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Social cognition in ADHD: Irony understanding and recursive theory of mind



Stéphanie Caillies^{a,*}, Vincine Bertot^{a,b}, Jacques Motte^b, Christine Raynaud^b, Michel Abely^b

^a Cognition, Health and Socialisation Laboratory (EA 6291), University of Reims Champagne Ardenne, 57 rue Pierre Taittinger, 51096 Reims Cedex, France

^b Department of Paediatrics, American Memorial Hospital, Reims University Hospital, 47 Rue Cognacq-Jay, 51092 Reims Cedex, France

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ABSTRACT

The main goal of the present study was to characterise the social cognition abilities of French children with ADHD, in terms of their understanding of people's recursive mental states and their irony comprehension. We hypothesised that these children have difficulty understanding second-order false beliefs and ironic remarks, owing to the executive dysfunction that is characteristic of ADHD. We therefore conducted an experiment in which children with ADHD and typically developing matched controls performed second-order false-belief and executive function tasks. They then listened to ironic stories and answered questions about the ironic comments and about the speakers' beliefs and attitudes. The groups differed significantly on second-order theory of mind, irony comprehension and executive functions, confirming that children with ADHD have impaired social cognition.

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1. Introduction

Attention deficit hyperactivity disorder (ADHD) is one of the most prevalent neurodevelopmental disorders in childhood. It is associated with impaired functioning not only in cognitive and academic domains, but in social ones, too (Barkley, 2003). Children with ADHD appear to display inadequate social behaviour (for a review, see Nijmeijer et al., 2008) and to have impaired social cognition (Uekermann et al., 2010). *Social cognition* can be briefly defined as the ability to understand other people's minds and, more specifically, to perceive emotion, empathise, attribute false belief and understand intended meaning, among others. Although deficits in the social cognition domain are clinically observed in ADHD, little research has been carried out in this area – a situation the present study sought to remedy. Some authors have reported social cognition difficulties in children with ADHD, specifically in emotion perception and/or processing (Pelc, Kornreich, Foisy, & Dan, 2006; Sinzig, Morsch, & Lehmkuhl, 2008), empathy (Braaten & Rosén, 2000; Dick, Ferguson, & Shochet, 2001; Marton, Wiener, Rogers, Moore, & Tannock, 2009), theory of mind (ToM; Gonzalez-Gadea et al., 2013; Ibáñez et al., 2011) and pragmatics

* Corresponding author at: C2S, EA 6291, Université de Reims Champagne-Ardenne, 57 rue Pierre Taittinger, 51096 Reims Cedex, France. Tel.: +33 03 26 91 36 37; fax: +33 03 26 91 37 09.

E-mail address: stephanie.caillies@univ-reims.fr (S. Caillies).

(Bignell & Cain, 2007; Camarata & Gibson, 1999; Geurts & Embrechts, 2008; Staikova, Gomes, Tartter, McCabe, & Halperin, 2013). The present study sought to further investigate both pragmatic language abilities and ToMin children with ADHD.

Pragmatics refers to the use and comprehension of language in context, rather than to the semantic or structural aspects of language. It involves skills such as using contextual information to interpret incoming utterances and understand implicit messages or figurative expressions (Grice, 1989). Among the different types of figurative language, irony is a common and frequently occurring figure of speech that is used to convey speakers' beliefs and attitudes to situational events, and thus serves a variety of social and communicative functions (Gibbs & Colston, 2012). In this sense, irony comprehension is a useful indicator of pragmatic abilities. Understanding an ironic utterance necessarily requires pragmatic inferences to be drawn from the context. For example, saying "*He is bright*" about an idiot can only be understood as ironic from the context. The literature on the development of irony comprehension suggests that recognition of irony begins at around 6 years of age. More specifically, this is when children start to detect that an ironic speaker does not believe what he/she has literally said (Ackerman, 1981; Andrews, Rosenblatt, Malkus, Gardner, & Winner, 1986; Winner & Leekam, 1991), although this does not mean that they necessarily understand all the components involved in irony comprehension, such as the speaker's attitude. Researchers have shown that the understanding of speakers' beliefs precedes that of speakers' attitudes (Ackerman, 1983; Andrews et al., 1986). It has also been suggested that children's understanding of a speaker's ironic intent depends on their cognitive ToM abilities (Filippova & Astington, 2008; Sullivan, Winner, & Hopfield, 1995). Once they have acquired a capacity for second-order mental state reasoning, children are likely to use the speaker's beliefs about the listener's (or target's) beliefs as cues to interpretation. As such, the ability to make inferences about other people's minds creates the possibility of irony detection.

In the literature, there has yet to be any research on the irony comprehension of children with ADHD, and rare are the studies that have investigated cognitive ToM abilities. Cognitive ToM is generally explored via false-belief tasks. The standard version of these tasks involves the unexpected transfer of a desired object, so that the protagonist entertains a false belief about the location of that object (Wimmer & Perner, 1983). Findings indicate that healthy children are able to successfully perform first-order false-belief tasks at around 4 years (e.g., Flavell, Flavell, & Green, 1983; Hogrefe, Wimmer, & Perner, 1986; Perner, Leekman, & Wimmer, 1987). However, they are unable to successfully complete second-order false-belief tasks, which involve the comprehension of recursive mental states (e.g., John thinks that Mary thinks that...), until they are about 6 or 7 years old (Coull, Leekam, & Bennett, 2006; Perner & Wimmer, 1985). To our knowledge, only three studies have investigated false-belief understanding in children diagnosed with ADHD, and these have yielded divergent results. Sodian and Hülshen (2005) found a significant difference between children with ADHD and their controls on a test of advanced false-belief understanding that required them to represent the protagonists' informational access. However, they did not find any difference between these children and their controls on the Strange Story test (Happe, 1994). Charman, Carrol, and Sturge (2001) also failed to find any significant difference between ADHD and control groups on the Strange Story test. Finally, Buitelaar, Van der Wees, Swaab-barneveld, and van der Gaag (1999) reported a significant difference on second-order false-belief understanding between a clinical subsample of nine children with ADHD and 11 psychiatric control children, unlike Sodian and Hülshen (2005). Hence, children with ADHD may encounter problems with false-belief tasks – problems that may also hinder irony understanding and, as a consequence, impair pragmatic abilities. Paradoxically, even though the Strange Story test relies on figure-of-speech and irony understanding, children with ADHD have been shown not to have difficulty with it (Charman et al., 2001; Sodian & Hülshen, 2005). Our study was intended to shed some light on these inconsistencies.

It is important to explore the cognitive functions that may underlie social cognition deficits in ADHD. Social cognition difficulties do not constitute the core symptom of ADHD which, according to the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV; American Psychiatric Association, 2000), is characterised by pervasive behavioural symptoms of hyperactivity, impulsivity and inattention, beginning in childhood. Three subtypes of the disorder are identified in the current clinical picture of ADHD offered in the DSM: predominantly inattentive, predominantly hyperactive-impulsive, and combined types. Recent theories of ADHD highlight the role of executive functions (EFs) in the disorder (Barkley, 1997; Castellanos, Sonuga-Barke, Milham, & Tannock, 2006; Willcutt, Doyle, Nigg, Faraone, & Pennington, 2005). EFs can be defined as a set of general-purpose control mechanisms, often linked to the prefrontal cortex, that regulate the dynamics of human cognition and action (Miyake & Friedman, 2012). There are generally agreed to be three core EFs: inhibitory control, encompassing behavioural inhibition and interference control (selective attention and cognitive inhibition), working memory (WM), and cognitive flexibility (Diamond, 2013). The debate about ADHD subtypes in terms of EF deficits (cf. Desman, Petermann, & Hampel, 2008; Di Trani et al., 2011) does not fall within the ambit of this paper. Regarding typical development, the finding that performances on false-belief tasks are correlated with performances on EF tasks is extremely robust (see Perner & Lang, 1999, for a review), particularly for inhibitory control, even when chronological and mental age are controlled for (Carlson & Moses, 2001; Carlson, Moses, & Breton, 2002; see also Flynn, 2007; Flynn, Malley, & Wood, 2004). Based on this evidence, we can hypothesise that the ToM deficits of children with ADHD are related to their inhibitory control deficits. Consistent with this, Sodian and Hülshen (2005) found that ToM impairments come to light in tasks with high inhibitory demands, and that children with ADHD are unimpaired on ToM tasks that do not require inhibitory control. They therefore suggested that ToM itself remains intact, but there is a failure to express this ability in situations that require inhibitory control. According to this rationale, a primary deficit in inhibitory control could lead to a failure to develop particular ToM skills in comparison with typically developing peers and, as a consequence, to impaired pragmatic processing, as inhibitory control is needed to understand irony. In accordance with the hypothesis of interrelations between

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