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False belief and relative clauses in Autism Spectrum Disorders

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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; Tager-Flusberg, 2007). Nonetheless, FB performance is not uniform in the autistic condition and a sizable subset of children

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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