Journal of Communication Disorders 74 (2018) 35–44

Contents lists available at ScienceDirect

Journal of Communication Disorders

journal homepage: www.elsevier.com/locate/jcomdis

False belief and relative clauses in Autism Spectrum Disorders

Stephanie Durrleman[a,*], Wolfram Hinzen[b,c,d], Julie Franck[a]

[a] Psycholinguistics Lab, Psychology Dept, University of Geneva, Switzerland
[b] ICREA (Institució Catalana de Recerca i Estudis Avançats), Pg. Lluis Companys 23, 08010 Barcelona, Spain
[c] Universitat Pompeu Fabra, Departament de Traducció i Ciències del Llenguatge, Roc Boronat, 138, 08018, Barcelona, Spain
[d] FIDMAG Germanes Hospitalaries Research Foundation, Benito Menni Hospital, Carrer del Doctor Antoni Pujadas, 38, 08830, Sant Boi de Llobregat, Barcelona, Spain

ARTICLE INFO

Keywords:
Theory of Mind
False belief
Relative clauses
Meta-representation
Intensionality
Autism Spectrum Disorders

ABSTRACT

Previous studies have suggested sentential complementation is the crucial ingredient of language that relates to false-belief (FB) reasoning, while the role of relative clauses (RCs) is less clear. Nevertheless, under the hypothesis that clausal embedding has a meta-representational effect, arguably implied in FB, one expects a link between FB and not only complementation but also relativization. Seventeen children with ASD (6 to 16 years, mean age 9;2) were assessed for RCs and FB. Comprehension of RCs significantly predicted FB performance, while none of the controlled factors played a predictive role (comprehension of simple sentences, vocabulary, morpho-syntax and working memory). Findings suggest that clausal embedding, common to both sentential complements and RCs, serves as a bootstrap for FB reasoning.

1. Introduction

1.1. Background: theory of mind and false belief reasoning

Understanding others' mental states and capitalizing on this to predict their behaviours is referred to as Theory of Mind (ToM) (Premack & Woodruff, 1978). An important phase in the development of ToM involves grasping that others can have a belief that conflicts with reality, and a common measure used to assess this in children is the false belief (FB) task (Wimmer & Perner, 1983), the most famous version being the Sally and Anne paradigm (Baron-Cohen, Leslie, & Frith, 1985). During this task, children are required to predict where a character, Sally, will first look for an object that was moved to a new location (by Anne) in her absence. In order to succeed, children must realize that Sally is likely to mistakenly look for the object where she left it, rather than where it is really located (Dennett, 1978). Success at various versions of this task is consistently reported to occur between the ages of 4 and 5 years in typically developing (TD) children (Milligan, Astington, & Dack, 2007; Wellman, Cross, & Watson, 2001), suggesting that an important conceptual change takes place during this period (Perner, 1991; Perner & Roessler, 2012; Wellman et al., 2001).

Many children with Autism Spectrum Disorders (ASD), however, struggle with this task until much later on, as initially shown by Baron-Cohen et al. (1985). These authors report that, despite having a mean nonverbal mental age of 9 years 3 months, 80% of the 20 children with ASD they tested failed, setting them apart from control groups of equivalent or even lower mental age. The finding that the population with ASD shows persistent difficulty in such ToM tasks has been confirmed by a series of studies (Happé, 1995; Naito & Nagayama, 2004; Yirmiya, Erel, Shaked, Solomonica-Levi, &, 1998), suggesting a mentalizing deficit implicated in their characteristic communicative and social difficulties (Frith, Morton, & Leslie, 1991;

* Corresponding author.
E-mail address: stephanie.durrleman@unige.ch (S. Durrleman).

https://doi.org/10.1016/j.jcomdis.2018.04.001
Received 17 December 2016; Received in revised form 5 April 2018; Accepted 9 April 2018
Available online 17 April 2018
0021-9924/

Tager-Flusberg, 2007). Nonetheless, FB performance is not uniform in the autistic condition and a sizable subset of children with ASD systematically manages to pass ToM tasks. How do they accomplish that? The main goal of the current work is to better understand cognitive tools which may assist in FB reasoning.

1.2. Language and false-belief success

A developmental link between language and ToM is by now well established in the literature, in both preschool TD children (Astington & Jenkins, 1999) and in older children with ASD (Steele, Joseph, & Tager-Flusberg, 2003). ToM and language, in the dynamics of the developing brain, could be considered then to be co-evolving systems. However, training studies (in TD: Hale & Tager-Flusberg, 2003; Lohmann & Tomasello, 2003) as well as longitudinal studies (in TD: Astington & Jenkins, 1999; and ASD: Tager-Flusberg & Joseph, 2005) suggest that language influences false-belief reasoning rather than vice-versa. In light of these findings, language capacities may provide an index for an evolving explicit mentalizing performance required by FB tasks.

As for which precise component of language could have a privileged impact on FB performance in ASD, certain authors suggest that this is grammar (Fisher, Happé, & Dunn, 2005; Paynter & Peterson 2010), and more specifically the structure of complement clauses (Tager-Flusberg, 2000; Tager-Flusberg & Joseph, 2005; Lind & Bowler, 2009), such as in (1):

(1) Certain researchers think/believe/say [that children with autism have difficulties with theory of mind].

The semantic and syntactic particularities of complementation arguably render them ideal tools for reasoning about other minds (de Villiers, 1995; de Villiers & de Villiers, 2000). As can be seen from the example in (1), clausal complements occur after verbs of cognition or communication, which convey propositional attitudes. Crucially, the truth-value of the complement clause is independent of that of the entire sentence. That is, whether or not children with autism experience difficulties in theory of mind is irrelevant for the entire sentence in (1) to be true, rather it suffices for certain researchers to think/believe/say so. Put in technical terms, the embedded clause is evaluated not *extensionally*, i.e. in relation to the world, but *intensionally*, in relation to the matrix subject's mental states. As such, this linguistic form allows the representation of the possible worlds of other minds (de Villiers & de Villiers, 2000), i.e. 'meta-representation', for which isolated words, simple sentences or images cannot suffice (Fodor, 1975; Olson, 1993; Segal, 1998).

Children with autism spontaneously produce few complements (Durrleman & Zufferey, 2013) and their performance on complements of verbs of communication correlates with performance on FB tasks (Lind & Bowler, 2009; Tager-Flusberg & Joseph, 2005). Durrleman and Franck (2015), controlling for IQ, found correlations between the false belief task and the comprehension of complement sentences with verbs of both communication (e.g. *say*) and cognition (e.g. *think*). However, no correlation was found between the false belief task and the comprehension of sentences with complements of perception verbs such as *see*. A key theoretical difference between perception verbs, on the one hand, and the communication and cognition verbs used in that study, is that the sentential complements in constructions like 'X says/thinks that P', P may or may not be true – the utterance doesn't imply anything one way or the other, while in 'X sees that P', the truth of P is taken to be independent of X's belief or mental states: it is presupposed by the speaker to be a fact. For this reason the sentence *Sally sees that the ball is in the box* is only felicitous if the ball is effectively in the box. In contrast to complement clauses such as *Sally says/thinks that the ball is in the box,* the truth-value of perception verbs also depends on an objective fact. Put in technical terms, the embedded clause is also evaluated *extensionally*, i.e. in relation to the world, not only *intensionally*, in relation to an agent's perceptual state, though such a state, i.e. seeing, is also clearly involved. This difference could explain the correlation between FB and certain cognition and communication verbs and the lack of correlation between ToM and perception verbs found in Durrleman and Franck (2015).

However, Durrleman et al. (2016a) found with a larger cohort that perception complements did correlate with FB in ASD, although the link was weaker than that which emerged with communication complements. The link may exist precisely because, although clauses embedded under 'see' are evaluated extensionally as just noted, they are still interpreted as relative to a person seeing, and hence as *a representation of* an external fact. Intensionality and meta-representation are therefore still involved, even if less obviously so. This is clearly demonstrated by the fact that *seeing that the policeman enters through the door* is not always equivalent to *seeing that Fred enters through the door*, if the person who is seeing does not know that the policeman is Fred, i.e. has different representations of both. It is possible, therefore, that the link between clausal embedding and FB understanding is general but that its strength is modulated by what type of embedding is involved.

This raises the question whether a link can also be found with other types of embedded clauses, namely relatives. Indeed relative clauses share the core grammatical property of embedding with clausal complements, as shown in (2)–(3), where the only difference (apart from the presence of a relative pronoun in (3)), is that a given clause is embedded under a verb in (2) but under a noun in (3):

(2) Tom thinks **that the man stole his wallet**.

(3) Tom saw the man **that/who stole his wallet**.

If clausal embedding is a relevant syntactic factor in the relation between language and FB, sentences with relative clauses should correlate with FB performance as well, for the same reason – though possibly to a lesser degree than clausal complements. Indeed as seen in the case of perception (e.g. *see*) vs. cognition/communication (e.g. *think/say*) clausal complements, the relation in question may be modulated by independent differences between embedded clauses that are arguments of verbs and relative clauses modifying nouns. In particular, unlike verbal clausal complements as seen in *John believes that the man stole the wallet*, nominal clausal adjuncts as seen in *the man that stole the wallet* merely modify a given object. NPs, whether with an embedded relative clause modifier or not, cannot as such be true or false and in this sense cannot represent a belief. However, they can represent objects under a certain description that corresponds to assumptions that a speaker has of the

objects he refers to, i.e. how he represents them. This underlying similarity between relative clauses and complements could be responsible for a relation with belief-reasoning.

Only few studies have explored the possible link between relative clauses and FB. Interestingly, a study by Pérez-Leroux (1998) reported a correlation between the production of elicited relative clauses and success at a FB task in 22 TD Spanish-speaking children aged 3;5 and 6;11 ($y = 0.852$). However the relative clauses in this study included the subjunctive mood, which the authors concluded was the crucial ingredient associated with theory of mind because it involves the computation of the truth value of the embedded utterance in possible worlds other than the actual world. In another study by Smith, Apperly, and White (2003), relative clauses without the subjunctive (e.g. *The girl kicked the man that jumped over the wall*) were assessed in 56 TD English-speaking children of 3;3 to 4 years and were shown to be predictive of FB performance ($\Delta R^2 = .106$). These were called 'complex relatives' by the authors because they involved two temporally distinct events (a prior jumping and later kicking), which are not conceptualized as independent but such that the event of jumping is represented as *part* of the event of kicking: the kicking is that of a man who jumped. Smith et al. identify this as a meta-representational effect, in the sense that an event (a kicking) is represented as being represented in a particular way (namely as one following a jumping). This is in contrast to a coordinated structure involving 'and' such as *The girl kicked the man and he jumped over the wall*, where the two events are reported as independent ones and there is no clausal embedding, anymore than there is meta-representation (Arsenijevic & Hinzen, 2011). These structures were not predictive of FB performance ($\Delta R^2 = .007$).

Like coordinates, Smith et al. (2003) propose that 'simple', single event relative clauses (e.g. *The girl kicked the man who is wearing a hat*) fail to predict FB because they fail to exhibit the dependency found between two events in complex relatives, since only a single event takes place, namely a kicking of a hat-wearing man. In other words, no second event is represented as occurring as part of a first. Smith and colleagues found no correlation between language and FB performance for simple, single-event relatives, which they took as evidence for the key role of event embedding in the relation between complex relatives and FB. However, it is not clear why the relatives called 'simple' would lack a meta-representational element: although the relative in this case does not depict an event but a state, the crucial meta-representational element is arguably still present, insofar as a given event (a kicking) is represented as being represented in a particular way, namely as being the event of kicking that happened to a man wearing a hat.

Another study exploring the relationship between relative clauses and FB is that of Hale and Tager-Flusberg (2003). In this work, 72 preschool TD children were trained on complement clauses as well as simple relative clauses (e.g. *the girl who jumped up and down/ shook her head*) so as to assess the potential impact of these on FB performance. The authors only reported a significant benefit on FB performance for children trained on sentential complements, who were thus significantly above the group trained on relative clauses for FB. These results led them to conclude that relative clauses do not influence belief reasoning in TD.

Thus, empirical reports about the relation between relativization and FB are mixed. Hale and Tager-Flusberg (2003) suggest that relative clauses are not related to FB, while Perez-Leroux (1998) and Smith et al. (2003) suggest a relation which is attributed to different sources. Perez-Leroux concludes that it is the subjunctive mood associated with relative clauses that relates to FB. However, Smith et al. (2003) found a significant correlation between FB and relative clauses without the subjunctive, suggesting that the subjunctive mood is not the key factor in the relation between relativization and FB. Yet, they only found a correlation for complex relative clauses, and not for simple relative clauses, which made them conclude that the crucial ingredient is meta-representation. However as we outlined above, even a simple relative clause functions so as to represent a representation in a particular way, and in this way by definition is also a meta-representation, as are propositional-attitude encoding clauses. Concretely, in the case of *The girl kicked the man that jumped over the wall*, we noted that a description is provided by a speaker that represents a participant in an event (the jumping), and this representation functions so as to identify this participant in another event (the kicking), rather than referring to an independent event. In the same way, the content of a clause embedded under *think* does not identify an independent fact, but it forms part of a description of a mental event of thinking. This invites the prediction that any linguistic expression involving a representation of a representation should be related to FB understanding. The lack of a significant correlation reported by Smith et al. (2003) for simple, relative clauses involving embedding (also known as restrictive relative clauses) may have been due to the aspectual simplicity of these sentences in which no event is embedded under the NP and interpreted as part of another event, rather, a single event (kicking) is done by a single agent who is both a man and has a certain perceptual feature (hat-wearing). The lack of correlation may also be due to the fact that the TD children tested were around 4 years and showed near-ceiling performance (Smith et al., 2003; see also Adani, 2011). Along similar lines, the lack of a correlation in the training study of Hale and Tager-Flusberg (2003) may be due to a floor effect; children in that study started with very low performance and only ultimately reached 58% accuracy on relative clause comprehension, which may be too low for a transfer to show up on FB (the situation was different for complements for which children could capitalize on their existing knowledge of the structure, as shown by their 74% success). More generally, null effects are always difficult to interpret without solid evidence that the statistical power of the test was high enough to avoid a Type II error.

1.3. The current study

We hypothesize that restrictive relative clauses and FB both share a component of meta-representation, which predicts that a relation between the two should be found in performance. This relation between FB performance and language is predicted to obtain between any kind of embedded clause that triggers a meta-representational interpretation of the clauses concerned,

like restrictive relative clauses and clausal embedding, as both of these share the crucial property of not representing an independent event/state (i.e. an extensional interpretation), but an event/state that is represented as part of another. Nevertheless, this link is only expected to be observable in a population showing some variation in the comprehension of the language structure without floor or ceiling effects. Children with ASD thus provide a key population to explore the specificity of this potential link between language and ToM. Children with ASD are often delayed with respect to their grammatical abilities (Eigsti, Bennetto, & Dadlani, 2007) including simple relative clauses (Durrleman & Franck, 2012). However, the link between relative clauses and FB in ASD children has not yet been explored. In line with the goal of the current study, we set out to test this link. If simple relative clauses provide a bootstrap to the development of FB, we expect these structures to be predictive of FB performance in the ASD population, where sufficient variation in the processing of relative clauses persists.

2. Method

2.1. Participants

A total of 34 native French speakers took part in this study (as well as in Durrleman & Franck, 2015). In order to participate, children had to be native French speakers.

Seventeen verbal participants with ASD (14 boys) aged 6–16 (mean age 9;2) were recruited through parent associations and psychologists in the Geneva region, Switzerland. All had been diagnosed by a specialist as meeting *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition* (DSM-IV) criteria for an autism spectrum disorder (American Psychiatric Association 1994), including qualitative impairments in social interactions and communication, as well as restricted, repetitive and stereotyped interests and activities. Parents gave written consent and testing was conducted in a quiet room at home.

Seventeen native French TD children (12 boys) aged 4–9 (mean age 7;6) were recruited from a school in Geneva. They were matched to the participants with ASD on non-verbal IQ assessed through the Raven's Progressive Matrices (Raven, Court, & Raven, 1998). ASD children scored 24 at the test and TD children scored 23.9; the two groups did not differ ($\beta = -.06$, $SE = 2.715$, $t = -.02$, $p = .983$). TD children were tested in a quiet classroom. The Ethics Committee of the Faculty of Psychology, University of Geneva, approved the study.

2.2. Material

2.2.1. Relative clause task

The materials used (stimuli and pictures) were taken from Adani (2011) where both subject relative clauses (e.g. *Show me the bear that is pushing the elephants*) and object relative clauses (e.g. *Show me the bear that the elephants are pushing*) were assessed. Given the additional complexity induced by locality constraints on object relative clauses (Adani 2011, Friedmann, Belletti, & Rizzi, 2009) which are irrelevant for the exploration of intensionality effects triggered by simple event embedding, we have focussed only on subject relative clauses in the current study. Children were told that they would see various characters and that they would be asked to point to one of them. The task involved sentence-picture matching with 12 pre-recorded subject relative clauses in total as in (4). These test items were preceded by 4 familiarization items and interspersed with 16 simple imperatives[1] used as controls as in (5), which were selected so as to avoid embedding and exhibit minimal intensionality: In (5), only two perceptual features have to be placed in conjunction, boy and umbrella. In this case, it is not strictly necessary that anything has to be represented as 'part of' another representation, in Smith et al.'s terms.

(4) Show me the pigs who are chasing the monkey

[1] It is important to note that while these structures still involve modification, in linguistic terms this is achieved via a prepositional phrase, which is phrasal and small syntactically, unlike the propositional modification involved in complement and relative clauses.

(5) Show me the boy **with the umbrella**.

In (5) a particular boy is referenced using two conjoined descriptions (predicates): (a) being a boy and (b) having an umbrella. In our task, both properties can be directly seen to apply and checked by both experimenter and participant when the picture is shown, and hence the task can be accomplished simply by looking for something in the picture that is both a boy and has an umbrella without further grammatical analysis. In (4), by contrast, the information contained in the modifier of the noun phrase 'the pigs' is grammatically more complex: it takes the form of a full embedded clause describing an intentional action picked out by the verb 'chase', which has an agent (the grammatical subject of the verb) and a patient (the grammatical object).

2.2.2. The false belief test

The assessment of ToM included 4 unexpected transfer tasks, including the Sally-Anne (Baron-Cohen et al., 1985) as well as 3 others of exactly the same format. Legos were used throughout anecdotes, which involved a protagonist, say Anne, moving an object, e.g. a ball, from one location to another during the absence of another protagonist, say Sally (see Durrleman & Franck 2015 for more details). Upon Sally's return, children were asked the test question targeting false belief (FB) attribution: Where will Sally look for the ball first? The term "first" ("en premier" in French) was added at the end of this question because it has been shown to improve performance (Siegal & Beattie, 1991; Surian & Leslie, 1999). Two control questions were also asked in order to guarantee that children were keeping track of the story, i.e. a 'reality question': "Where is the ball really?" and a 'memory question': "Where was the ball in the beginning?".

The maximum score participants could obtain for this task was 4. Only participants who passed the two control questions were considered for the analyses of FB scores, and thus any difficulties with FB questions did not stem from an underlying difficulty to accurately keeping track of the story.

2.2.3. The Raven's progressive matrices (Raven et al., 1998)

This is a standardized intelligence task with the particularity of being essentially nonverbal. It is composed of 36 items focusing on visual problem solving in which the child is presented with various pieces depicting a visual geometric design, and has to select the missing piece among multiple choices. Performance at this task was used to pair TD children to ASD children, as well as to control for the role of a general intelligence factor (non-verbal IQ) independent of our two target tasks bearing on language and theory of mind.

2.2.4. Standardized language tasks

Children with ASD completed two language tasks. The first language task assessed grammar, the Production d'Enoncés du Bilan Informatisé de Langage Oral (Prod-E BILO, Khomsi, Khomsi, Pasquet, & Parbeau-Gueno, 2007). In this task, expressive grammar is assessed via 29 test items implying the use of various grammatical constructions (e.g. accusative clitics, passives, quantifiers, verbal and nominal inflections, etc. – see Appendix for illustrations). The child hears the beginning of a sentence, which must be completed according to illustrations presented on a computer screen (e.g., Ici, le garcon est debout; là, la fille …[est assise]/"Here the boy is standing; there, the girl… [is sitting]"). As the test (relative clause) sentences and the control (simple) sentences differed in grammatical complexity, we wanted to have a measure allowing to control for impact of general grammatical ability and ensure that any link arising between test sentences and false belief was not due to global grammar.

The second language task we administered, the 'Echelle de Vocabulaire en images Peabody' or EVIP (Dunn, Thériault-Whalen, & Dunn, 1993), assessed vocabulary. This task proposes four picture cards at a time from which the child has to select one corresponding to the word s/he hears. The task commences with 5 examples followed by 170 test items of increasing levels of difficulty. As the test (relative clause) sentences and the control (simple) sentences differed in the involvement of an active verb, we wanted to have a lexical measure to be able to

control for impact of general lexical ability and ensure that any link arising between test sentences and false belief was not due to global vocabulary.

2.2.5. Verbal working memory

Sentences with RCs diverge from simple declaratives in grammatical complexity, however they also do so in length and thus arguably in verbal working memory (compare example 4 with example 5. For more examples, see the appendix). To determine if such memory impacted FB performance, and to be able to control for this, we measured this independently via a non-word repetition task, constructed following the phonotactic rules of French (Poncelet & Van der Linden, 2003). During this task, children had to repeat 32 non-words: 24 items involving simple CV syllable structures, e.g. "zu", ranging from two to eight syllables and 18 items involving complex CCV syllable structure (e.g. "pra"), ranging from two to six syllables, as complex syllable structures are harder to repeat. For each number of syllables, there were always three items (see the Appendix for examples). The items were presented from the shortest to longest non-word, the simple list was administered before the complex list, with a break between the latter. Children were told that they would be asked to repeat a series of words that didn't mean anything. Four one-syllable words were first used as training items to ensure that the child had understood the type of response expected. The experimenter then read out each of the test items, making sure that they were read as one word for each item (i.e. without breaks between syllables). All the stimuli were presented to the child even when they made mistakes. The items were printed out on a sheet of paper used for scoring. The child's answers were recorded using an Olympus VN-6500PC recorder in high quality mode, without an external microphone. An item was considered as correct when all of the syllables had been repeated, or when one or two of the syllables contained a phoneme differing by no more than one articulatory feature (for consonants), or was acoustically similar (for vowels). A list of permitted variations per phoneme was taken into consideration, along the lines of Poncelet and Van der Linden (2003). Scores were calculated based on the total number of syllables children could successfully repeat (for the CV list: 105, and for the CCV list: 60).

2.3. Data analyses

Four analyses were conducted using various packages provided in R (Bates, Machler, Bolker, & Walker, 2015; R Development Core Team, 2016). We first examined by way of simple regression analyses whether ASD children differed from TD children on the three critical tasks: false belief, relative clauses, and simple imperatives. Under our hypothesis that ASD children are impaired both in false belief and in relative clause comprehension, we expected differences between the two populations on the first two measures, but no difference on simple imperatives. Second, we tested the prediction of our main hypothesis, according to which relative clauses and false belief share a component of meta-representation, that relative clauses should predict performance on the false belief test. We conducted multiple regression analyses including performance on relative clauses as a predictor as well as other potential predictors, namely group, performance on simple imperatives and performance on Ravens' matrices. Regression subset selection including exhaustive search was then conducted (using the leaps package in R) in order to select the model that best fit the data. Given that our hypothesis applies independently of whether children are ASD or TD, this analysis was conducted on the whole group. Third, in order to test the hypothesis that previous studies on TD children failed to report a link between subject relative clauses and false belief because of a lack of variability among that population, we conducted separate linear models for each population. If our hypothesis is correct, a link should appear in the ASD group, but not in the TD group, replicating previous studies. Finally, given the well-known high variability among ASD children on more general grammatical, lexical and memory measures, we explored whether performance on the BILO, the EVIP and the non-word repetition task played a role in the link observed between relative clauses and false belief in that group, by possibly mediating it. We ran the full model including all possible predictors, i.e., performance on relative clauses, simple imperative sentences, Raven's matrices, BILO, EVIP and verbal working memory, and determined the best model to account for false belief performance. Our hypothesis predicted that the best fit should be obtained with the model including only performance in relative clause comprehension, since other factors should play no any additional explanatory role.

3. Results

Children's performance on the relative clauses, simple imperatives, and the false belief condition of the Sally-Ann task is reported in Table 1. Simple models testing the effect of Group (ASD vs. TD) on performance on these tasks showed that performance on the false belief test was significantly higher in the TD group than in the ASD group ($\beta = .34$, $SE = .123$, $t = 2.73$, $p = .010$), and that TD children were also significantly better at comprehending relative clauses than ASD children ($\beta = .17$, $SE = .055$, $t = 3.07$, $p = .004$).

Table 1
Average performance (in percent), Standard Deviation (in brackets) and range of performance for the two groups of children on the relative clause task, the simple imperatives and the false belief condition of the Sally & Ann task.

	Relative clauses	Simple imperatives	False belief
ASD	78.9 (22.1) Range: 33.3–100	97.8 (3.8) Range: 87.5–100	54.4 (41.7) Range: 0–100
TD	96.1 (6.7) Range: 75–100	97.1 (3.9) Range: 87.5–100	88.2 (29.5) Range: 0–100

The two groups did not differ in their performance on simple imperatives ($\beta = -.007$, $SE = .013$, $t = -.56$, $p = .581$). For the general language measures of the group with ASD (grammar: BILO and vocabulary: EVIP), please see Table 2.

In order to test our main hypothesis that performance on relative clauses predicted performance on the false belief test, we conducted multiple regression analyses including as predictors performance on relative clauses as well as other potential predictors, namely group, performance on simple imperatives and performance on Ravens' matrices. The full model indicated that the four factors explained together 40% of the variance ($R^2 = .405$, $F(4,29) = 4.922$, $p = .004$). However, only comprehension of relatives turned out to significantly predict performance on the false belief task ($\beta = 1.059$, $p = .02$); neither group, comprehension of simple imperatives or Raven's matrices were predictive (respectively: $\beta = .154$, $p = .268$, $\beta = -0.363$, $p = .834$ and $\beta = 0.005$, $p = .577$). Regression subset selection including exhaustive search was then performed, and confirmed that the best model was the one that only included relative clauses, which explain 37% of the variance ($R^2 = .37$, $F(1,32) = 18.83$, $p < .001$), showing that comprehension of relatives significantly predicted performance on the false belief test ($\beta = 1.32$, $p < .001$).

Models conducted on each population separately showed that whereas comprehension of relative clauses significantly predicted false belief performance in ASD children ($\beta = .14$, $SE = .39$, $t = 2.93$, $p = .010$), it failed to do so in TD children ($\beta = .95$, $SE = 1.12$, $t = .85$, $p = .41$), in line with previous studies showing no effect in TD children.

Table 2
Mean scores, Standard Deviation (in brackets) and range of performance at the EVIP and BILO tasks for the ASD children.

	BILO	EVIP	Verbal WM
ASD	12.76 (6.6) Range: 3–23	8.23 (3.7) Range: 51–129	100.8 (33.6) Range: 53–160

Finally, we conducted the full model on ASD children including as predictors all the measures that had been collected in that group, i.e., performance on relative clauses, simple imperative sentences, Raven's matrices, but also BILO, EVIP and verbal working memory. Regression subset selection including exhaustive search showed that the best model was the one including as predictor performance on relative clauses alone. Comprehension of relative clauses explained 36% of the variance ($R^2 = .36$, $F(1,15) = 8.56$, $p = .01$) and significantly predicted performance on the false belief test ($\beta = 1.14$, $p = .01$).

4. Discussion

A wide literature has shown a tight link between the ability to process complement clauses and FB in both TD and ASD (de Villiers, 1995; de Villiers & de Villiers, 2000; Tager-Flusberg, 2000; Durrleman and Franck, 2015; Durrleman et al., 2016a, 2016b; Lind & Bowler, 2009; Tager-Flusberg & Joseph, 2005). Our goal was to determine the underlying linguistic ingredient implied in FB reasoning. We hypothesized that it is clausal embedding which mediates the link between complement clauses and FB, as embedding allows meta-representation. We thus predicted a relation between false belief-reasoning and structures other than sentential complements also involving embedding, such as restrictive relative clauses. The results support our hypothesis: comprehension of restrictive relative clauses was found to predict performance on a FB task. This predictive link was found overall on our group of ASD and TD children, but carried mostly by the ASD group.[2]

That specific structures involving embedding appear more closely related to belief-reasoning in ASD than TD has already been reported by Tager-Flusberg (2000); Tager-Flusberg and Joseph (2005), and has been recently confirmed by Farrar, Benigno, Tompkins, and Gage (2017) thanks to a meta-analysis. One possible explanation, following our discussion of the existing literature in the introduction, is that the link cannot show up in TD children due to their performance in the relative clause task being already at near ceiling. Another, non-exclusive possibility, is that children with ASD may experience more difficulty engaging in social interactions, which moreover frequently rely on linguistic abilities, and thus they would have a diminished access to social cues that could assist their TD peers in constructing their false belief understanding (Baron-Cohen, Wheelright, Hill, Raste, & Plumb, 2001; Kleinman, Marciano, & Ault, 2001; Klin, Jones, Schultz, Volkmar, & Cohen, 2002).

Importantly, various other factors introduced in the model all failed to predict FB performance, which allows us to discard possible alternative explanations. First, the effect is not simply due to a link between intention-reading and FB. We tested control sentences (i.e. simple imperatives) similar to the test (relative clause) sentences in requiring that the child figures out the communicative or referential intention of the experimenter (like: which animal is intended?). So, if intention-reading as such was responsible for the effect, it should have been found for control sentences as well, which was not the case. Second, the effect is not due to verbal working memory. Test sentences were longer than control sentences, and one could argue that memory is necessary to a certain extent to succeed at the FB task as well, as one needs to track the location of the object and remember whether or not the protagonist witnessed the displacement. However, memory failed to predict FB scores. Third, it is not grammatical complexity in a generic or unspecific sense that underlies the predictive link found between relative clauses and FB: although control and test sentences differ in grammatical complexity, grammatical complexity, as measured by BILO, failed to predict FB. Moreover, vocabulary, which was also

[2] Although our results suggest that performance to the other tasks (EVIP, BILO, Verbal WM) added no variance to the variance due to relative clause comprehension, one cannot exclude that the lack of effect of these other factors be due to lack of power.

more complex in the test sentences due to the involvement of an action verb, also failed to show any predictive effect on FB.

Rather, we suggest that the reason that relative clauses correlate with FB performance, just like complement clauses, is likely because these two share a form of clausal embedding involving meta-representation, which is also involved in FB reasoning. Thus a restrictive relative clause represents an object (e.g. a monkey) as how it is represented by a speaker, namely as the one chasing the pigs. That nominal complements (i.e. relative clauses) and verbal complements (i.e. sentential complements) both involve meta-representation is further confirmed by the fact that both types of clauses can exhibit intensionality effects. Thus, referring to a man as *the man who stole his wallet*, need not be equivalent to referring to him as *the man who is his neighbour*, even if the two complex NPs happen to pick out the same man. This is shown in (6), where a) could be accepted even if b) is not, if the speaker is ignorant on whether the thief is the neighbour:

(6) a. This is the man who is his neighbour.

b. This is the man who stole his wallet.

Hence, how the man that is represented is *described* (i.e. how he is meta-represented) matters. In contrast to (6), in (7a), with comma intonation, or in (7b), with two independent assertions, the accuracy of the description provided in the second clause does *not* matter to the identity of the referent picked out in the first clause. Consequently, if the description were to turn out to be false, the man in question would still be relevantly identified:

(7) a. This is the man, who (incidentally) is (also) my neighbour.

b. This is the man; he is (also) my neighbour.

The shift from a restrictive to a non-restrictive, parenthetical form of embedding (7a) or to a structure lacking embedding (7b) thus makes a fundamental difference, suggesting clausal subordination (as in 6) to be a crucial factor in what generates intensionality effects (Arsenijević & Hinzen, 2012). This motivates the explanatory hypothesis that, if clausal embedding is the relevant factor connecting verbal clausal complements to FB and it shows in (restrictive) relative clauses as well, the connection in question could hold for the same reason in both cases: both types of clauses are meta-representational, in line with the fact that they both can give rise to intensionality effects.

In instances of prepositional modifiers, which characterized our control sentences, by contrast, we would not expect meta-representational effects to arise because in order to comprehend these sentences, only two properties are involved that have to be conjoined: for instance, boy and umbrella, or pigs and monkeys. The task, therefore, can be solved extensionally, by looking at which properties are instantiated where, and hence without representing any representations. No description (e.g. *chasing the monkey*) has to be processed that has to be understood as part of another (e.g. *pigs*). Still, we acknowledge that in order to unambiguously attribute the effects we found with the relative clauses, which included two arguments and were eventive, to their involving embedding, future work should investigate relative clauses with intransitive predicates (*the pig that is running*) and relative clauses that include predicates similar to the ones in the control clauses (*the boy that had an umbrella*).

Our results are in line with the previous finding by Smith and colleagues on TD children that complex relative clauses containing the embedding of an event within another event (e.g. *The girl kicked the man that jumped over the wall*) were linked to FB performance (Smith et al., 2003). However, the same authors reported that simple relative clauses that did not involve event embedding showed no link to FB. Since simple relative clauses by our argument also involve meta-representation, our hypothesis therefore predicted a significant link here as well. We argued that the lack of effect in that study may be due to a ceiling effect in this population's comprehension of simple relative clauses, and therefore reflect a Type II error. Our own results on TD children bring support to this possibility: we showed that while the predictive link between relative clauses and FB showed up in the whole group of children tested as well as in the ASD population alone, it failed to show up in the TD population alone. Similarly to Smith et al. (2003), the TD group performed rather high on the two tasks, such that the small variability in the data prevented the effect to show up. Our results also suggest the possibility that the lack of effect reported in the training study by Hale and Tager-Flusberg (2003) is due to a Type II error, due to the weakness of the effect.

Our findings are also consistent with Pérez-Leroux's (1998) study reporting a link between restrictive relative clauses embedded under intensional verbs such as *looking for* and false belief understanding. However, our study also suggests that the presence of an intensional verb cannot be the essential factor. In line with our above speculation that meta-representation, common to both relative clauses and complements and giving rise to intensionality effects in both cases, is the missing link between language and belief attribution, significant links (all yielding $p < .01$) have recently been found in TD between infants' understanding of intensionality and standard false belief tasks (Rakoczy, Bergfeld, Schwarz, & Fizke, 2015). Rakoczy et al.'s study revises earlier findings (Apperly & Robinson, 1998, 2003; Russell, 1987), according to which children's understanding of intensionality takes a further 2 years to mature after false belief tasks are mastered around 4 years. Rakoczy et al. (2015) take the correlation they found to be independent of verbal ability. However this may result from how they measured verbal ability: they used a vocabulary task (the vocabulary subscale of the Kaufman Assessment Battery for Children; Kaufman & Kaufman, 1999). There is no a priori reason to expect a link between vocabulary and intensionality. In contrast, given the links between ToM and embedded clauses, we do expect a link between intensionality and a verbal task that taps into the comprehension of complement clauses. The reason, as noted classically since Frege (1892), is again that complement clauses, and particularly those with non-factive verbs such as *think*, paradigmatically exhibit intensionality: *Sally thinks Peter is her neighbour* and *Sally thinks the fireman is her neighbour* are not equivalent, even if *Peter* and *the fireman* are descriptions referring to the same person. This is very similar to the forms of intensionality studied in Rakoczy et al. (2015), e.g. when two descriptions such as *pen* and *rattle* refer to the same object, but an agent may not know that. Vocabulary as such, by contrast, does not exhibit intensionality effects, which only arise within grammatical structures when language is used to refer to an object or fact under a description.

Intensionality as a key concept to link false belief and language also has the virtue that it is arguably graded, depending on the

construction type in which it occurs. Thus we have already noted that the link between complement clauses and ToM performance obtains robustly for verbs of communication and belief but not as robustly for verbs of perception such as *see* (Durrleman & Franck, 2015; Durrleman, Marinis, & Franck, 2016b). The reason is that while the former verbs of these two types of complement-taking verbs belong to the most classical cases of intensionality identified since Frege (1892), the latter have a factive interpretation and the extent to which they involve intensionality is less clear. Intensionality however remains present to some degree even in embedded clauses presupposed to be true, as has been noted for long in the linguistic literature (e.g. Sheehan & Hinzen, 2011), and in relative clauses, as shown above. It may thus be appropriate to speak of a *scale*, such that intensionality effects are strongest with complement clauses with matrix verbs of communication and belief, but weaker with complement clauses with perception verbs or in relative clauses.[3]

In sum, in the domain of clausal complements, our study is a first step in showing a link between simple relative clauses and FB in a population that struggles with these two domains of cognition. That other studies do not report this link follows from the hypothesis that it is a weaker one than the link between sentential complements and FB, in line with the broader possibility of a scale along which language, intensionality, and false belief connect with each other in development. Additional research is necessary to investigate more finely this possible gradation, not only in the relations between language and ToM, but also in intensionality tasks themselves.

5. Conclusion

With this study, we explored the hypothesis that relative clause structures involving embedding show a link to ToM, like complement clauses. We argue that this link is weaker in relative clauses than in complements, and that therefore the lack of effect in previous studies may be due to a Type II error. We tested that hypothesis in children with ASD. This population has been claimed to rely particularly on language for figuring out solutions to FB tasks requiring an explicit response, and to show persistent variation both in such ToM tasks and in relative clause performance, therefore offering the relevant testing grounds to assess our hypothesis without being confronted to the issue of statistical power of experimental designs. In line with our hypothesis, we found that comprehension of simple (single event) relative clauses predicted performance on a false belief task in that population. This link moreover cannot stem from general language abilities or verbal memory, as shown by the absence of links between FB and simpler control sentences and links between FB and general measures of vocabulary, morpho-syntax and nonword repetition. Our findings thus support the specificity of the link between language and Theory of Mind as measured by FB tasks in ASD, and suggest that embedding, common to both complements and relative clauses, may be a key ingredient for accomplishing meta-representation, and a key source for intensionality effects.

In light of our findings, future work should pursue charting the connection between intensionality in different linguistic constructions and ToM. This could be achieved by more systematically assessing the links between various grammatical structures involving different levels of intensionality within the same participants so as to determine which ones show most privileged links to ToM: complements with and without factive complement clauses (*Peter thinks/says the paper is red* vs. *Peter sees/hates that the paper is red*), infinitives with verbs of appearance (*the paper seems to be red*) and relative clauses (*the paper that is red*), but also different types of descriptions (*is a die* vs *is* red). Such investigations promise to continue to elucidate the underlying linguistic signature of the cognitive process of mentalizing.

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at https://doi.org/10.1016/j.jcomdis.2018.04.001.

References

Adani, F. (2011). Rethinking the acquisition of relative clauses in Italian: Towards a grammatically based account. *Journal of Child Language, 38*, 141–165. http://dx.doi.org/10.1017/S0305000909990250.

Apperly, I., & Robinson, E. (1998). Children's mental representation of referential relations. *Cognition, 67*, 287–309.

Apperly, I., & Robinson, E. (2003). When can children handle referential opacity? Evidence for systematic variation in 5- and 6-year-old children's reasoning about beliefs and belief reports. *Journal of Experimental Child Psychology, 85*, 297–311. http://dx.doi.org/10.1016/S0022-0965(03)00099-7.

Arsenijević, B., & Hinzen, W. (2012). On the absence of X-within-X recursion in human grammar. *Linguistic Inquiry, 43*(3), 423–440.

Astington, J. W., & Jenkins, J. M. (1999). A longitudinal study of the relation between language and theory-of-mind development. *Developmental Psychology, 35*, 1311–1320.

Baron-Cohen, S., Leslie, A. M., & Frith, U. (1985). Does the autistic child have a theory of mind? *Cognition, 21*(1), 37–46.

Baron-Cohen, S., Wheelright, S., Hill, J., Raste, Y., & Plumb, I. (2001). The 'Reading the Mind in the Eyes' test – revised version: A study with normal adults: And adults with Asperger syndrome or high-functioning autism. *Journal of Child Psychology and Psychiatry, 42*, 241–251.

[3] What may be particularly informative about non-factive verbs of communication and belief for learning about belief states, and in particular false-beliefs, is that the matrix and embedded sentences can mismatch in their truth. This does not hold for perception verbs like 'see' or factive verbs like 'know'. For example, a child hearing "John thinks Mary fell" but knowing that Mary did not fall will learn that "…[Mary fell]" embedded under "think" is relative to a belief-holder (i.e. the matrix subject). The child can induce that if this is a valid sentence then John must "think" (but hold a FB!) that "Mary fell". The same is partially true for relative clauses, since a child hearing a man referred to as "the man who stole the wallet", but knows he did not, can induce that the speaker must wrongly presuppose "the man stole the wallet". 'See' and 'know' complements would not offer this learning-rich mismatch, although they would be useful in the input when contrasted in meaning with other verbs of cognition such as 'think' ("Before John thought Mary fell; now he knows she did not", ; see also Shatz, Wellman, & Silber, 1983; Papafragou, Cassidy, & Gleitman, 2007).

Bates, D., Machler, M., Bolker, B., & Walker, S. (2015). Fitting linear mixed-effects models using lme4. *Journal of Statistical Software, 67*, 1–48. http://dx.doi.org/10.18637/jss.v067.i01.
Dennett, D. (1978). Beliefs about beliefs. *Behavioral and Brain Sciences, 4*, 568–570.
de Villiers, J. G. (1995). Steps in the mastery of sentence complements. *Paper presented at the biennial meeting of the Society for Research in Child Development*.
de Villiers, J., & de Villiers, P. A. (2000). Linguistic determinism and the understanding of false beliefs. In P. Mitchell, & K. Riggs (Eds.). *Children's reasoning and the mind* (pp. 189–226). Hove, UK: Psychology Press.
Dunn, L., Thériault-Whalen, C., & Dunn, L. (1993). *Échelle de vocabulaire en images peabody [Peabody picture vocabulary scale]*. Toronto: Psycan.
Durrleman, S., & Franck, J. (2012). *Atypical subject relative clause processing in children with autism', poster presented at architectures and mechanisms for language processing (Amlap)*. Riva del Garda Italy.
Durrleman, S., & Franck, J. (2015). Exploring links between language and cognition in autism spectrum disorders: Complement sentences, false belief, and executive functioning. *Journal of Communication Disorders, 54*, 15–31.
Durrleman, S., & Zufferey, S. (2013). *Investigating complex syntax in autism. Advances in Language Acquisition.* Newcastle: Cambridge Scholars Publisher.
Durrleman, S., Burnel, M., Thommen, E., Foudon, N., Sonie, S., Reboul, A., et al. (2016a). The language-cognition interface in ASD: Complement sentences and false belief reasoning. *Research in Autism Spectrum Disorders, 21*, 109–120.
Durrleman, S., Marinis, T., & Franck, J. (2016b). Syntactic complexity in the comprehension of wh-questions and relative clauses in typical language development and autism. *Applied Psycholinguistics, 37*, 1501–1527.
Eigsti, I.-M., Bennetto, L., & Dadlani, M. B. (2007). Beyond pragmatics: Morphosyntactic development in autism. *Journal of Autism and Developmental Disorders, 37*, 1007–1023.
Farrar, J. M., Benigno, J. P., Tompkins, V., & Gage, N. A. (2017). Are there different pathways to explicit false belief understanding? General language and complementation in typical and atypical children. *Cognitive Development, 43*, 49–66.
Fisher, N., Happé, F., & Dunn, J. (2005). The relationship between vocabulary, grammar, and false belief task performance in children with autistic spectrum disorders and children with moderate learning difficulties. *Journal of Child Psychology and Psychiatry, 46*(4), 409–419.
Fodor, J. (1975). *The language of thought.* New York: Crowell.
Frege, G. (1892). *Über Sinn und Bedeutung in Zeitschrift für Philosophie und philosophische Kritik*, *100*, 25–50.
Friedmann, N., Belletti, A., & Rizzi, L. (2009). Relativized Relatives: Types of intervention in the acquisition of A'-dependencies. *Lingua, 119*, 67–88.
Frith, U., Morton, J., & Leslie, A. M. (1991). The cognitive basis of a biological disorder: Autism. *Trends in Neurosciences, 10*, 433–438.
Hale, C. M., & Tager-Flusberg, H. (2003). The influence of language on theory of mind: A training study. *Developmental Science, 6*(3), 346–359.
Happé, F. G. E. (1995). The role of age and verbal ability in the theory of mind task performance of subjects with autism. *Child Development, 66*(3), 843–855.
Kaufman, A., & Kaufman, N. (1999). In P. Melcher, & U. Preuß (Eds.). *Kaufman assessment battery for children*(4th ed.). Frankfurt am Main, Germany: Swets Test Services Trans.
Khomsi, A., Khomsi, J., Pasquet, F., & Parbeau-Gueno, A. (2007). *BILO bilan informatisé du langage oral*.
Kleinman, J., Marciano, P., & Ault, R. (2001). Advances theory of mind in high-functioning adults with autism. *Journal of Autism and Developmental Disorders, 31*, 29–36.
Klin, A., Jones, W., Schultz, R., Volkmar, F., & Cohen, D. J. (2002). Defining and quantifying the social phenotype in autism. *American Journal of Psychiatry, 159*, 895–908.
Lind, S. E., & Bowler, D. M. (2009). Language and theory of mind in autism spectrum disorder: The relationship between complement syntax and false belief task performance. *Journal of Autism and Developmental Disorders, 39*(6), 929–937.
Lohmann, H., & Tomasello, M. (2003). The role of language in the development of false belief understanding: A training study. *Child Development, 74*(4), 1130–1144.
Milligan, K., Astington, J. W., & Dack, L. A. (2007). Language and theory of mind: Meta-analysis of the relation between language ability and false-belief understanding. *Child Development, 78*(2), 622–646.
Naito, M., & Nagayama, K. (2004). Autistic children's use of semantic common sense and theory of mind: A comparison with typical and mentally retarded children. *Journal of Autism and Developmental Disorders, 34*(5), 507–519.
Olson, D. R. (1993). The development of representations: The origins of mental life. *Canadian Psychology, 34*, 1–14.
Papafragou, A., Cassidy, K., & Gleitman, L. (2007). When we think about thinking: The acquisition of belief verbs. *Cognition, 105*, 125–165.
Paynter, J., & Peterson, C. C. (2010). Language and ToM development in autism versus Asperger syndrome: Contrasting influences of syntactic versus lexical/semantic maturity. *Research in Autism Spectrum Disorders, 4*.
Perner, J. (1991). *Understanding the representational mind.* Cambridge, MA: MIT Press.
Perner, J., & Roessler, J. (2012). From infants' to children's appreciation of belief. *Trends in Cognitive Sciences, 16*(10), 519–525.
Poncelet, M., & Van der Linden, M. (2003). L'évaluation du stock phonologique de la mémoire de travail: élaboration d'une épreuve de répétition de non-mots pour population francophone. *Revue de neuropsychologie, 13*, 377–407.
Premack, D., & Woodruff, G. (1978). Does the chimpanzee have a theory of mind? *Behavioral and Brain Sciences, 1*(04), 515–526.
Rakoczy, H., Bergfeld, D., Schwarz, I., & Fizke, E. (2015). Explicit theory of mind is even more unified than previously assumed: Belief ascription and understanding aspectuality emerge together in development. *Child Development, 86*(2), 486–502.
Raven, J. C., Court, J. H., & Raven, J. (1998). *Progressive matrices standard (PM38) Éditions du centre de psychologie appliquée*.
Russell, J. (1987). Can we say.? Children's understanding of intensionality. *Cognition, 25*, 289–308. http://dx.doi.org/10.1016/S0010-0277(87)80007-0.
Segal, G. (1998). Representing representations. In P. Carruthers, & J. Boucher (Eds.). *Language and thought* (pp. 146–161). Cambridge: Cambridge University Press.
Shatz, M., Wellman, H. M., & Silber, S. (1983). The acquisition of mental terms: A systematic investigation of the first reference to mental state. *Cognition, 14*, 201–321.
Sheehan, M., & Hinzen, W. (2011). Moving towards the edge. *Linguistic Analysis, 3*(3-4), 405–458.
Siegal, M., & Beattie, K. (1991). Where to look first for children's knowledge of false beliefs. *Cognition, 38*, 1–12.
Smith, M., Apperly, I., & White, V. (2003). False belief reasoning and the acquisition of relative clause sentences. *Child Development, 74*, 1709–1719.
Steele, S., Joseph, R. M., & Tager-Flusberg, H. (2003). Developmental change in theory of mind abilities in children with autism. *Journal of Autism and Developmental Disorders, 33*, 461–467.
Surian, L., & Leslie, A. M. (1999). Competence and performance in false belief understanding: A comparison of autistic and three-year-old children. *British Journal of Developmental Psychology, 17*, 141–155.
Tager-Flusberg, H., & Joseph, R. M. (2005). How language facilitates the acquisition of false-belief understanding in children with autism. In J. W. Astington, & J. A. Baird (Eds.). *Why language matters for theory of mind* (pp. 298–318). New York: Oxford University Press.
Tager-Flusberg, H. (2000). Language and understanding minds: Connections in autism. In S. Baron- Cohen, H. Tager-Flusberg, & D. J. Cohen (Eds.). *Understanding other minds: Perspectives from developmental cognitive neuroscience*(2nd ed.). Oxford: Oxford University Press.
Tager-Flusberg, H. (2007). Evaluating the theory-of-mind hypothesis of autism. *Current Directions in Psychological Science, 16*, 311–315.
Wellman, H., Cross, D., & Watson, J. (2001). Meta-analysis of theory of mind development: The truth about false belief. *Child Development, 72*, 655–684.
Wimmer, H., & Perner, J. (1983). Beliefs about beliefs: Representation and constraining function of wrong beliefs in young children's understanding of deception. *Cognition, 13*(1), 103–128.
Yirmiya, N., Erel, O., Shaked, M., & Solomonica-Levi, D. (1998). Meta-analyses comparing theory of mind abilities of individuals with autism, individuals with mental retardation, and normally developing individuals. *Psychobiological Bulletin, 124*(3), 283–307.