and the various language measures, hierarchical regression

analyses were conducted. As performance on measures at the second time point was correlated both with age and earlier performance on that measure these two variables were entered first in each analysis. The effects of other relevant variables over and above these factors could thus be considered in the second step.

3.3. Predicting ToM from language

In considering the role of language on ToM development, two questions were considered: whether the individual language measures would predict later ToM, once age and earlier ToM were controlled for, and which of the individual language measures would prove to be the best predictor of ToM. The results regarding the first question can be seen in Table 4. Note that this table consists of four different regression analyses: model 1 is the same for each analysis and hence is only given once; each model 2 (a–d) represents an analysis in which each language measure is considered separately.

Table 4
Predicting ToM wave 2 from age, ToM wave 1 and each individual language measure at wave 1.

	B	SE *B*	*β*	R^2	ΔR^2
Model 1					
Age	0.05	0.11	.04	.43	.43***
ToM 1	0.63	0.08	.64***		
Model 2a: Mental vocabulary 1 to ToM 2					
Age	0.04	0.10	.03	.46	.03*
ToM 1	0.58	0.08	.59***		
Mental vocabulary 1	0.32	0.14	.18*		
Model 2b: General vocabulary 1 to ToM 2					
Age	−0.02	0.10	−.02	.48	.05**
ToM 1	0.48	0.09	.48***		
General vocabulary 1	0.09	0.03	.29**		
Model 2c: Reynell 1 to ToM 2					
Age	−0.03	0.10	−.03	.50	.07***
ToM 1	0.41	0.10	.42***		
Reynell 1	0.23	0.06	.36***		
Model 2d: Sentential complementation 1 to ToM 2					
Age	0.06	0.11	.05	.43	.00
ToM 1	0.65	0.09	.66***		
Sentential complementation 1	−0.12	0.15	−.07		

* $p \leq .05$.
** $p \leq .01$.
*** $p \leq .001$.

Table 4 demonstrates that earlier general vocabulary, mental vocabulary and general sentence comprehension significantly predict later ToM. Model 2a shows that adding mental vocabulary to the model adds a significant 3% to the initial 42.7% explained variance ($R^2_{adj} = 44\%$; $F(3,97) = 27.19$; $p < .001$). Model 2b presents the findings regarding general vocabulary: adding earlier general vocabulary to the model also results in a significant addition to the percentage of explained variance ($R^2 = 47.6\%$; $R^2_{adj} = 46\%$; $F(3,97) = 29.34$; $p < .001$). Model 2c shows the results for the relationship between general sentence comprehension and ToM. The addition of the Reynell test performance allowed the model to explain an extra 7% of the variance in ToM, a significant addition ($R^2 = 49.5\%$; $R^2_{adj} = 47.9\%$; $F(3,97) = 31.65$; $p < .001$).

The following regression analyses investigate the relative importance of the language measures. Table 5, model 2a, compares the two measures at the sentential level (sentential complementation understanding and general sentence comprehension), model 2b the two measures at the lexical level (general and mental vocabulary) and model 2c assesses the relative importance of each language measure when they are all present in one model. The initial model of these analyses is identical to the one presented in Table 4, so only the final step of the various models is presented in Table 5.

Table 5 (model 2a) shows that this model explains 50.4% of the variance in later ToM ($R^2_{adj} = 48.3\%$; $F(4,96) = 24.40$; $p < .001$). Earlier performance on the general sentence comprehension measure is still a significant predictor of later ToM, even once age, earlier ToM and earlier sentential complementation understanding are taken into account ($t(96) = 3.78$; $p < .001$). Earlier understanding of sentential complements was not a significant predictor of later ToM. Only the general sentence comprehension measure thus significantly predicts later ToM once the two sentential measures are pitted against each other. Model 2b in Table 5 which compares the two lexical measures, explains 49.6% of the variance ($R^2_{adj} = 47.5\%$; $F(4,96) = 23.65$; $p < .001$). Both earlier performance on the general and the mental vocabulary measures significantly predict later ToM, even once age and earlier ToM is taken into account ($t(96) = 2.75$; $p = .01$ for general vocabulary and $t(96) = 1.98$; $p = .05$ for mental vocabulary). Model 2c in Table 5, the

Table 5
Predicting ToM wave 2 from age, ToM wave 1 and all language measures at wave 1.

	B	SE *B*	*β*	R^2	ΔR^2
Model 2a: Sentential measures					
Age	−0.02	0.10	−.02	.50	.08***
ToM 1	0.44	0.10	.45***		
Sentential complementation 1	−0.20	0.15	−.11		
Reynell 1	0.25	0.07	.38***		
Model 2b: Lexical measures					
Age	−0.02	0.10	−.02	.50	.07**
ToM 1	0.45	0.09	.46***		
Mental vocabulary 1	0.27	0.14	.15*		
General vocabulary 1	0.08	0.03	.26**		
Model 2c: All language measures					
Age	−0.04	0.10	−.03	.53	.11***
ToM 1	0.40	0.10	.40***		
Mental vocabulary 1	0.20	0.13	.11		
General vocabulary 1	0.06	0.03	.19		
Reynell 1	0.16	0.07	.25*		
Sentential complementation 1	−0.24	0.15	−.13		

* $p \leq .05$.
** $p \leq .01$.
*** $p \leq .001$.

model with all the language measures inserted, explains 53.3% of the variance in later ToM (R^2_{adj} = 50.4%; $F(6,94) = 17.91$; $p < .001$). Aside from earlier ToM ($t(94) = 4.00$; $p < .001$), only earlier performance on the Reynell test for language comprehension significantly predicted later ToM ($t(94) = 2.26$; $p = .03$), controlling for age, earlier ToM and the other language measures. Out of all the language measures, then, only children's earlier performance on the general test of sentence comprehension significantly predicted later understanding of other people's mental states if all language measures are taken into account.

3.4. Predicting language from ToM

The final analyses considered whether earlier ToM could predict later performance on the individual language measures, controlling for age and earlier performance on the language measure. These analyses can make it clear whether the relationship found previously for language to ToM are unidirectional or bidirectional. The first of these analyses considered whether earlier ToM significantly predicts later general vocabulary. The results can be found in Table 6.

The final model demonstrates that although age does not significantly predict later general vocabulary, earlier ToM is a significant predictor of later general vocabulary ($t(97) = 3.60$; $p = .001$). Furthermore, adding ToM to the initial model allows it to describe 6% more of the variance in general vocabulary at wave 2 (a significant addition); the final model thus describes 52.1% of the variance (R^2_{adj} = 50.7%) with an overall significant relationship ($F(3,97) = 35.22$; $p < .001$). ToM thus significantly predicts wave 2 general vocabulary, controlling for age and wave 1 general vocabulary.

Table 6
Predicting general vocabulary wave 2 from age, general vocabulary wave 1 and ToM wave 1.

	B	SE *B*	*β*	R^2	ΔR^2
Model 1					
Age	0.41	0.33	.10	.46	.46***
General vocabulary 1	0.61	0.08	.63***		
Model 2					
Age	0.24	0.31	.06	.52	.06***
General vocabulary 1	0.44	0.09	.45***		
ToM 1	0.99	0.28	.32***		

*** $p \leq .001$.

The second regression analysis considered whether earlier ToM would also significantly predict later understanding of mental state terms. Table 7 gives the results of this analysis.

Table 7
Predicting mental vocabulary wave 2 from age, mental vocabulary wave 1 and ToM wave 1.

	B	SE *B*	*β*	R^2	ΔR^2
Model 1					
Age	0.16	0.08	.19*	.14	.14***
Mental vocabulary 1	0.33	0.11	.30**		
Model 2					
Age	0.10	0.08	.12	.18	.04*
Mental vocabulary 1	0.27	0.11	.24**		
ToM 1	0.14	0.06	.22*		

* $p \leq .05$.
** $p \leq .01$.
*** $p \leq .001$.

The final model demonstrates that although age does not significantly predict later mental vocabulary once the other factors in the model are taken into account, earlier ToM significantly predicts later mental vocabulary ($t(97) = 2.19$; $p = .03$). Furthermore, the addition of ToM allows the model to describe a significant additional 4% of the variance in mental vocabulary at wave 2 ($R^2 = 17.6\%$; $R^2_{adj} = 15.1\%$; $F(3,97) = 6.91$; $p < .001$). As was the case for general vocabulary, earlier ToM significantly predicts mental vocabulary even when earlier mental vocabulary and age are controlled for. This means that the relationship is bidirectional in the case of ToM and general and mental vocabulary: earlier ToM predicts later general and mental vocabulary and earlier general and mental vocabulary predict later ToM ($t(97) = 3.00$; $p = .003$ for general vocabulary and $t(97) = 2.31$; $p = .02$ for mental vocabulary).

The third analysis, presented in Table 8, addresses the question whether ToM also predicts children's understanding of sentential complementation constructions.

Table 8
Predicting sentential complementation wave 2 from age, sentential complementation wave 1 and ToM wave 1.

	B	SE *B*	*β*	R^2	ΔR^2
Model 1					
Age	0.07	0.07	.09	.29	.29***
Sentential complementation 1	0.53	0.09	.51***		
Model 2					
Age	0.03	0.07	.04	.31	.02
Sentential complementation 1	0.47	0.10	.45***		
ToM 1	0.10	0.06	.18		

*** $p \leq .001$.

The final model shows that only earlier performance on the sentential complementation task is a significant predictor of later sentential complementation understanding ($t(97) = 4.78$; $p < .001$). Adding ToM to the initial model with age and earlier understanding of sentential complementation does not enhance the percentage of explained variance significantly and neither is ToM a significant predictor of sentential complementation understanding. The relationship between understanding of sentential complementation and ToM did not prove to be significant in either direction. Earlier ToM thus does not predict later understanding of sentential complements, but neither does earlier understanding of sentential complements predict later ToM.

Table 9 gives the results of the fourth and final analysis, assessing whether ToM predicts the child's performance on the general sentence comprehension measure (the Reynell test). The final model shows that neither age nor earlier ToM significantly predict later Reynell performance, and that the addition of ToM to the model does not significantly add to the percentage of explained variance. A unidirectional relationship was thus observed for the Reynell test and ToM: whereas earlier ToM did not predict later performance on the Reynell test, earlier performance on the Reynell test did predict later ToM ($t(97) = 3.60$; $p < .001$).

These four analyses thus suggest that earlier ToM is a significant predictor for some components of language (general and mental vocabulary), but earlier ToM was not predictive of general sentence comprehension or sentential complementation understanding. There is thus a bidirectional relationship between the vocabulary measures and ToM, no relationship between sentential complementation and ToM and a unidirectional relationship from general sentence comprehension to ToM. If all the language components are considered in one model in relationship to ToM, only children's earlier performance on the general test of sentence comprehension significantly predicted later ToM.

Table 9
Predicting Reynell wave 2 from age, Reynell wave 1 and ToM wave 1.

	B	SE *B*	*β*	R^2	ΔR^2
Model 1					
Age	−0.01	0.09	−.01	.61	.61***
Reynell 1	0.50	0.04	.78***		
Model 2					
Age	−0.02	0.09	−.02	.62	.01
Reynell 1	0.46	0.06	.73***		
ToM 1	0.09	0.08	.09		

*** $p \leq .001$.

4. Discussion

The aim of this paper was to shed light on the developmental relationship between language and ToM by assessing Dutch-speaking children's explicit understanding of false beliefs and domains of language that have been claimed to be relevant in the development of this ability (general and mental vocabulary, sentential complements and general sentence comprehension ability). In line with various previous studies assessing English-speaking children (e.g. Milligan et al., 2007; Slade & Ruffman, 2005), the results of this study indicate that for children acquiring Dutch there is a bidirectional relationship between language and ToM development. Although the vocabulary measures were not the strongest predictor of later ToM (the vocabulary measures were no longer predictive of later ToM once the child's general sentence comprehension ability was taken into account), the findings from this study suggest that there is a bidirectional relationship between ToM and general and mental vocabulary. Hearing labels for unobservable entities like mental states may thus prompt children to think about what these terms might be labelling and to conceptualise the distinctions that the various terms make (cf. Cheung et al., 2009; Low, 2010; Pyers & Senghas, 2009), and, conversely, understanding of other people's mental states also seems to provide the child with the conceptual grounding to acquire and use appropriately vocabulary that expresses this understanding (cf. Papafragou, 2001; Papafragou & Li, 2001). In this way, development in the domains of vocabulary and understanding of mental states may bootstrap each other, thereby furthering the child's development in both areas of cognition.

Unlike general and mental vocabulary, understanding of sentential complementation constructions was not related significantly to ToM development in this sample. Earlier ToM did not predict later understanding of sentential complementation constructions, nor did earlier understanding of sentential complements predict later ToM. Given that many previous studies have reported a link from understanding of sentential complementation constructions to ToM (e.g. de Villiers, 2005, 2007; de Villiers & Pyers, 2002), this finding might seem surprising. We suggest that this failure to find evidence for this relationship is due to the use of a sentential complementation task that does not presuppose an understanding of false beliefs, lies or mistakes, while acknowledging that the results of the current study need to be replicated and that there is potentially some room for improvement regarding the specific task we used (see the following section for further discussion of these points). Of course, given the preponderance of mental state verbs in these constructions, encountering sentential complementation constructions does provide the child with exposure to mental state terms and, as such, will have a positive effect on the child's ability to understand false beliefs (given the relationship between mental state term understanding and ToM development detailed above), but the current study casts doubt on the suggestion that it is this syntactic frame in and of itself that provides the child with the representational means to deal with false beliefs.

Our results thus indicate that general and mental vocabulary are bidirectionally related to ToM and that there is no evidence to suggest that understanding of sentential complements predicts ToM. The only measure that was unidirectionally related to ToM was the general sentence comprehension measure. Furthermore, out of all the language measures, the child's earlier performance on the general sentence comprehension measure was found to be the best predictor of her later understanding of false beliefs. The fact that the current study finds evidence for this relationship between general sentence comprehension ability and ToM in a non-English-speaking population provides cross-linguistic support for the general language hypothesis: there seems to be a profound relationship between the development of language in a general sense and explicit false belief understanding (Astington & Jenkins, 1999; Cheung et al., 2004; Farrar et al., 2017; Milligan et al., 2007; Slade & Ruffman, 2005). Understanding that other people's mental states can differ from your own requires the child to be able to separate her own representation of reality from those of others. Having a sufficiently advanced level of language development, regardless of the particular language you are exposed to, thus seems to play a fundamental role in the child being able to sort out the nature of false beliefs and understanding their effects on behaviour at an explicit level.

4.1. Limitations of the current study and future directions

In the current study, a novel measure for the assessment of sentential complementation understanding was employed, given that the traditional task was deemed to be problematic. On the basis of children's performance on this task in relation to the ToM tasks, we concluded that we could not provide evidence for the claim that sentential complementation understanding plays a fundamental role in enabling the child to develop explicit false belief understanding. However, although we believe that the novel task provides a purer assessment of children's understanding of sentential complementation constructions than the original task (at least from the point of

view of assessing its relation to false belief understanding), it is likely that the task poses demands on the child's working memory capacity as well. By including memory control questions that children had to pass in order to receive points for the task, it was made unlikely that children would be credited with sentential complementation understanding when in reality they were just guessing. This may explain why the performance on the sentential complementation task is relatively poor in the first wave (children score an average of 2 points out of a maximum of 6) and is still not particularly strong in the second wave (averaging around 2.5 points out of 6), although it does represent a statistically significant development in the performance on this task. It is possible that the working memory aspect of the procedure entails that children who may have at least some understanding of sentential complements were not awarded points in this domain due to working memory limitations. In wave 1, 51 children (50%) fulfilled the criterion of answering at least three of the four memory control questions correctly and thus were awarded points for the task if they answered the test questions correctly; in wave 2, 68 children (67%) fulfilled this criterion. Many children thus did not receive points on the task as a result of their insufficient performance on the memory control questions. However, given that the relationship between language and ToM development was at the heart of the current research, we believe that it is preferable to have a sentential complementation task with a more demanding working memory component than one that seems likely to confound understanding of false beliefs and sentential complementation constructions. This was also one of the reasons (aside from practical constraints on test battery length) why we did not include the traditional task in the test battery: we did not feel that we would gain information by adding a task that likely confounds false belief and sentential complementation understanding. We thus predict that we would have found a relationship between false belief and sentential complementation understanding if we had included the traditional task, but given the results of the novel task, we would still have concluded that we had not found evidence for there being a relationship between understanding of the tensed realis sentential complementation construction *as such* and false belief understanding. It should also be noted that our task uses a communication verb (*say*) with a tensed realis complement (unlike desire verbs or verbs like *promise* that have been used in other studies that have not used the traditional test of sentential complementation understanding) and that there is a subtle distinction between reality and the state of affairs as conveyed by the sentential complement. Our task thus incorporates those aspects of sentential complements that de Villiers and her colleagues consider to be crucial for ToM development (de Villiers & de Villiers, 2014). At the same time, it is clear that we do not have the direct conflict in perspectives that characterises the original task. We recognise that this might actually be an important component of this task (in the sense that it might be the child's understanding of this aspect of the task that is predicting later false belief understanding), but our aim was to assess whether an understanding of the tensed realis sentential complementation construction in and of itself would predict later false belief understanding (as opposed to the experiences that being exposed to this syntactic frame afford). Our task was optimised towards an assessment of the children's understanding of the syntactic frame and thus our main focus was on ensuring that the child's ability to understand false beliefs, lies or mistakes would not obscure that picture. Our findings thus suggest that the child's understanding of the syntactic characteristics of tensed realis sentential complementation constructions is not a predictor of false belief understanding, but being exposed to sentential complements that convey perspective conflicts may well play a role in enabling this development. A task that does use tensed realis sentential complementation constructions to convey a conflict in perspective, but that does not rely on the child's understanding of false beliefs, mistakes or lies for the story to make sense[5] could be created in order to test this hypothesis.

At any rate, the current findings do not provide evidence to suggest that understanding of the syntactic characteristics of tensed realis sentential complementation constructions predicts false belief understanding. Although, of course, this result should be replicated in a novel sample (and ideally with a sample that speaks a language other than Dutch such that cross-linguistic generalisability can also be established) and perhaps changes to our task could be made to reduce the burden on working memory.

Another point that should be noted is that only one aspect of mental language was considered in the current study. Given that previous research has generally focused on the role of epistemic mental terms in ToM development, we chose to assess various categories within this one domain (i.e. epistemic mental state verbs, modals and auxiliaries). However, this entails that the results likely only generalise to this particular domain of mental language and not to other types that might also be relevant for ToM development. Indeed, vocabulary relating to desire, volition and emotions (*want*, *decide*, *hate*) also refers to mental states that are not directly observable and thus hearing explicit labels for these states could trigger the child to reflect on their meaning, thereby benefitting ToM development. However, it seems likely that the development of explicit false belief understanding, with its primary reliance on an understanding of differences in people's knowledge states (what a story character thinks about the location of an object as opposed to the child's knowledge regarding its location) relies most heavily on the child acquiring epistemic mental state terminology. It remains a possibility, however, that a broader, or different, measure of mental language would have found a unique role for mental language in the development of explicit false belief understanding (that is, over and above the role that general sentence comprehension played in this development). Indeed, future research could broaden the scope of the current study by expanding on both the mental language measure and the ToM measure to include, for instance, emotional and volitional components (e.g. the relationship between understanding of emotional vocabulary and hidden emotions) or by investigating how ToM development relates to language comprehension at the discourse level. Children's comprehension of non-literal language (e.g. sarcasm, metaphors) or other kinds of discourse occurrences in which understanding of other people's mental states and intentions is important (e.g. understanding of faux-pas or white lies) may thus also be an interesting domain for future research.

As well as raising novel questions to be answered in future research, then, the results of the current study demonstrate that, as has been found for children from English-speaking backgrounds, various components of linguistic ability play a crucial role in the

[5] That is, whether or not a character can ultimately be considered to be correct or incorrect in her thoughts or statements should ideally not be part of the set-up.

development of explicit false belief understanding for children acquiring Dutch. However, false belief understanding was also shown to be relevant in furthering vocabulary development. Acquiring language and developing ToM is thus a truly interrelated process, with developments in both domains allowing the child to enter into more advanced interactions in both the linguistic and the social domain.

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