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Inferential ability in children with cerebral palsy, spina bifida and pragmatic language impairment

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ABSTRACT

The aim of the study was to investigate and compare the ability to make inferences in three groups of children ranging from 5;2 to 10;9 years: 10 children with cerebral palsy (CP), 10 children with spina bifida and hydrocephalus (SBH) and 10 children with pragmatic language impairment (PLI). The relationship between inferential and literal comprehension was investigated by analysing atypical responses. For this analysis an analytic framework was developed. The PLI group performed significantly worse on inferential questions than the CP group. It was only in the PLI group that problems with inferential questions exceeded the problems with literal questions, and the CP group even performed significantly better in this condition. Inferential comprehension was found to be related to language comprehension in the CP group, but was more related to the ability to predict future developments in the SBH- and PLI-groups. The PLI group relied more on world knowledge and associations than on text-related factors when delivering an atypical response compared to the CP group. The analysis of atypical responses proved to be a promising tool for the planning of an adequate intervention.

1. Introduction

The ability to make inferences is intrinsically linked to comprehension, linguistically related as well as more cognitively and emotionally related. Inference generation, requiring adaptation to the linguistic and physical context and to various contextual demands, provides a useful means to examine pragmatic ability.

Inference generation facilitates coherence (Perkins, 2007), and thus supports comprehension (Norbury & Bishop, 2002). The ability to make inferences is essential for effective communication, since language often is undetermined and requires to be embellished in order to be understood (Leinonen, Ryder, Ellis, & Hammond, 2003), and since most communicative expressions have meaning beyond what is stated linguistically (Leinonen & Letts, 1997). Ryder and Leinonen (2003) and Leinonen et al. (2003) aptly argue that the linguistic expression is only a starting point for interpretation. To make an inference, we need to bring together information from the linguistic expression, the context and previous knowledge and experience to work out the possible intended meaning (Leinonen & Letts, 1997; Letts & Leinonen, 2001). It is commonly maintained that pragmatic comprehension, and thus the ability to make inferences, is also embedded in cognition. Long- and short-term memory, theory of mind, reasoning skills, lexical and syntactic knowledge, integration and thinking are central to the comprehension process (Leinonen et al., 2003; Perkins, 2007).

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Difficulties with inference generation can be observed from two interrelated viewpoints according to Perkins (2007); the intrapersonal domain and the interpersonal domain. In the intrapersonal domain, the main issue is to integrate different sources of information within a coherent framework, and to adjust prior assumptions to new information. In the interpersonal domain, on the other hand, inference plays a crucial role in determining what the interlocutor actually means by integrating input such as speech, writing, gesture, and facial expression. In addition, it is necessary to consider the interlocutor's knowledge, intentions and beliefs, this being done through cognitive skills such as memory, knowledge and theory of mind (ToM).

An often used task to determine when children first acquire a ToM is false belief, i.e. the ability to understand that beliefs can also be false. ToM, where language and cognition is considered to interact with each other (Miller, 2004), is commonly seen as a critical cognitive capacity involved in pragmatic understanding (Perkins, 2007). By ToM is meant "the ability to predict and explain people's behaviour with reference to mental states" (Slaughter & Repacholi, 2003, p. 1). Difficulties with ToM ability have been reported for children with various impairments as, e.g. autism (e.g. Baron-Cohen, Leslie, & Frith, 1985), deafness (Woolfe, Want, & Siegal, 2002), severe speech and physical impairment (Falkman, Dahlgren Sandberg, & Hjelmquist, 2005), communication disabilities (Dahlgren, Dahlgren Sandberg, & Hjelmquist, 2003), specific language impairment (SLI; Gillott, Furniss, & Walter, 2004) and pragmatic language impairment (PLI; Botting & Conti-Ramsden, 1999). In the extensive research concerning ToM during the past decades, underlying factors such as problems with executive functioning (Hughes, 1998), linguistic ability (Miller, 2004), weak central coherence and lack of conversational experience (Woolfe et al., 2002; Frith, 1989; Falkman et al., 2005) have been proposed as contributing reasons for insufficient ToM ability. In a study of children with severe speech and physical impairment by Falkman et al. (2005), the delayed false belief skills of the children lead the authors to suggest that these were caused by impoverished communicative experiences on behalf of the children. The possible implication of language impairment in the development of ToM deficits has been discussed by, e.g. Miller (2004). Miller found evidence that children with SLI, mean age 4;1, performed at an age appropriate level when the false belief task was less demanding linguistically. Although there has been a tendency to attribute difficulties with ToM to the intrapersonal domain, several researchers have suggested that children's understanding of their partners' inner states is crucially related to contextual factors such as the emotional context of the interaction. Possibly, ToM is important for the ability to draw inferences regarding social situations and the pragmatics of interaction (Lewis & Carpendale, 2002).

In a much cited study by Bishop and Adams (1992) where 8–12-year-old children with SLI and children with PLI were compared, a general impairment of story comprehension was found. No significant differences between the groups regarding the ability to answer inferential and literal questions occurred, although there was a tendency for the PLI-group to perform more poorly than the SLI-children with inferential questions. Moreover, the PLI-group was more prone to give answers suggesting they had not understood the question. Similar problems with inference ability in children with language impairment have later been found in numerous studies (Dodwell & Bavin, 2007; Ford & Milosky, 2008) as well as for children with PLI (Leinonen & Letts, 1997; Letts & Leinonen, 2001; Norbury & Bishop, 2002; Botting & Adams, 2005), even though it must be emphasized that these problems often were manifested as trends rather than being significant. In the study by Letts and Leinonen (2001) it is noticeable that literal questions did not constitute a problem for children with language impairment, mean age 8;1 years. Pragmatic impairment itself does not always result in story comprehension deficits, two-thirds of the children in the PLI group in the Bishop and Adams study (1992) scored within normal limits. Some children with PLI did not have undue difficulty with inferential questions. It has been suggested that children with PLI do not have a deficit in inferencing *per se*, and that these children might be able to make inferences in the context of structured situations, while their difficulties surface in conversation (Botting & Adams, 2005). Another possibility is that children with PLI can make inferences, although not always appropriate (Norbury & Bishop, 2002).

In the study by Bishop and Adams (1992) several possible underlying causes to problems with story comprehension, and more specifically inferential comprehension, were mentioned; expressive language problems, difficulty in understanding questions in the absence of a concrete visual context and difficulties in remembering the story. Some additional possible causes, such as low general ability and weak structural language skills, were put forward in a later study by Norbury and Bishop (2002). In this study the authors found that 9-year-old children with SLI performed poorly on both inferential and literal comprehension questions based on stories generated from a series of pictures. The authors suggest that inferencing deficits may arise for quite different reasons in different groups of children, e.g. as part of a broader comprehension problem in some children and as a result of a more selective deficit in central coherence in others. Another often suggested possible underlying cause for problems in story comprehension is the linguistic form of the question. For example are "why" questions customarily thought to be the most difficult question form, and open-ended questions to be more difficult than yes/no questions (Leinonen & Letts, 1997). "Why" and "how" questions involve the ability to predict future developments and an awareness of cause and effect, and appear later than "what's that" questions (Leinonen & Letts, 1997). Ryder and Leinonen (2003) conclude that it is important to consider the contextual demands of the question when trying to understand how children answer them. The complexity of a question is rather explained in terms of the cognitive demands it makes than in its linguistic complexity. Integrating information could also be problematic for children with SLI, resulting in low inferencing scores (Dodwell & Bavin, 2007).

In a study with a somewhat different approach, it was demonstrated that knowledge availability is not sufficient to ensure adequate inference generation in children with typical development (Barnes, Dennis, & Haefele-Kalvaitis, 1996). In spite of the fact that the children in this study were taught the same knowledge base about an imaginary planet, their