



# Theory of mind and irony comprehension in children with cerebral palsy

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## ABSTRACT

The main goal of the present study was to characterise the pragmatic abilities of French children with cerebral palsy through their understanding of irony and other people's mental states. We predicted that children with cerebral palsy would have difficulty understanding false-belief and ironic remarks, due to the executive dysfunction that accompanies the motor disorders of cerebral palsy. We conducted an experiment in which children with cerebral palsy and typically developing matched controls performed theory-of-mind and executive function tasks. They then listened to ironic stories and answered questions about the speakers' beliefs and attitudes. The groups differed significantly on second-order theory of mind, irony comprehension and working memory, indicating pragmatic difficulties in children with cerebral palsy.

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## 1. Introduction

“Cerebral palsy” (CP) describes a group of disorders of the development of movement and posture causing activity limitations, which are attributed to nonprogressive disturbances that occurred before, during or shortly after birth. Today, it is acknowledged that cognitive disturbances often accompany the motor disorders of cerebral palsy, and they are now included in the definition of this condition. The motor disorders of cerebral palsy are often accompanied not just by impaired cognition, but also by disturbances of sensation, communication, perception and/or behaviour, and/or by seizure disorders (Bax, Goldstein, Rosenbaum, Leviton, & Paneth, 2005). Although the literature on children with CP continues to focus mainly on their motor impairment, a growing body of studies is investigating their cognitive functioning.

Due to their motor dysfunction, as well as to varying degrees of speech impairment, children with CP often experience less spontaneous contact with the environment, and their potential for social interaction and the active manipulation of objects is much reduced, compared with that of their peers (Pennington & McConachie, 2001; Voorman, Dallmeijer, Van Eck, Schuengel, & Becher, 2010). This results in communication challenges that are not well characterised in the literature. Although there is an extensive body of findings regarding speech and language in children with CP (Hustad, Gorton, & Lee, 2010; Pirlan et al., 2007), descriptions of their communication abilities are few and far between.

In the literature, many communication abilities are described as pragmatic abilities. The term “pragmatic abilities” encompasses language and theory-of-mind (ToM) abilities, as well as memory, executive functions and emotions (Perkins, 2007). Holck, Nettelbladt, and Dahlgren-Sandberg (2009) compared the pragmatically related abilities of children with CP with those of two other clinical groups. Their results did not clearly indicate a pragmatic impairment in children with CP (see also Holck, Dahlgren-Sandberg, & Nettelbladt, 2010). Nevertheless, pragmatically related problems observed by clinical practitioners in children with CP require further research. Investigating pragmatic abilities is, however, a complex business,

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as several dimensions are involved, not least the understanding of others' mental states, language comprehension, and the process of inferring the speaker's intended meaning.

In the literature, the understanding of others' mental states has generally been investigated via false-belief tasks within the ToM framework (Flynn, 2006). 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 children with typical development become able to successfully perform false-belief tasks at around 4 years (e.g., Flavell, Flavell, & Green, 1983; Hogrefe, Wimmer, & Perner, 1986; Perner, Leekam, & Wimmer, 1987). Children 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...), until they are about 6 or 7 years old (Coull, Leekam, & Benett, 2006; Perner & Wimmer, 1985). Few studies have attempted to investigate false-belief understanding in children with CP. Dahlgren, Dahlgren-Sandberg, and Hjelmquist (2003) studied the ToM abilities of nonvocal children with CP. They predicted that, given the role played by conversational experience in ToM development (Milligan, Astington, & Dack, 2007), the children with CP would have difficulty understanding other people's mental states. Consistent with this prediction, results indicated that the nonvocal children had difficulty with false-belief understanding (see also Dahlgren, Dahlgren-Sandberg, & Larsson, 2010). We cannot know from this result whether their difficulty stemmed from a ToM deficit or whether it simply reflected slow but normal development. Falkman, Dahlgren-Sandberg, and Hjelmquist (2005) attempted to answer this question by adopting a longitudinal methodology. Results obtained for six children with CP displaying a severe speech impairment pointed to a normal pattern of development in false-belief understanding, but with a severe delay compared with children without any disability.

The ability to take other people's mental states into account in a given social situation is a prerequisite for successful interpersonal communication, but probably not sufficient in itself (Martin & McDonald, 2003). Pragmatic abilities also involve going beyond the meaning of what is said, enriching, and sometimes even inverting, that which is encoded linguistically by adding a wealth of implicit information that makes it possible to retrieve the speaker's intended meaning; that which is implied (Grice, 1989). Gibbs (1999) has claimed that what is said is determined by semantics – knowledge about the semantic content of the utterances and about the world – and what is implied by pragmatics – knowledge about the speaker and about the specific context. Both levels potentially require the drawing of inferences, as what is actually said is not always semantically explicit. Two kinds of inferences can therefore be distinguished: semantic inferences that require the retrieval of general, background knowledge and that provide an interpretation of what the speakers say, and pragmatic inferences, which are based on the retrieval of contextual specific information and provide an interpretation of what the speakers imply. Little is known about inferential ability in children with CP. Holck et al. (2010) recently investigated inference-drawing in children with CP. In their study, children were asked inferential questions after reading short stories. The results did not clearly indicate inferential difficulties in children with CP, but in this study, the inferential questions mostly required the retrieval of general, background knowledge.

The present study probed the pragmatic abilities of children with CP by investigating ToM and pragmatic inference-drawing. ToM was assessed through first- and second-order false-belief understanding, and pragmatic inferences through verbal irony comprehension. Irony is a kind of nonliteral language that has no identifiable semantic criteria, in the sense that the semantics of an ironic sentence and a nonironic one are indistinguishable (Attardo, 2002). For example, saying "He is bright" about an idiot can only be understood as ironic from the context. In other words, understanding an ironic utterance necessarily requires pragmatic inferences drawn from the context. There is a growing body of literature to show 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. It had previously been shown that the understanding of speakers' beliefs precedes that of speakers' attitudes (Ackerman, 1983; Andrews et al., 1986). In sum, findings suggest that irony comprehension requires a long and complex development. Moreover, it has been suggested that children's understanding of an ironic speaker's intent depends on their ToM skills (Filippova & Astington, 2008; Sullivan, Winner, & Hopfield, 1995). Once they have acquired a capacity for second-order mental state reasoning, children are able 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 CP, and as we previously mentioned, few studies have investigated false-belief understanding. And yet both irony comprehension and the understanding of others' mental states are important social skills, which may be affected by the cognitive disturbances that accompany the motor disorders of CP. Assuming, therefore, that social skills can be affected in CP and that they may reflect cognitive deficits, the cognitive functions that potentially underlie social cognition deficits in CP also need to be explored. Difficulties in ToM and irony comprehension may result from executive dysfunction. "Executive function" refers to the cognitive processes involved in goal-directed problem-solving – processes such as working memory, inhibitory control, and error correction (Marcovitch & Zelazo, 2009). Children with CP are at risk of specific executive function deficits which, in turn, increase the risk of pragmatic difficulties. Based on the assumption that children with CP have communication problems arising from their reduced social interaction and the specific nature of their executive function, we predicted that they would display poorer pragmatic abilities than their typically developing peers. More specifically, they would be less likely to understand false beliefs and ironic utterances.

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