Technische Universität Dortmund
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Internal and External Factors Associated with Preschoolers' Theory of Mind Performance: The Role of Preterm Birth and Group Membership

Kumulative Dissertation
zur Erlangung des akademischen Grades
doctor philosophiae (Dr. phil.)

vorgelegt von

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Mai 2022

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Abstract

Theory of Mind is the ability to attribute mental states to oneself and others. It allows one to understand that people may have different desires or beliefs and that these may also sometimes be false. As an advanced Theory of Mind is a crucial prerequisite for adequate social interactions, it is important to identify factors that improve or impair Theory of Mind performance. Such factors may be of an internal (e.g., children’s abilities, developmental delays) or external nature (e.g., task characteristics). The current thesis aims at systematically investigating preterm children’s Theory of Mind development as well as the role of a protagonist’s group membership in children’s Theory of Mind performance.

The first publication of this thesis is a perspective on the social consequences of preterm birth. A review of the literature revealed that preterm children face deficits in social competencies as well as in social cognition, and that these difficulties persist from infancy to school age. As social-cognitive abilities were found to be closely linked to social competencies in typically developing children, a systematic investigation of preterm children’s social-cognitive development might help to understand the underlying mechanisms of their social interaction problems.

The second publication of the current thesis provides insight into the pattern of preterm children’s Theory of Mind development. Preterm and full-term children’s Theory of Mind performance was assessed at three, four, and five years of age using a Theory of Mind scale. The longitudinal data revealed fewer Theory of Mind competencies in preterm children than in full-term children at age three years but not at age five years. Therefore, preterm children showed a delay rather than a general deficit in their Theory of Mind development. These findings indicate that difficulties in mental state attribution may account for the emergence but not for the persistence of preterm children’s social problems.

The third publication addresses the question of whether a protagonist's group membership affects children's attribution of mental states to this protagonist. A series of four experiments revealed that children's performance in Theory of Mind tasks was not consistently affected by the protagonist's group membership. Exploratory analyses focusing on explicit group identification yielded some findings in line with the hypothesis that children attribute fewer false beliefs to ingroup members than to outgroup members. However, follow-up experiments failed to replicate these findings, suggesting that group membership may have no effect on children's Theory of Mind performance.

Taken together, our findings demonstrated that preterm birth as an internal factor was associated with delayed Theory of Mind development, while a protagonist's group membership as an external factor did not affect children's Theory of Mind performance. Social implications of the results, strengths and limitations of the studies, as well as future research directions will be discussed in detail.

1 Theory of Mind

By asking whether chimpanzees have a Theory of Mind, Premack and Woodruff (1978) introduced a topic that initially caused a remarkable philosophical debate. Commentaries on this article by Bennett (1978), Dennett (1978) and Harman (1978) marked the starting point of more than 40 years of empirical research. Since that time, developmental psychologists have studied Theory of Mind (ToM) in detail, generating valuable insights into this field of social-cognitive development in humans. Its relevance for everyday life is certainly one reason for the immense and persisting research interest.

ToM is the ability to attribute mental states to oneself and others (Premack & Woodruff, 1978). It requires the understanding that mental states like beliefs and desires are subjective. In other words, ToM allows one to understand that people may have different desires or beliefs and that in some cases, these also differ from reality (Perner, 1991). Moreover, recognizing that behavior is mainly driven by these mental states (Wellman & Woolley, 1990) is a core skill in social interactions. Inferring other people's thoughts, desires or knowledge enables us to explain and predict their behavior (Mitchell, 1997), putting us in a position to show socially adequate behavior on our own part (Astington & Jenkins, 1995). Unsurprisingly, ToM is closely linked to social competence. Advanced ToM competencies are associated with prosocial behavior (Imuta et al., 2016) and popularity (Slaughter et al., 2002), while poor ToM skills are associated with aggressive behavior (Olson et al., 2011) and peer rejection (Slaughter et al., 2015).

1.1 Measuring Theory of Mind

The age at which children develop the ability to attribute mental states and to use this information to predict other people's behavior has been systematically studied using so-called false-belief tasks. A well-known false-belief scenario is presented in the form of a puppet show and can be summarized as follows (Wimmer & Perner, 1983): Maxi leaves the kitchen soon after he has placed a piece of chocolate in a blue cupboard. In his absence, Maxi’s mother takes the chocolate out of the blue cupboard and puts it in a green cupboard. She leaves the kitchen and soon after Maxi returns. At this point of the story, children are asked to indicate where Maxi will look for the chocolate. This question is based on the assumption that children will only indicate the blue cupboard if they are aware of Maxi’s false belief about the chocolate’s current location. Typically, 3-year-olds fail this task, indicating that Maxi will look for the chocolate where it really is (green cupboard). In contrast, the majority of 4-year-olds show false-belief understanding, indicating that Maxi will look for the chocolate where he placed it (blue cupboard; Wimmer & Perner, 1983).

The Maxi paradigm is an example of a change-of-location task. Another possibility to investigate false-belief understanding is unexpected-content tasks, such as the Smarties task (Perner et al., 1987). In this task, children have to guess what is in a closed Smarties box. Since children are usually familiar with this candy, they answer “Smarties”. Afterwards, they are shown that the box does not contain Smarties but instead contains a pencil. After closing the box again, children are asked three questions. First, they are asked about the actual contents of the box. Second, they are asked about their own belief they held before they had looked in the box. Finally, they are asked what their friend would think about its contents, if he/she entered the room and saw the closed box. As in the Maxi-paradigm, children have to infer a false belief in order to correctly predict the other person’s behavior. However, there is one major difference between the Maxi paradigm and the Smarties task. As participants are not part of the Maxi story, they follow it as an observer who has full knowledge of reality all of the time. In contrast, children taking part in the Smarties task experience holding a false belief themselves before they learn the actual contents of the box. Despite being put directly into the other person’s shoes, the majority of 3-year-olds failed to understand that the other person holds a false belief (Perner et al., 1987). This finding is in accordance with a developmental pattern of false-belief understanding revealed by a meta-analysis (Wellman et al., 2001), which indicates that correct performance in a variety of false-belief tasks increases from below chance level to above chance level between three and four and a half years of age.

However, several studies using implicit instead of explicit paradigms triggered a debate regarding the developmental onset of ToM competencies (Buttelmann et al., 2009; Onishi & Baillargeon, 2005; Southgate et al., 2007). Implicit tasks place fewer demands upon children's language and computation abilities than do explicit tasks. For example, Southgate et al. (2007) recorded 25-month-old toddlers' gaze direction during the presentation of a false-belief scenario via eye tracking. The authors were interested in the participants' anticipatory looking after the protagonist, who was ignorant of the object replacement, had returned to the scene. The toddlers spent significantly more time focusing on the location to which the protagonist would reach if she held a false belief than on the other location, leading to the conclusion that they attributed a false belief to the protagonist and anticipated her behavior according to this false belief. This finding is in line with other studies using implicit ToM measures. For example, toddlers were able to pass violation-of-expectation tasks (Onishi & Baillargeon, 2005) and helping tasks (Buttelmann et al., 2009) within their second year of life. However, it is unclear which mechanisms enable toddlers to pass these tasks. Some researchers suggested that the results from implicit looking time studies (e.g., Southgate et al., 2007) could be explained by the application of simple behavior rules (e.g., people search for objects where they last saw them) rather than by belief attribution (Perner & Ruffman, 2005; Ruffman & Perner, 2005). Therefore, the studies of the current thesis exclusively focused on explicit tasks.

For a long time, most of the research in this area was based on single tasks (e.g., false-belief tasks) addressing only one aspect of ToM. However, developing a ToM comprises the understanding of various mental states such as desires, beliefs, knowledge, and emotions (Wellman, 2002). Understanding what another person wants, thinks, knows, and feels is a prerequisite for explaining that person's previous actions or predicting his/her future actions. To account for the various dimensions of ToM development, scaled sets of tasks (e.g., Wellman & Liu, 2004) should be preferred over single tasks. Based on a meta-analysis summarizing prior research using different ToM tasks, Wellman und Liu (2004) created a comprehensive ToM scale. The authors assumed that reasoning about some mental states starts earlier than reasoning about other mental states and thus created a sequence of tasks with increasing difficulty, which they empirically confirmed (Wellman & Liu, 2004). As such, this sequence represents the developmental steps in preschool children's understanding of mental states. More precisely, children understand that two persons may differ in their desires before they understand that two persons can hold different beliefs. Furthermore, children are able to attribute false beliefs to someone else before they become aware that a person can display a certain emotion in his/her facial expression while actually feeling another emotion.

The advantages of using a ToM scale are manifold. First, compound scores are more stable since they represent an averaged measurement of various mentalizing skills (Hughes et al., 2000). Second, considering ToM as a continuous variable instead of a dichotomous variable allows researchers to discriminate the development into different underlying skills (Wellman & Liu, 2004). Third, ToM deficits (e.g., in clinical samples) can be studied in more detail and contribute to our knowledge about underlying causes of differences in ToM development (Hughes & Dunn, 1998). Finally, a multi-dimensional measurement can help to investigate the interplay between ToM and other factors of children's social and cognitive development (Wellman & Liu, 2004).

1.2 Factors Associated with Theory of Mind Performance

ToM deficits cause significant difficulties in social interactions. For example, impaired ToM development is associated with poor social competence (Capage & Watson, 2001) and less social acceptance by peers (Banerjee & Watling, 2005; Slaughter et al., 2002). Therefore, a large amount of research has focused on developmental, cognitive, and social factors associated with ToM performance. An overview of these factors, distinguishing between internal and external factors, is provided below.

1.2.1 Internal Factors

Internal factors that are associated with ToM performance encompass children's abilities, such as cognitive precursors, correlates, and developmental delays and disorders.

1.2.1.1 Early Social-Cognitive Skills

Early social-cognitive capacities like social understanding and joint attention have been found to be precursors of later ToM development (Aschersleben et al., 2008; Charman et al., 2000; Sodian & Kristen-Antonow, 2015; Wellman et al., 2008). In the first year of life, infants start to see other persons as intentional agents, that is, they attribute goals to another person's behavior (Gergely et al., 1995). Longitudinal studies have revealed that infants' understanding of goal-directed behavior, assessed using looking time tasks, predicts their ToM performance at the age of 4 years (Aschersleben et al., 2008; Wellman et al., 2008). When infants start to perceive others as intentional agents, they also understand that other persons may focus on some aspects in the environment while ignoring others (Tomasello et al., 1993). This rudimentary knowledge of selective attention leads to so-called joint attention, a term which refers to the coordination of attention between interaction partners and some object in the environment (Tomasello, 1995). Infants engage in joint attention by following interaction partners' gazes, alternating their own gaze between interaction partners and objects, or pointing at objects in order to direct others' attention (Moll & Meltzoff, 2011).

Infants start to engage in joint attention from the age of nine months, setting the stage for learning experiences, especially in language acquisition. To learn novel words for objects, infants have to direct their attention to the object, to which their interaction partner is referring (Friedrich & Friederici, 2008). Furthermore, joint attention provides early experiences of differentiating one's own perspective from that of others (Moll & Meltzoff, 2011; Tomasello, 1999). Accordingly, early joint attention is related to later ToM competencies. Longitudinal findings indicated that joint attention at 12 months of age predicted false-belief understanding at 50 months of age (Sodian & Kristen-Antonow, 2015).

1.2.1.2 Language

A large number of tasks addressing explicit ToM competencies are presented verbally (e.g., Perner et al., 1987; Wellman & Liu, 2004; Wimmer & Perner, 1983). Even though children may respond nonverbally, e.g., by pointing to a location, passing these tasks requires several language abilities, as processing a story as well as the questions of ToM tasks calls for semantics and syntax.

Several studies have demonstrated a relation between language abilities and ToM performance (Astington & Jenkins, 1999; Cutting & Dunn, 1999; Farrar et al., 2009; Jenkins & Astington, 1996; Milligan et al., 2007). A meta-analysis by Milligan et al. (2007) using data from 104 studies revealed a moderate to large effect size that was independent of age, and revealed that various language abilities are related to false-belief understanding. General language, semantics, receptive vocabulary, syntax and memory for complements were related to children's ToM performance (Milligan et al., 2007). In line with these results, both vocabulary and grammar were related to ToM performance in preschool children with specific language impairments (Farrar et al., 2009). Furthermore, false-belief task performance has been linked to the use of mental state terms (Ensor & Hughes, 2008; Meins et al., 2013), insofar as children's use of mental state words at age 2.5 years predicted their false-belief understanding at age 4.5 years (Brooks & Meltzoff, 2015).

The direction of the relationship between language and ToM is still under debate. When 3-year-olds were tested repeatedly over the course of seven months, earlier language performance was found to predict later ToM performance, whereas earlier ToM performance did not predict later language performance (Astington & Jenkins 1999). In contrast, some findings indicate a bidirectional relationship between language and ToM (Slade & Ruffman, 2005), although the reported effects of language on ToM were stronger than vice versa.

1.2.1.3 Executive Functions

The construct of executive functions subsumes a variety of higher cognitive skills, including working memory, inhibitory control, and attentional flexibility. These cognitive processes serve to monitor and control our thoughts and enable us to choose goal-directed actions. Therefore, executive functions play a key role in the development of children's social competence (Razza & Blair, 2009). Moreover, there are several reasons to examine the relationship between executive functions and children's social-cognitive development. First, between three and five years of age, major improvements occur in children's development of both executive functions (Jones et al., 2003; Zelazo et al., 1997) and ToM skills (Wellman et al., 2001). Second, this temporal concordance in children's development might result from maturation of the prefrontal cortex, which proceeds rapidly during this time period (Diamond, 2002; Thatcher, 1991). The prefrontal cortex is a brain region highly involved in ToM (Goel et al., 1995; Sabbagh & Taylor, 2000) as well as executive functions (Diamond, 2002; Miller, 2000). Third, executive functions are a prerequisite for successful completion of ToM tasks. As seen in the example of the Maxi paradigm (Wimmer & Perner, 1983), it is necessary to maintain information on conflicting perspectives in working memory. Moreover, children have to inhibit an answer based on their own knowledge about reality in favor of an answer based on someone else's false belief. Not surprisingly, several studies revealed relationships between ToM and working memory (Gordon & Olson, 1998; Hughes, 1998) and between ToM and inhibitory control (Carlson & Moses, 2001; Carlson et al., 2002; Hughes, 1998). In accordance with the results from language studies outlined in section 1.2.1.2, a longitudinal study indicated that the development of inhibitory control precedes the development of ToM abilities but not the other way around (Flynn et al., 2007).

1.2.1.4 Clinical Samples

Given that a wide range of clinical samples suffer from cognitive deficits, it is important to focus not only on typically developing children but also on clinical samples when examining the close relationship between cognitive competencies and ToM. Furthermore, several clinical disorders include problems of social behavior, raising the question of whether these social deficits result from problems in social cognition. For example, ToM deficits have been reported in autism spectrum disorder (Baron-Cohen et al., 1985; Baron-Cohen, 1995; Leslie & Frith, 1988), hearing impairments or deafness (Peterson & Siegal, 2000; Schick et al., 2007), schizophrenia (Brüne, 2005; Corcoran & Frith, 2003), depression (Cusi et al., 2013), borderline personality disorder (Németh et al., 2018; Preißler et al., 2010), and different types of dementia (Cuerva et al., 2001; Gregory et al., 2002; Snowden et al., 2003). However, the typical age of onset for some of these disorders is in early adulthood. As the present thesis primarily deals with ToM development in preschool children, we focus here on disorders that are already present within the first years of life.

1.2.1.4.1 Autism Spectrum Disorder

There is probably no other clinical sample whose ToM development has been studied in more detail than individuals affected by autism spectrum disorder (ASD), a neurodevelopmental disorder characterized by deficits in social communication and social interaction (American Psychiatric Association, 2013). Individuals affected by ASD frequently fail to initiate or maintain reciprocal conversations (Jones & Schwartz, 2009), and in addition to verbal deficits, they face problems in non-verbal communication. Abnormalities in eye contact (Senju & Johnson, 2009), as well as insufficient abilities in reading or using gestures and facial expressions adequately, impede social interaction (American Psychiatric Association, 2013). Furthermore, ASD is marked by deficits in interpreting non-literal language such as metaphors and sarcasm (Martin & McDonald, 2004; Ozonoff & Miller, 1996). Frequently, initial symptoms of atypical communication or interaction become apparent long before ASD is diagnosed in early childhood (Volkmar et al., 2004) and these symptoms persist into adulthood if there is no effective intervention (for a review, see Howlin, 2000). As a result, ASD is associated with an increased risk of peer rejection and social withdrawal (Rotheram-Fuller et al., 2010). However, it should be mentioned that there is considerable variation in the severity of symptoms. So-called “high functioning” autism, for example, describes individuals with milder autistic symptoms and without severe cognitive impairment (Baron-Cohen, 2000). The diversity of ASD symptoms and the broad continuum of their severity is also reflected in studies on ToM development in this clinical sample.

Baron-Cohen et al.’s (1985) ToM hypothesis was a starting point for extensive research on social cognition in adults and children with autism. The core of their hypothesis was the view that deficits in ToM explain social interaction difficulties in ASD. This hypothesis was tested by comparing autistic children’s false-belief reasoning with the performances of normal children and children with Down’s syndrome. While at least 85% of both control groups passed the false-belief task, 80% of autistic children failed to do so. Their failure to attribute false beliefs cannot be explained by mere intellectual deficits, since the mental age of the autistic group was higher than the mental age of the normally developing control group, and children with Down's syndrome passed the task despite their severe mental retardation. Accordingly, it was assumed that another cognitive deficit accounts for social symptoms of ASD. Several studies have since confirmed a ToM deficit in ASD, replicating the original pattern of findings (Happé, 1995; Leekam & Perner, 1991; Leslie & Frith, 1988).

Nevertheless, the ToM hypothesis raised some critical issues. First, it cannot account for the full range of social ASD symptoms (Tager-Flusberg, 2007). It is especially questionable how the ToM hypothesis could explain early symptoms that define ASD, some of which emerge long before one would expect advanced ToM competencies even in typically developing children (Tager-Flusberg, 2001). Second, researchers are faced with the question of whether ASD is associated with a general and persisting ToM deficit, a developmental delay, or a completely different pattern of ToM development (Baron-Cohen, 1991). Recent findings indicate that later steps, but not early steps, of ToM development in ASD deviate from typical development (Peterson et al., 2005). Third, the ToM hypothesis is challenged by a small group of high-functioning autistic children. These children are able to pass false-belief tasks but nevertheless have difficulties to cope with social interactions (Bowler, 1992; Peterson et al., 2009). Investigations into the mechanisms that allow some ASD children to pass ToM tasks have yielded various insights. They seem to use problem-solving strategies based on logical reasoning and knowledge about language relations (Tager-Flusberg, 2007), but fail to transfer the concept of ToM to more complex, real-life social interactions (Scheeren et al., 2013). The assumption of compensatory problem-solving strategies has emerged from neuroimaging studies (Frith & Frith, 2003) and studies focusing on implicit ToM. Some individuals with ASD pass language-based, explicit ToM tasks but consistently fail implicit ToM tasks (Senju et al., 2009), which are less prone to compensatory strategies.

1.2.1.4.2 Deafness

As mentioned in section 1.2.1.2, language and ToM are closely related. Therefore, it seems appropriate to scrutinize the ToM development of deaf children, whose conversational experiences clearly differ from those of hearing children. The question thus arises of the extent to which deafness affects ToM. Does a lack of verbal communication about other people's mental states impede children's ToM? Is ToM development hampered if children cannot follow others' verbal conversations about mental states?

Several studies have indicated that deaf children's ToM development is delayed compared to that of typically developing children (Jones et al., 2015; Peterson & Siegal, 1995; Peterson & Siegal, 2000; Schick et al., 2007). However, research indicates a clear distinction between deaf children from hearing families (late signers) and deaf children who grow up in families with signing deaf parents or siblings (native signers): Native signers' ToM performance was similar to that of normal hearing children (Courtin, 2000; Peterson & Siegal, 1999), whereas late signers showed a delay in ToM development (Courtin, 2000; Peterson & Siegal, 1995; Woolfe et al., 2002). The mean age at passing a nonverbal ToM task in late signers was almost nine years, representing a delay of about four years compared to normal hearing children (Figueras-Costa & Harris, 2001).

This discrepancy between late signers and native signers indicates that early conversational experiences play an important role in children's ToM development (Peterson & Siegal, 1999; Woolfe et al., 2002). Hearing parents are able to communicate with their hearing children from birth onward. Likewise, signing deaf parents can fluently communicate with their deaf children regardless of whether a topic is abstract or visible (Meadow et al., 1981). However, hearing parents of deaf children often struggle to communicate fluently, especially in the first years (Harris, 1992). In some areas of sign language, hearing parents do not reach sufficient skills at all, and in particular, they have difficulties using sign language to communicate about abstract topics like mental states (Harris, 1992; Meadow et al., 1981; Moeller & Schick, 2006; Vaccari & Marschark, 1997). As such, deaf children's communication is often limited to visible topics, and this lack of conversation about mental states may even impede their acquisition of the vocabulary necessary to characterize beliefs or feelings (Peterson & Siegal, 1995). Evidence for the importance of regular communication about mental states comes from hearing children. Children who frequently talk with parents, siblings, or friends about their own or others' thoughts and feelings show advanced performance in ToM tasks (Brown et al., 1996; Ruffman et al., 2002

1.2.1.4.3 Prematurity

Worldwide, around 15 million babies are born prematurely every year, accounting for 7-14 % of all newborns (Blencowe et al., 2012). For a long time, birth weight was used to define prematurity. However, the use of birth weight criteria to define prematurity led to newborns who were born full term but with small-for-gestational-age being identified as premature (Hack, 2006). Therefore, gestational age is the more accurate criterion. According to World Health Organization (2018) criteria, preterm birth is defined as birth <37 weeks of gestation. Births <33 weeks of gestation and <28 weeks of gestation are termed very preterm and extremely preterm, respectively. From 2009 to 2017, German preterm birth rates varied between 8% and 9% (Berger et al., 2019). However, many countries have reported increasing rates of preterm births (Keirse et al., 2009; Norman et al., 2009; Tracy et al., 2007; Zeitlin et al., 2013). The main reasons for this increase are manifold. First, maternal age is positively associated with risk of preterm birth. Consequently, as the mean maternal age at birth rises, so too does the risk of preterm birth (Schure et al., 2012). Second, advances in reproductive medical techniques have led to an increase in the number of multiple pregnancies (McClamrock et al., 2012), and preterm birth rates for multiple pregnancies lie at 40-60%, which is six times higher than for singletons (Blondel et al., 2002). Third, over recent years, higher maternal body mass indices have become increasingly important risk factors for preterm birth (Keirse et al., 2009). Even though prematurity is still the main reason for perinatal (75%) and neonatal (35%) mortality (Berger et al., 2019), improvements in neonatal care have led to an increase in survival rates up to 90% (Taylor et al., 2000). However, reduced mortality has been accompanied by higher morbidity. Preterm birth is associated with numerous short-term as well as long-term medical and neurodevelopmental problems (Wilson-Costello et al., 2005).

Preterm children have an elevated risk of sensory disabilities, relating to hearing and vision (Bohin et al., 1999; Doyle et al., 2004), reduced physical growth (Hack et al., 2003; Taylor et al., 2000), and physical disabilities such as cerebral palsy (Bracewell & Marlow, 2002; Moster et al., 2008). Additionally, they face several cognitive and behavioral difficulties (for an overview, see Arpino et al., 2010; Bhutta et al., 2002; Treyvaud et al., 2012). For example, preterm children showed lower IQ scores than full-term children (Briscoe et al., 1998; Løhaugen et al., 2010). Moreover, preterm birth is associated with language difficulties (Sansavini et al. 2007) relating to comprehension (Landry et al., 2002), as well as speech production (Foster-Cohen et al., 2007). Preterm children are also more likely to show poorer executive functioning, including working memory and cognitive flexibility (Aarnoudse-Moens et al., 2009).

In addition to these cognitive deficits, children born preterm face a variety of social problems (for a review, see Ritchie et al., 2015). For instance, they have difficulties establishing relationships (Hille et al., 2008) and show lower social competence than do their full-term counterparts (Ritchie et al., 2015). These difficulties are reported in 2-year-olds (Alducin et al., 2014; Spittle et al., 2009) and persist into school age (Hille et al., 2001; Reijneveld et al., 2006; Ross et al., 1990). In general, poor social competence is associated with peer rejection, delinquency, and negative experiences at school (Ladd, 1990; Vitaro et al., 2001). Therefore, it is essential to find out more about early precursors of preterm children’s social difficulties. One important area associated with successful social interaction is social cognition. As reported at the beginning of this thesis, there is a close link between ToM and social functioning, but very little is known about preterm children’s social-cognitive skills. So far, studies focusing on this topic have yielded inconsistent findings. One study examining 4-year-olds did not find any differences between preterm and full-term children’s performance in three false-belief tasks (Jones et al., 2013), while another study reported that 4-year-old preterm children failed false-belief tasks more often than their full-term peers (Roldán-Tapia et al., 2017). Finally, two studies investigated preterm and full-term children at 8 or 10 years of age, revealing mixed results in terms of group differences, depending on the type of ToM tasks used (Mossad et al., 2017; Mossad et al., 2021). These studies have in common that they reported cross-sectional data primarily based on false-belief tasks. As a result, previous studies do not allow any conclusions to be drawn about the course of preterm children’s ToM development. Additionally, it remains to be clarified how preterm children perform on a broader range of ToM tasks.

1.2.2 External Factors

As indicated by ASD research, internal factors such as neurological processes affect ToM performance. However, research in deaf children suggests that it is important to focus on external factors associated with ToM development as well. For instance, deaf children’s ToM development was impaired if they were late signers but not if they were native signers. Therefore, social interaction partners and their manner of communication may affect children’s ToM competence. Besides these social issues, characteristics of ToM tasks should be considered as external factors potentially affecting children’s performance.

1.2.2.1 Family Background

There are several family variables associated with children's ToM development, including parental socioeconomic status (Devine & Hughes, 2018), parental sensitivity, and attachment security (Symons & Clark, 2000). Variables like parental mental-state talk and family size have been most widely studied and will be considered in detail here.

Previous research indicated that family conversation plays a crucial role in children's social-cognitive development. For a long time, the focus of interest was on maternal mental state talk. Mothers' use of mental state words and their tendency to talk about the social world vary greatly (Peterson & Slaughter, 2003). Mothers' mental state talk, in turn, correlates with their children's ToM performance (Devine & Hughes, 2018). Maternal use of mental state words even has predictive power for their children's later ToM development (Ruffman et al., 2002). While the role of mother-child communication for children's ToM development has been studied in detail, father-child communication has received less attention. While one study reported that fathers use mental state words less frequently than mothers (Jenkins et al., 2003), the study tested both parents simultaneously, meaning that the data represented fathers' communication when the mothers were present. A more recent study examined the relationship between mothers' and fathers' mental state talk with children's ToM separately (LaBounty et al., 2008). The authors reported that fathers often use terms describing negative emotions and references to desires, and that the use of these terms correlated with 3-year-olds' ToM competence. Moreover, fathers' use of terms referring to desires while communicating with their 3-year-olds predicted children's ToM performance at age five. Therefore, mothers' as well as fathers' mental state talk contributes to children's ToM development.

The effect of having siblings on ToM performance has been investigated in detail, with studies yielding mixed findings. Some studies revealed a positive link between having any siblings and ToM (Jenkins & Astington, 1996; Perner et al., 1994), while others reported positive relationships between older but not younger siblings and ToM (Lewis et al., 1996; Ruffman et al., 1998). Finally, some studies revealed no relationship between siblings and ToM at all (Cole & Mitchell, 2000; Peterson & Slaughter, 2003). Two studies reported a linear sibling effect regardless of siblings' age (Jenkins & Astington, 1996; Perner et al., 1994). Thus, children with one sibling show improved ToM compared to only children, and children with two siblings show improved ToM compared to children with only one sibling. Another study confirmed that older as well as younger siblings were beneficial for children's ToM development as long as siblings were aged between 12 months and 13 years (Peterson, 2000). This suggestion of an age range for the sibling effect is in line with approaches to explain the mechanisms behind it. First, siblings with a small age difference afford frequent opportunities for pretend play, which is positively associated with ToM development (Howe et al., 1998; Howe et al., 2002; Youngblade & Dunn, 1995). Second, disputes are more likely if siblings are not younger than 12 months or older than 13 years. This is relevant since arguing with siblings offers many opportunities to reason about their mental states (Dunn & Munn, 1985; Foote & Holmes-Lonergan, 2003; Slomkowski & Dunn, 1992). Nevertheless, this approach has been challenged by studies revealing that low levels of disputes between siblings are associated with high levels of ToM (Cutting & Dunn, 2006; Hughes & Ensor, 2005).

In sum, there is strong evidence that family variables are related to children's ToM performance. In addition, frequent contact with older children and adults beyond the family contribute to mental state reasoning (Lewis et al., 1996). Generally speaking, rich and frequent social interactions create the breeding ground for ToM development. So far, underlying mechanisms as well as the interplay between family variables remain unclear.

1.2.2.2 Task Characteristics

As reported in section 1.1, a change in children's ToM performance occurs within the preschool years. It might be proposed that children undergo a conceptual change within this time. However, some researchers have suggested that these changes might be explained by distinct characteristics of ToM tasks. For example, children were more likely to pass a false-belief task if the presented story inferred that somebody deliberately transferred an object in order to play a trick on the other protagonist (Chandler et al., 1989). However, there are also contradictory findings, indicating that emphasizing the motivation of a protagonist does not influence children's performance (Sodian et al., 1991). In order to investigate potential task artifacts more systematically, Wellman et al. (2001) conducted a meta-analysis of 178 studies. The results indicated that none of the following variables affected children's performance: the type of false-belief task (change-of-location vs. unexpected-content), the type of question (belief vs. behavior), the nature of the protagonist (real person vs. videotaped person vs. puppet), or the target of belief reasoning (reasoning about one's own false belief vs. reasoning about others' false beliefs). By contrast, the following variables did influence children's performance: the protagonist's motives for the transformation of an object (deliberately to play a trick vs. without an explicit reason), children's participation (helping to transfer the object vs. passively observing), and salience of mental states (the protagonist's mental states were explicitly stated vs. not stated).

As mentioned above, the meta-analysis revealed that the nature of the protagonist does not affect ToM performance. Therefore, it does not matter whether the protagonist is a real person or a puppet. However, it remains open whether other variables concerning the protagonist would exert an effect. For example, a protagonist's social group membership might influence children's attribution of false beliefs. Social groups are omnipresent in infants' and children's everyday life. They use indicators like age (French, 1987), race (e.g., Kowalski & Lo, 2001), gender (Miller et al., 2006), or language (e.g., Kinzler et al., 2010) to define their own and others' group memberships. Affiliation to a particular group is often linked to social preferences for ingroup members over outgroup members (ingroup bias; Brewer, 1979). Language and accent in particular have been found to influence infants' and children's ingroup preferences. For example, infants preferred to imitate the actions of a speaker of their own language compared to a speaker of a foreign language (Buttelmann et al., 2013). Moreover, children were more likely to accept toys from, or to be friends with a model who previously spoke in their own language than with a model who previously spoke in another language (Kinzler et al., 2007). As can be seen from these studies, group membership affects many facets of social interaction. This leads to the question of whether the attribution of mental states is also affected by a target's group membership. If children differently attribute mental states to ingroup members than to outgroup members, this may also have an impact on their behavior in social interactions with members of different groups.

So far, only a small number of studies have investigated the influence of a protagonist's group membership on children's ToM performance, and have yielded effects pointing in opposite directions. On the one hand, 5-6-year-old children used more mental state words describing the action of animated triangles that were introduced as members of their ingroup compared to triangles that were introduced as members of an outgroup (McLoughlin & Over, 2017). In line with this, 9-13-year-old children's mindreading was more accurate if the target was an ingroup member than an outgroup member who was perceived as a threat (Gönültaş et al., 2020). On the other hand, 4-5-year-old children with high ingroup affiliation were more successful in false-belief tasks addressing outgroup members than in tasks addressing ingroup members (Sudo & Farrar, 2020). In accordance with this, in another study, young adults passed false-belief tasks with outgroup targets more frequently than tasks with ingroup targets (Todd et al., 2011). The attribution of mental states to a target was more often biased by participants' own mental states if the target was an ingroup member than an outgroup member.

2 Rationale of the Current Thesis

Past research on ToM focused special attention on the developmental onset of this competence (Wellman et al., 2001). Thus, studies on children's ToM often focused on matured components, such as many of the internal factors summarized above. In this context, investigating clinical samples at increased risk of ToM deficits or developmental delay is highly relevant. Bearing in mind the role of ToM for successful social interactions, deficits should be identified as early as possible, as systematic intervention may help to minimize unfavorable long-term consequences. However, research on deaf children's ToM indicated that internal factors sometimes interact with external factors. Therefore, a mature ToM concept does not rule out that children have greater or lesser motivation to reason about mental states under certain circumstances. For example, task variables (e.g., the protagonist's social group membership) may affect children's ToM performance.

Following these considerations, the aim of this thesis was twofold. First, we sought to improve the insights into preterm children's ToM development. Therefore, we wrote a perspective paper reviewing the literature on this topic and raising open questions. Subsequently, we conducted a longitudinal study in preterm children using a ToM scale. In this regard, we took into account that previous studies generated cross-sectional data only and focused on narrow ToM concepts.

Second, we aimed to extend the research on task variables affecting children's ToM performance. Therefore, we conducted a study investigating the influence of a protagonist's group membership on false-belief attribution in a series of four experiments.

3 Perspective – Zmyj, N., Witt, S., Weitkämper, A., Neumann, H., & Lücke, T. (2017). Social cognition in children born preterm: A perspective on future research directions. *Frontiers in Psychology*

Social cognition in children born preterm: A perspective on future research directions

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Published in *Frontiers in Psychology*, 2017, *8*(455). https://doi.org/10.3389/fpsyg.2017.00455

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Abstract

Preterm birth is a major risk factor for children’s development. It affects children´s cognitive and intellectual development and is related to impairments in IQ, executive functions, and well-being, with these problems persisting into adulthood. While preterm children’s intellectual and cognitive development has been studied in detail, their social development and social-cognitive competencies have received less attention. Namely, preterm children show problems in interactions with others. These interaction problems are present in relationships with parents, teachers, and peers. Parents’ behavior has been identified as a possible mediator of children’s social behavior. Maternal sensitivity and responsiveness as well as absence of mental disorders foster children’s social development. In this article, we will report on the social side of impairments that preterm children face. The review of the literature revealed that preterm infants’ joint attention abilities are impaired: They are less likely to initiate joint attention with others and to respond to others’ efforts to engage in joint attention. These deficits in joint attention might contribute to later impairments in social cognition, which in turn might affect social interaction skills. Based on these three domains (i.e., problems in social interaction, parental behavior, and impairments in joint attention), we suggest that preterm children’s social cognitive abilities should be investigated more intensively.

Keywords: preterm birth, social cognition, social problems, Theory of Mind, joint attention

Introduction

Preterm birth is a major risk factor for children's development (Aarnoudse-Moens et al., 2009b). It affects preterm children's motor development (Jeyaseelan et al., 2006; Sansavini et al., 2015) and somatic health (Saigal and Doyle, 2008), as well as their cognitive and intellectual development: Impairments in IQ, executive functions, and well-being are related to a preterm birth, and these problems persist into adulthood (Løhaugen et al., 2010). While these factors of preterm children's intellectual and cognitive development have been studied in detail, their social development and social-cognitive competencies have received less attention. This lesser interest in social-cognitive development is surprising, as preterm children face problems not only in their intellectual development but also in social interaction (for a review, see Chapieski and Evankovich, 1997). Reading the following paragraphs, it should be noted that the definitions of preterm and very preterm birth vary across studies, both in the criteria used (birth weight or gestational age or both) and the specific critical values. Usually, the critical values are a birth weight of less than 1500 g and a gestational age under 33 weeks (Aarnoudse-Moens et al., 2009b). According to WHO criteria, preterm birth is defined by a gestational age of less than 37 weeks. Therefore criteria defining preterm birth should be taken into account thoroughly before comparing various findings (for an overview of definitions of preterm birth given by the studies reported below, see Appendix, Table 1).

Interaction Difficulties with Others

Preterm children's interaction difficulties are reported to be manifold: A systematic review of 23 studies dealing with social development in children between 0 and 17 years of age revealed 16 out of 21 studies reporting more peer problems and social withdrawal in preterm children compared to full-term children (Ritchie et al., 2015). More specifically, at 2 years of age, children born very preterm already have lower social competence (e.g., listening to parents or playing with other children, Spittle et al., 2009) and are rated as less socially competent by their parents (Alduncin et al., 2014; Johnson et al., 2015) than their full-term peers. Preterm children also show more externalizing behaviors than their full-term peers (Bhutta et al., 2002; Potijk et al., 2012), imposing special challenges on their social environment.

Other studies considering very-low-birth-weight infants between 5 and 10 years of age have reported a persistence of social problems into school age (Ross et al., 1990; Hille et al., 2001; Reijneveld et al., 2006), underlining the relevance of this topic. Preterm children were found to be not as accepted by peers as full-term children, and were more likely to withdraw from social situations (Hoy et al., 1992; McCormick and Workman-Daniels, 1996; Nadeau et al., 2003). They were also verbally victimized more often (Nadeau et al., 2004), and rated as socially immature (Nadeau et al., 2003). Various possible reasons for these findings have been discussed (Nadeau et al., 2004). For instance, minor motor difficulties might lead to exclusion from the peer group and to victimization, and preterm children have more of these motor difficulties than their full-term peers (Holsti et al., 2002). Preterm children might themselves feel uncomfortable during physical activities with their peers who are more dexterous than themselves (Yude et al., 1998).

However, some studies indicate that preterm children do not, in general, show more difficulties in social interaction than their peers. A study differentiating between two subgroups of preterm children revealed only preterm children with medical risk factors (e.g., intraventricular hemorrhage) exhibiting more difficulties in social interaction than full-term peers (Landry et al., 1990). In accordance with this finding, brain abnormalities could be identified as a predictor of social competence (Ritchie et al., 2015). The predictive power of gestational age and brain abnormalities might serve as an explanation for one report that does not support the suggestion of differences in social competence between preterm and full-term children (Jacob et al., 1984). This study included preterm children with a birth weight up to 2500 g and a gestational age up to 37 weeks. These values are higher than in the studies that reported differences in social competence between preterm and full-term children, thereby favoring the inclusion of preterm children at lower medical risk.

Besides brain abnormalities and motor difficulties, parental behavior emerged as a crucial factor in preterm children's interaction problems. Therefore this aspect will be considered in more detail in the following section.

The Role of Parent's Behavior in their Preterm Children's Social Behavior

Preterm children's social behavior cannot be considered without taking a closer look at its relationship to parents' behavior and mental condition. A recent study revealed that mothers who reported more depressive symptoms, more perceived stress as a parent, and a reduced sense of coherence had children with fewer social skills. This relationship, however, was not domain-specific for social skills, but was also prevalent in emotional-behavioral problems as well as in fewer executive functions (Huhtala et al., 2014). The relationship between maternal stress and children's social problems applies to preterm as well as full-term children (Assel et al., 2002). However, there is a higher prevalence of perceived stress (Huhtala et al., 2011), anxiety (Brooten et al. 1988; Bener, 2013) and depression (Brooten et al., 1988; Huhtala et al., 2011; Bener, 2013) among mothers of preterm infants compared to mothers of full-term children.

In addition to mothers' mental condition, the parental interaction style seems to be important for preterm children's social development. The first point to mention is maternal directiveness. In general, parental behavior that is not highly controlling or that does not restrict children's behavior predicts a larger and faster increase in social development (e.g., compliance with maternal requests, Landry et al., 1997b). Mothers of preterm children were found to give their 3-year-old children fewer choices in interaction than mothers of full-term children (Landry et al., 1990), and this directive behavior was negatively associated with children's initiation of activities. For preterm infants with medical risk factors, this might have been an adaptive strategy, because it takes into account the individual cognitive delay. However, for preterm infants without these risk factors, maternal directiveness was not related to the children's cognitive delay or social problems.

Using a micro-analytic coding system, 12-month-old preterm infants could be shown to differ from full-term controls concerning co-regulation and affective intensity in mother-infant interaction (Sansavini et al., 2015). More precisely, co-regulation patterns of preterm dyads were less frequently characterized by symmetry and showed more frequent unilateral elements. These characteristics of mother-infant interaction pose a risk to preterm children since symmetrical co-regulation was positively related to motor development in this group. Additionally, dyads including preterm infants were characterized by less positive and more neutral affective intensity exhibited by infants as well as their mothers.

Examining parental behavior from a long term perspective reveals growing evidence that it is also predictive for preterm children's later development: Positive parenting during early childhood resulted in better cognitive as well as social-emotional outcomes at kindergarten entry (Maupin and Fine, 2014). More specifically, maternal sensitivity (i.e., mother following child's topic in play) and verbal reciprocity (i.e., responding vocally to infant vocalization) in 1-year-olds predicted social competence (i.e., solving hypothetical problems in a non-hostile way) in 5-year-olds (Beckwith and Rodning, 1996). In a recent study, researchers found not only that preterm infants have more problems in social situation than full-term infants (Forcada-Guex et al., 2006), but also that the mothers' and the infants' interaction behavior at 6 months of age predicted problems in social situations at 18 months of age. Mother-infant dyads in which the mothers were rated as controlling and the infants were rated as compulsive-compliant had more problems in social situations than other dyads, including preterm infants and full-term infants.

As mentioned in the previous chapter, preterm children show more externalizing behaviors than same-aged full-term children (Bhutta et al., 2002; Potijk et al., 2012). Again, this relationship is not independent of parental behavior in the way that maternal responsiveness has been found to moderate the prevalence of externalizing behavior: Preterm children of high responsive mothers at 2 years of age show less externalizing behavior at 8 years of age than preterm children of low responsive mothers (Laucht et al., 2001). Converging findings come from another longitudinal study with a group of full-term and preterm children, in which the mothers' warm sensitivity at 2 years of age predicted social responsiveness at 4 years of age (Miller-Loncar et al., 2000).

Social-cognitive Skills in Preterm Children: Evidence from Studies on Joint Attention and Theory of Mind skills

This article focuses on the role of social-cognitive skills in explaining preterm children's interaction problems. Since these skills develop rapidly within the first years of life and might be impaired in similar ways to intellectual and cognitive skills. In the first year of life, full-term infants typically start to attribute goals to another person's behavior (Gergely et al., 1995) and are even able to imitate observed behaviors (Meltzoff, 1988). They also start to learn words for objects (Friedrich and Friederici, 2008). In order to learn novel actions or novel words in social interactions, infants have to direct their attention to the same object as the interaction partner. This so-called 'joint attention' is regarded as a basic social-cognitive skill (Tomasello et al., 2005) that also predicts preterm infants' later social language and intelligence (Smith and Ulvund, 2003): In particular, the initiation of joint attention—and not the response to offers of joint attention—contributes to later IQ. Preterm infants' attention also mediates the link between the risks of prematurity and later cognitive development.

Therefore prematurity *per se* does not directly affect cognitive development. More likely, gestational age correlates with focused attention which in turn is related to cognitive performance (Reuner et al., 2014).

Joint attention skills differ between preterm and full-term infants. Responding to joint attention signals (i.e., following the gaze of an experimenter) was more often observed in full-term than in preterm infants at 9 months of age (De Schuymer et al., 2011). Likewise, initiating joint attention (e.g., pointing towards an object) was more often observed in full-term than in preterm 2-year-olds (De Groote et al., 2006). Preterm infants in the first 2 years of life also showed less joint attention in terms of exploratory responses such as toy manipulation as well as communicative responses such as following eye gaze vocalizations and imitating social interaction (Garner et al., 1991). These deficits translate to the infants' behavior: Preterm infants were less likely than full-term infants to reach for toys in joint attention situations (Landry and Chapieski, 1988). Difficulties in motor skills might additionally contribute to the latter finding. In contrast, there is one report that preterm infants responded to joint attention interactions with their mothers in the same manner as full-term infants. However, preterm infants moved their attention away from situations of joint attention more often than full-term infants (Landry, 1986). Another study also demonstrated that preterm infants with medical risk factors showed a slower increase in social initiation (but not in social response) than preterm infants without medical risk factors or full-term infants (Landry et al., 1997a). The reason for differences in joint attention skills between full-term and preterm infants may be manifold. First, preterm infants look away from the parents' face more often and are less responsive than full-term infants (Crnic et al., 1983; De Schuymer, et al., 2012). Second, preterm infants show general problems in attention, such as shifting gaze to peripheral stimuli, in which they are slower than full-term infants (De Schuymer et al., 2012). Third, the severity of medical risk factors of preterm infants is negatively correlated with abilities to regulate attentional processes such as longer looks to an experimenter's talking in motherese compared to full-term infants (Eckerman et al., 1994). This finding indicates that preterm infants are not less attentive in general. Rather, they are more reactive and less self-regulated in their attentional behavior than full-term infants.

However, preterm and full-term 2-year-olds were also reported not to differ in the amount of initiation of social interaction (Greenberg and Crnic, 1988). This discrepancy might be partly explained by methodological aspects: The inclusion criteria for preterm infants in Greenberg and Crnic's (1988) study was a gestational age of 38 weeks or younger, and in Landry 's (1986) study, the sample size was rather low, with around 24 infants per group. These details may have obscured differences between groups.

Social-cognitive skills besides joint attention, such as imitation, goal understanding, and self-other differentiation have not yet been tested in preterm infants. Research in this regard would complement the existing knowledge about infants' social cognition and potential underlying mechanisms for preterm children's difficulties in social interaction. These social-cognitive skills might be mediated by environmental factors. For example, neonatal care, such as the Newborn Individualized Developmental Care and Assessment Program (NIDCAP), embeds the infant in the natural parent niche, avoids over-stimulation, stress, pain, and isolation, and supports self-regulation, competence, and goal orientation. NIDCAP improves brain development, functional competence, health, and life quality (Als and McAnulty, 2011). Additionally, administration of some nutrients (e.g., omega-3 long-chain polyunsaturated fatty acids) to children with a gestational age of less than 29 weeks also shows beneficial effects (Zhang et al., 2014).

Impairments in preterm children's social-cognitive abilities are not restricted to early forms like joint attention but apply to later forms as well. A variety of findings on social-cognitive skills related to Theory of Mind indicate deficits in preterm children. For example, at the age of 7 they were found to show weaker empathic development compared to full-term controls (Campbell et al., 2015). Between 8 and 11 years of age preterm children struggle with interpreting nonverbal cues from facial expressions and body movements properly (Williamson and Jakobson, 2014b). Compared to full-term children, they show a lack of competence in reasoning somebody's emotions on the basis of these cues. This deficit may result from a preference for looking at eyes over the mouth which is not as pronounced in preterm children as it is in full-term ones (Telford et al., 2016). Additionally, when confronted with the animated triangle task (Abell et al., 2000), school aged preterm children demonstrated less social attribution skills relative to full-term peers (Williamson and Jakobson, 2014a). These difficulties were indicated by inappropriate descriptions of the animations including overattribution of mental states to randomly moving triangles and underattribution of mental states to shapes interacting socially. Future research on Theory of Mind should clarify if these attribution problems are restricted to a rather abstract level or if they exist on the interpersonal level as well. Both of the studies mentioned above revealed an association between social-cognitive deficits and negative behavioral outcomes in preterm children. These difficulties are expressed by increased 'autistic-like' traits. However, both estimations of these traits refer to parent-report exclusively. Since autistic-like traits are likely to be overestimated in preterm children (Stephens et al., 2012) especially when rated by parents (Gray et al., 2015), they have to be treated with caution. Theory of Mind represents a social-cognitive skill that has considerable predictive power in terms of social acceptance (Slaughter et al., 2002). By means of Theory of Mind, children acknowledge the representational nature of an individual's mental state. Theory of Mind allows cognition such as perception and beliefs to be conceived of as the result of mental acts, as well as the realization that these mental acts can be wrong. The insight into false beliefs is therefore a key aspect of developing a mature understanding of others' cognitive functioning. At around the age of 4, children are able to solve a classic task of false-belief understanding by Wimmer and Perner (1983), in which the protagonist of a story, called “Maxi”, puts a chocolate in a blue cupboard and goes outside. While Maxi is playing outside, his mother moves the chocolate from the blue cupboard to a green cupboard. When children were asked where Maxi will look for his chocolate when he comes back, 3-year-olds incorrectly assumed that he will look in the green cupboard, where the mother put the chocolate. In contrast, 4-year-olds were aware that Maxi believes that the chocolate is still in blue cupboard and will accordingly look for it there. Only one study has directly tested false-belief understanding in preterm children at the age of 4 so far. The authors used two standard false-belief understanding tasks and one rather novel false-belief understanding task. Preterm children did not perform differently from full-term children on the tasks (Jones et al., 2013). This finding is surprising, because in the same study sample, preterm children showed the typical deficits in social interactions compared to full-term children. Nevertheless, the finding might be explained by the type of tasks the researchers used. Despite the standard nature of two of the tasks, their psychometric properties are rather unexplored, and there is no standardized way of conducting them.

Future research: Theory of Mind in Preterm Children

In the present article, we showed that preterm infants’ joint attention is impaired in comparison to that of full-term infants. This basic social-cognitive skill is important for the infants’ later development of social interactions and learning of novel behavior. This early impairment might represent a first step in a cascade of maladjusted social development (see Bornstein et al., 2013 for a similar account on cognitive development). It is interesting, however, that little is known about preterm children’s later social-cognitive skills, such as Theory of Mind.

Impaired social-cognitive skills are mirrored in problems in social interactions (Badenes et al., 2000; Slaughter et al., 2002; Banerjee and Watling, 2005). These studies showed that lower Theory of Mind abilities are associated with less social acceptance by peers. There is also evidence that the way in which parents interact with their children is related to their children's Theory of Mind. Parents who use more words that focus on mental states (e.g., to believe, to want) have children with higher Theory of Mind abilities than parents who use fewer of these words (Dunn et al., 1987; Sabbagh and Callanan, 1998; Jenkins et al., 2003). Based on the social difficulties and altered maternal interaction styles reported above, one might assume that preterm children's development of a Theory of Mind is delayed or even impaired.

Further evidence for the necessity to find out more about Theory of Mind abilities in preterm children is provided by deficits in cognitive skills that are associated with prematurity and impaired Theory of Mind abilities simultaneously. First, prematurity is related to impairments in language development (Barre et al., 2011) showing a linear relationship between gestational age and language skills (Foster-Cohen et al., 2007). Preterm children show problems in a variety of language outcomes including vocabulary size, quality of word use as well as morphological and syntactic complexity (Foster-Cohen et al., 2007). Since it is well known that several language abilities contribute to the development of Theory of Mind (Cutting and Dunn, 1999; Milligan et al., 2007; Farrar et al. 2009), one might assume that preterm children's language deficits hinder their Theory of Mind abilities.

Second, children born at less or equal 34 weeks of gestation and having a birth weight of less than 2500 g show impaired executive functions (Alduncin et al., 2014): More precisely, preschoolers born preterm were found to have difficulties concerning inhibitory control (Bayless and Stevenson, 2007; Aarnoudse-Moens et al., 2009a, 2012), working memory (Ni et al., 2011; Aarnoudse-Moens et al., 2012; Brumbaugh et al., 2014;) and attention shifting (Bayless and Stevenson, 2007; Aarnoudse-Moens et al., 2009a;). With the exception of inhibition, these problems persist up to adolescence (Aarnoudse-Moens et al., 2012). The executive functions listed above are closely linked to Theory of Mind tasks requiring working memory to bear in mind different perspectives and inhibitory control to suppress the own knowledge in favor of a correct answer. Associations between executive functions and Theory of Mind are well established especially for inhibition (Carlson and Moses, 2001) and working memory (Carlson et al., 2002). Again, these relationships indicate impaired Theory of Mind in preterm children.

As mentioned above, evidence concerning Theory of Mind abilities in preterm children is limited to one study relying solely on two tasks comprising unknown psychometric properties. Therefore, future research should apply a Theory of Mind battery with better psychometric properties (e.g., Peterson et al., 2012) and additional established procedures like the Children's Faux Pas Test (Baron-Cohen et al., 1999) or the "Reading the Mind in the Eyes" Test (Baron-Cohen et al., 2001). To gain a more complete insight in preterm children's Theory of Mind abilities, it would be desirable to take into account parental judgment as further source of information by using a questionnaire inquiring children's behavior in everyday situations (e.g., Tahiroglu et al., 2014).

Conclusion

Preterm children face problems in social interactions. These problems might be based on difficulties in social-cognitive skills, and can be moderated by parental behavior. The emphasis on preterm children's motor, physiological, and intellectual development in past research should be enriched by a closer look at preterm children's social-cognitive development.

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Appendix

Table 1

Definitions of Preterm Birth

Source	Preterm Participants				
	Weeks of Gestation	**Birth Weight (grams)**	**Exclusion Criteria**	**Age at Assessment**	**Control Group**
Aarnoudse-Moens et al., 2012	≤30		twins, severe disabilities (need for physical assistance in daily activities)	4-12 years	yes
Aarnoudse-Moens et al., 2009	≤30		mental and motor handicaps too profound to allow task execution	6 years	yes
Alduncin, et al., 2014	≤34	<2500	sensory impairments, genetic syndrome, congenital heart disease	3-5 years	yes
Assel et al., 2002	≤36	≤1600	sensory impairments, meningitis, encephalitis, symptomatic congenital syphilis, congenital abnormalities of the brain, short bowel syndrome, positive for the HIV antibody, mother less than 16 years of age, non-English-speaking background, maternal drug abuse	3-4 years	yes
Barre et al., 2011*	≤32	≤1500	medical complications (e.g., intraventricular hemorrhage)	≥24 months	yes
Bayless & Stevenson, 2007	<32		multiple births, severe disability (blindness, hearing loss, spastic paralysis that affected the upper limbs)	6-12 years	yes
Bener, 2013	<37	<2500		NA (postpartum mothers)	yes
Bhutta et al., 2002*	various	various	primary examination of low birth weight children	> 5 years	yes

Brooten et al. 1988		≤1500	life-threatening congenital anomalies, Grade 4 intraventricular hemorrhage, extensive surgical intervention, oxygen dependency for more than 10 weeks	at discharge, 9 months (corr.)	No
Brumbaugh, Hodel, & Thomas, 2014	34-36		neurologic insult or disease, cyanotic congenital heart disease, serious medical illness (e.g., cancer, organ transplant), admission to a special care or intensive care nursery (only for full-term children).	4 years	yes
Campbell et al., 2015	≤28			7 years	yes
Chapieski & Evankovich, 1997*		1001-2501		1-70 months	yes/no
Crnic et al., 1983	<38	<1801	multiple births, major abnormalities, rehospitalization greater than five days in the first month following discharge	1 month (corr.), 4 months (corr.), 8 months (corr.), 12 months (corr.)	yes
De Groote, Roeyers, & Warreyn, 2006	<30 <37 + severe neonatal complications	<1250	significant mental or physical retardation that prevented standardized testing	2 years	yes
De Schuymer et al., 2012	28-34		severe intraventricular haemorrhage (grade III/IV), periventricular leukomalacia, severe sensory impairments	4 months (corr.), 6 months (corr.)	yes

De Schuymer et al., 2011	≤32		sensory impairments, meningitis, encephalitis, symptomatic congenital syphilis, congenital abnormality of the brain, short bowel syndrome, primary caregiver less than 18 years of age, maternal drug abuse, non-Dutch speaking background	3 months (corr.), 6 months (corr.), 9 months (corr.)	yes
Eckerman et al., 1994		<1501	congenital anomalies	29-42 weeks (postconceptional)	no
Forcada-Guex et al., 2006	<34		congenital malformations, chromosomal anomalies, evident parental psychiatric illness, drug abuse, language barriers, severe developmental problems at 6 months, visual impairment	6 months (corr.), 18 months (corr.)	yes
Foster-Cohen et al., 2007	<28 28-32	<1500	congenital abnormalities, non-English-speaking background	2 years (corr.)	yes
Garner, Landry, & Richardson, 1991		<1600		6 months, 12 months, 24 months	yes
Gray, Edwards, O'Callaghan, & Gibbons, 2015	≤30		mothers with multiple pregnancies more than twins, mothers with twins where one twin died, mothers with a baby with a major congenital abnormality, mothers with a baby that was not expected to survive to hospital discharge, mothers who were not English speaking	2 years (corr.)	yes

Greenberg & Crnic, 1988	<38	<1801	multiple births, major abnormalities, rehospitalization longer than five days in the first month following discharge	4 months (corr.), 8 months (corr.), 12 months (corr.), 24 months (corr.)	yes
Hille et al., 2001		≤1000		8-10 years	yes
Holsti, Grunau, & Whitfield, 2002		<800	major neurosensory handicaps, ambulatory cerebral palsy, Verbal IQ < 85 or Performance IQ < 85	9 years	yes
Hoy et al., 1992	<38	<1501		6-9 years	yes
Huhtala et al., 2011	<37	≤1500	multiple anomalies, osteogenesis imperfecta	2 years (corr.)	no
Huhtala et al., 2014	<37	≤1500	anomalies, syndromes, language problems	4-5 years	no
Jacob et al., 1984	<37	<2500	multiple births	3 years	yes
Johnson et al., 2015	32-36		major structural or chromosomal congenital anomalies	2 years (corr.)	yes
Jones, Champion, & Woodward, 2013	≤32		congenital abnormalities, non-English-speaking background	4 years (corr.)	yes
Landry, 1986	<36	<1600	cerebral palsy, sensory handicaps, non-intraventricular hemorrhage-related forms of hydrocephalus	6 months	yes
Landry & Chapieski, 1988	<36	<1600	cerebral palsy, sensory handicaps, non-intraventricular hemorrhage-related forms of hydrocephalus	6 months (corr.)	yes
Landry et al., 1990	<32			36 months (corr.)	yes

Landry, Denson, & Swank, 1997	<36	<1600	sensory impairments, meningitis, encephalitis, symptomatic congenital syphilis, congenital abnormality of the brain, short bowel syndrome, positive for HIV antibody, primary caregiver less than 16 years of age, maternal drug abuse, only Spanish-speaking background	6 months (corr.), 12 months (corr.), 24 months (corr.), 36 months (corr.)	yes
Laucht, Esser, & Schmidt, 2001		<1500 1500-2500	multiple births, severe physical disabilities, genetic defects, metabolic diseases	3 months (corr.), 2 years (corr.), 4;6 years (corr.), 8 years	yes
McCormick & Workman-Daniels, 1996		<1000 1001-1500 1501-2500		8-10 years	yes
Miller-Loncar et al., 2000	<37	<1600	significant sensory impairments, meningitis, encephalitis, symptomatic congenital syphilis, congenital abnormalities of the brain, short bowel syndrome, positive for the HIV antibody, primary caregiver less than 16 years of age, maternal drug abuse, non-English-speaking background	1 year (corr.), 2 years (corr.), 4;6 years (corr.)	yes
Nadeau et al., 2003	<29	<1500		7 years	yes
Nadeau et al., 2004	<29	<1500		7 years	yes
Ni, Huang, & Guo, 2011		<1500		6 years	yes
Potijk et al., 2012	32-35		congenital malformation or syndrome	4 years	yes
Reijneveld et al., 2006	<32	<1500		5 years	yes

Reuner et al., 2014	23-32 33-36		congenital anomalies, major sensory impairment, severe brain injury (periventricular leukomalacia, intraventricular hemorrhage of Grade 3 and 4), other neurological complications, maternal drug abuse	7 months (corr.), 24 months (corr.)	yes
Ritchie, Bora, & Woodward, 2015*	≤33	≤1500	samples including high-risk or medically selected children only	0-17 years	yes
Ross, Lipper, & Auld, 1990		<1501	congenital anomalies	7-8 years	no
Sansavini et al., 2015	≤28		major cerebral damage, congenital malformations, visual or hearing impairment	12 months (corr.)	yes
Smith & Ulvund, 2003	≤34	<1501		13 months (corr.), 8 years	no
Spittle et al., 2009	<30	<1250		2 years (corr.)	yes
Stephens et al., 2012	<27		hearing impairment, blindness, severe cerebral palsy	18-22 months (corr.)	no
Telford et al., 2016	<33		major congenital malformations, chromosomal abnormalities, congenital infection, major overt parenchymal lesions (cystic periventricular leukomalacia, haemorrhagic parenchymal infarction), posthaemorrhagic ventricular dilatation	6-10 months (corr.)	yes
Williamson & Jakobson, 2014a		<1500	major sensory impairment (e.g., blindness or deafness), ventriculo-peritoneal shunting for posthemorrhagic hydrocephalus	8-11 years	yes

Williamson & Jakobson, 2014b		<1500	major sensory impairment (e.g., blindness or deafness), ventriculo-peritoneal shunting for posthemorrhagic hydrocephalus	8-11 years	yes
Zhang et al., 2014	<29			36 weeks	yes/no

* values indicate criteria for study selection in meta-analysis or review articles; corr. = corrected age; NA = not applicable

4 Study 1 – Witt, S., Weitkämper, A., Neumann, H., Lücke, T., & Zmyj, N. (2018). Delayed theory of mind development in children born preterm: A longitudinal study. *Early Human Development*

Delayed Theory of Mind Development in Children Born Preterm: A Longitudinal Study

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Published in *Early Human Development*, 2018, *127*, 85–89.

https://doi.org/10.1016/j.earlhumdev.2018.10.005

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Abstract

Background: Children born preterm are at high risk of developmental delay in various cognitive domains. Moreover, problems in social interaction are more frequently reported in preterm children than in their full-term peers. These difficulties can be observed at two years of age and seem to persist until school age. Although closely linked to social acceptance, remarkably little research has focused on social-cognitive skills such as Theory of Mind in preterm children.

Aim: The aim of the current study was to assess Theory-of-Mind development in preterm (n = 34) and full-term (n = 38) children over the course of two years.

Methods: A Theory-of-Mind scale was administered at the children's age of 3, 4, and 5 years, and we additionally assessed and controlled for general cognitive development.

Results: At the age of 3, mean Theory-of-Mind scores were 1.23 (SD = 0.65) for preterm and 1.58 (SD = 0.76) for full-term children. By the age of 5, preterm children's performance (M = 3.50, SD = 1.16) was similar to that of full-term children (M = 3.52, SD = 0.98), revealing a significant interaction effect between birth status and time of measurement, $F(1, 44.424) = 4.76$, $p = .035$.

Conclusion: The interaction effect indicates that preterm children show a delay rather than a general deficit in Theory-of-Mind development. Mechanisms underlying this course of development are still unknown. To examine why problems in social interaction persist despite improving Theory-of-Mind abilities, future research should extend the focus to implicit mental reasoning in preterm children.

Keywords: preterm birth, social-cognitive skills, Theory of Mind

Introduction

Prematurity is often accompanied by a variety of deficits in child development [1]. For example, much is known about cognitive problems faced by preterm children: Studies have reported lower IQ scores [2,3] and language problems (for a review, see van Noort-van der Spek, Franken, & Weisglas-Kuperus [4]) as well as difficulties in executive functions like attention shifting [5,6], inhibitory control [7,8], and working memory [7,9].

While there is broad evidence for cognitive deficits in preterm children, little is known about their social-cognitive skills. Given that many of these skills develop during the first years of life, it cannot be ruled out that preterm children show deficits in this regard similar to the deficits in cognitive and intellectual skills. One of the first social-cognitive skills observable in early childhood is joint attention, which refers to interaction partners paying attention to an object together. Joint attention skills have been found to differ between full-term and preterm infants in two ways: Initiation of joint attention in 2-year-olds [10] and responses to joint attention signals in 9-month-olds [11] were observed more frequently in full-term than in preterm children.

Besides early forms of social cognition such as joint attention, some later forms have also been found to be impaired in the context of prematurity. These include empathy [12], interpretation of non-verbal cues like body movements and facial expressions [13], and social attribution [14]. Theory-of-Mind abilities, however, have so far only received limited research attention with regard to preterm children. Theory of Mind represents a social-cognitive skill that is characterized by the understanding that mental states (e.g., beliefs or desires) are subjective and represent the basis of one's behavior [15]. One major aspect of developing a Theory of Mind is the realization that mental representations differ from reality in some cases. This false belief understanding can be tested using classical tasks (e.g., Wimmer & Perner [16]), in which children see a protagonist place an object in one location and then observe the object being secretly moved to another location while the protagonist is away. Having a Theory of Mind allows children from the age of around four to understand that the protagonist believes his or her object is still in its original location. Based on this knowledge, they will also be able to predict where the protagonist will look for the object.

To date, only a small number of studies have addressed false belief understanding in preterm children, and have yielded inconsistent results. One of these studies comprised three false-belief tasks and revealed no differences between 4-year-old preterm and full-term children [17]. However, the psychometric properties of some of the tasks used in this study had not been explored in high-risk samples. Moreover, the authors reported a floor effect in some Theory-of-Mind tasks, raising doubts about whether measurement was conducted at an appropriate age. A recent study focusing on neural processing during false-belief tasks also revealed no differences between preterm and full-term children on a behavioral level [18]. Another recent study showed that 4-5-year-old preterm children performed worse than full-term children when they had to predict the action of another individual who held a false belief [19].

The paucity of interest in preterm children's Theory of Mind is also surprising given that reasoning about mental states is fundamental for interaction with others [20]. In turn, social interaction has been reported to be challenging for preterm children for several reasons (for a review, see Ritchie, Bora, & Woodward [21]). At the age of 2 years, preterm children were found to show less social competence compared to full-term children [22]. This observation is in line with parental judgment, with preterm children's social competence as rated by parents being lower than that of full-term children of the same age [23,24]. Interaction problems persist at least until school age and are expressed through social withdrawal [25,26] and verbal forms of victimization [27]. Various factors which are frequently found in preterm children may help to explain the challenges they face in social life. First, medical risk factors [28] and brain abnormalities [21] might contribute to later social problems. Second, preterm children more frequently suffer from impaired motor skills compared to full-term children [29,30] and might therefore become a target for victimization and exclusion from the peer group or from social activity. Third, parent-child interaction might shape preterm children's social behavior. In particular, characteristics of maternal interaction are related to preterm children's social development. In a cross-sectional study, mothers of 3-year-old preterm children were found to show more directive behavior than mothers of full-term children, which in turn correlated negatively with children's initiation of activities [28]. A longitudinal study revealed that mother-child interaction predicted problems in social situations 12 months later [31]. Additionally, parents of 8-year-old preterm children still reported higher rates of overprotection than parents of full-term peers [32], indicating a long-lasting effect of prematurity on children's social behavior.

Overall, based on several aspects of preterm children's cognitive and social development, there are various reasons to assume impaired Theory-of-Mind abilities in this group. First, impairments in basic social-cognitive skills like joint attention may have negative consequences for the development of later forms like Theory of Mind. Second, a positive correlation between Theory of Mind and social competence has often been reported in the literature [33,34], suggesting that social deficits in preterm children might also be related to deficits in Theory-of-Mind abilities. Third, certain aspects of parental behavior (e.g., use of mental state language) are associated with Theory-of-Mind development in children [35-37]. As reported above, mothers of preterm children often show an altered interaction style, which could have an unfavorable effect on their children's social-cognitive skills. Finally, children born preterm show deficits in executive functions [23] and language development [38], cognitive skills which are closely linked to Theory-of-Mind abilities [39,40].

In summary, there are various reasons to take a closer look at preterm children's social-cognitive skills. In order to extend and deepen the knowledge about this topic, we used a Theory-of-Mind scale [41], which represents a more reliable and valid measure than single false-belief tasks. Furthermore, we collected longitudinal instead of cross-sectional data, allowing us to gain insight into the course of development of social-cognitive skills in preterm and full-term children. We predicted that preterm children would show lower Theory-of-Mind scores than full-term children.

Methods

Participants

The sample consisted of two groups. The first group included 34 preterm children with a birth weight below 1500 g. These children participated in a follow-up program of the Department of Neuropediatrics at University Children's Hospital Bochum (Germany) from 2013 to 2017 and their parents were asked to take part in the present study. The second group comprised 38 full-term children who were recruited from a database of parents who had previously volunteered to participate in child development studies. Three additional full-term children took part in the study but had to be excluded from analysis due to birth parameters which turned out to be below the threshold for participation, defined as Apgar scores > 8 (n = 1) and umbilical pH values > 7.2 (n = 2).

Severe brain injuries, syndromic disorders, bronchopulmonary dysplasia, and chronic liver or kidney diseases were defined as exclusion criteria for both groups. Groups were matched for children's age and parental education. Most of the parents indicated having either a university degree (38.9% mothers, 36.1% fathers) or university entrance-level qualifications (25.0% mothers, 15.3% fathers). 81% of the parents were German native speakers. Children participated at the age of 3 years (t_1) and were followed up at the ages of 4 and 5 years (t_2 and t_3). Table 1 provides further characteristics and birth parameters separately for the preterm and full-term group. At each visit, parents received an expense allowance of 5 Euros and children were given a certificate of participation as well as a small gift. The study was approved by the local ethics committee and a parent of each child signed informed consent forms prior to the child's participation in the study.

Table 1

Preterm and Full-Term Children's Characteristics at Birth and at Times of Testing

Measure	Preterm	Full-term	*t*	*p*
% twin	5.88	0.00		
Mean (SD) gestational age (weeks)	28.3 (1.92)	39.6 (1.28)	-28.97	<.001
Mean (SD) birth weight (g)	1074 (289)	3529 (423)	-27.71	<.001
Mean (SD) birth weight for gestational age percentile	35.0 (23.6)	48.6 (27.5)	-2.15	.035
Mean (SD) maternal age at birth (years)	32.9 (5.41)	31.9 (5.46)	0.81	.419
n (t_1)	26	26		
n (t_2)	25	32		
n (t_3)	16	21		
Mean (SD) age (t_1)	3; 2; 8 (51 days)[a]	3; 2; 12 (29 days)	-0.45	.658
Mean (SD) age (t_2)	4; 3; 14 (85 days)[a]	4; 3; 7 (51 days)	0.34	.735
Mean (SD) age (t_3)	5; 3; 21 (93 days)[a]	5; 3; 12 (62 days)	0.35	.728

[a]corrected age

Design

The study had a longitudinal design, testing children at 3, 4 and 5 years of age. Children were assigned to the groups based on their birth status.

Materials and Procedure

Each year, children participated in two sessions. In the first session, cognitive development was assessed using a well-established test. This enabled us to take into account any differences in general cognitive developmental status between preterm and full-term participants for further analysis. The second session assessed children’s Theory-of-Mind abilities.

Cognitive development.

At 3 years of age, children’s cognitive development was assessed using the Mental Scale of the German version [42] of the Bayley Scales of Infant Development (BSID-II; [43]). Items were administered in accordance with the manual and included the domains of memory, categorization, language, numbers, problem solving and social communication. Raw scores were transformed into a Mental Development Index (MDI) score, which is standardized in a similar way to IQ scores (M = 100, SD = 15).

At 4 and 5 years of age, the German version [44] of the Wechsler Preschool and Primary Scale of Intelligence (WPPSI-III; [45]) was used to assess children’s cognitive development. The execution of seven core subtests, namely Block Design, Information, Matrix Reasoning, Vocabulary, Picture Concepts, Word Reasoning and Coding, allowed for the generation of three different IQ scores: Full IQ score, Verbal IQ score and Performance IQ score. All subtests were conducted according to the administration and scoring manual.

Theory of Mind.

Children’s Theory-of-Mind abilities were assessed via the German version [46] of the Extended Theory-of-Mind Scale [41]. This tool consists of seven tasks, which all deal with a discrepancy between a protagonist’s mental state on the one hand, and reality or another person’s (e.g. the participant’s) mental state on the other hand. For each task, children were told a story about one of the protagonists, represented by toy figures. Picture cards, which showed parts of the story, served as visual support. Afterwards, children were asked one or two test questions and up to two control questions in order to assess their comprehension of the story. In order to pass a task, children had to correctly respond to all test and control questions. Therefore, children obtained a score of 0 or 1 for each task. In accordance with the manual, tasks were presented in a fixed order with increasing levels of difficulty: diverse desires, diverse beliefs, knowledge access, explicit false belief, contents false belief, hidden emotion and sarcasm. The explicit false-belief task is an additional task which the authors recommend to be administered but not to be considered for calculating the total Theory-of-Mind score. Hence, children's Theory-of-Mind development was described by a score ranging from 0 to 6, representing the sum of passed Theory-of-Mind tasks.

Statistical analysis

Statistical analyses were conducted using SPSS 22.0. Theory-of-Mind data were analyzed using linear mixed models (LMMs) for several reasons: First, linear mixed models can handle the dependency of observations typically present in longitudinal studies. Second, using this method, listwise deletion is not necessary. Since linear mixed models can deal with varying numbers of observations, all data can be considered for analysis, even if single observations are missing for a participant. Finally, such models enable constant and time-varying covariates to be combined as predictors [47].

Results

Cognitive development

At 3 years of age, mean MDI scores in the preterm (M = 101.50, SD = 13.24) and full-term group (M = 98.96, SD = 13.38) did not differ significantly, $t(50) = 0.69$, $p = .495$, d = -0.19. Four-year-old preterm children's Full IQ scores (M = 94.61, SD = 11.29) also did not differ from those of their full-term peers, M = 95.28, SD = 12.38, $t(53) = -0.21$, $p = .838$, d = 0.06. Likewise, 5-year-old preterm children's Full IQ scores (M = 99.13, SD = 12.38) did not differ from those of full-term children (M = 102.57, SD = 11.09), $t(34) = -0.87$, $p = .388$, d = 0.30. In accordance with the Full IQ scores, the verbal IQ scores, which might be of particular interest with respect to verbally presented Theory-of-Mind tasks, did not differ between preterm and full-term children at any point of time (all p-values > .608).

Theory of Mind

The development of Theory-of-Mind abilities in preterm and full-term children is depicted in Figure 1. As mentioned above, linear mixed models were used to analyze Theory-of-Mind data. After comparing alternative models, we chose the model revealing the best model fit according to Akaike's information criterion (AIC). This model included *participant* as random effect as well as *birth status, time of measurement, IQ* and *birth status*time of measurement* interaction as fixed effects.

Analysis revealed a main effect of time of measurement, $F(1, 44.822) = 156.52$, $p < .001$, showing a general improvement of Theory-of-Mind abilities with increasing age in the whole sample. Furthermore, the main effect of birth status was statistically significant, $F(1, 43.663) = 7.87$, $p = .007$, indicating better performance in the full-term group than in the preterm group. This main effect was qualified by a statistically significant birth status*time of measurement interaction effect, $F(1, 44.424) = 4.76$, $p = .035$, revealing that group differences depended on the time of measurement. A closer look at the maximum likelihood estimates of the fixed effect parameters indicated that the average increase in the Theory-of-Mind score from t_1 to t_3 was higher for preterm ($b = 1.261$, 95% CI [1.002, 1.520]) than for full-term children ($b = 0.885$, 95% CI [0.287, 1.234]).

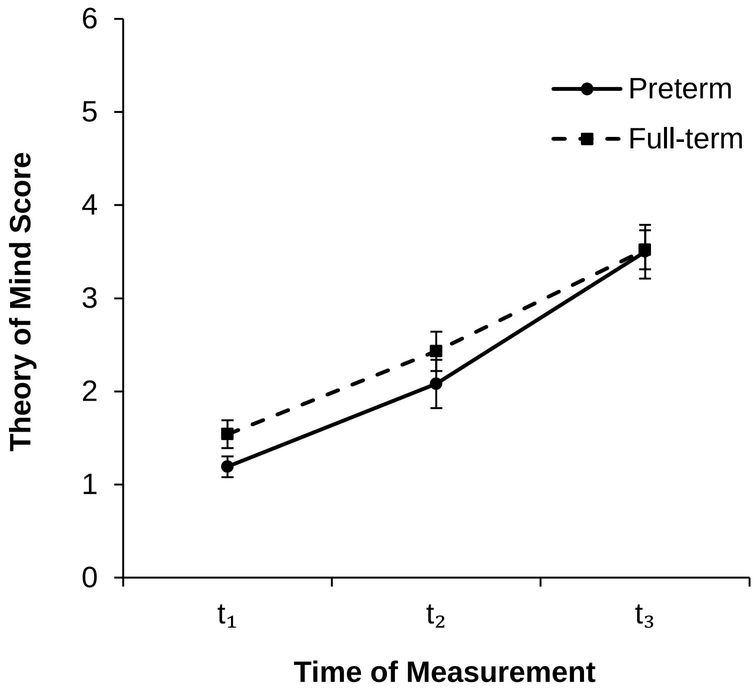

Figure 1. Mean Theory-of-Mind scores for preterm and full-term children from t1 to t3. Error bars represent standard error of the mean.

Discussion

To our knowledge, the present study is the first to assess the development of Theory-of-Mind abilities in children born preterm over the course of two years. Our findings suggest that preterm and full-term children differ in terms of solving Theory-of-Mind tasks depending on the time of measurement. By the age of 5, preterm children had closed the gap between them and full-term children which had been apparent two years earlier, indicating a developmental delay rather than a general Theory-of-Mind deficit. Since we considered children's MDI and IQ scores in our analyses, and matched the two groups with respect to educational background, we are able to rule out the possibility that differences in solving Theory-of-Mind tasks were due to a different cognitive development status or educational background. Our finding that preterm children's Theory-of-Mind abilities improved faster over time compared to those of full-term children might explain the results of a previous study [18], which revealed no group differences in solving false-belief tasks at the age of 9 years: According to our findings, Theory-of-Mind abilities have already improved in preterm children by this age. Future research should address the question of how environmental factors such as early childhood education or administration of special therapies affect Theory-of-Mind development in preterm and full-term children.

Our findings might also be relevant for explaining other deficits of children born preterm. For example, preterm children are more likely to face problems in social interaction than their full-term peers. Since Theory of Mind is positively associated with social acceptance [33,34], it should be considered as a potential factor in explaining preterm children's interaction difficulties. The assumption of impaired Theory-of-Mind abilities in preterm children is only partially supported by our findings: While preterm children improve in terms of correctly solving Theory-of-Mind tasks, social problems persist far beyond the age of 5 [26]. Therefore, one might assume that Theory-of-Mind deficits play a role in the emergence of social difficulties but not in their persistence.

An alternative explanation for long-lasting interaction problems despite improving results on the Theory-of-Mind scale might lie in the development of alternative strategies for solving typical Theory-of-Mind tasks. Applying internalized rules about social structures allows the individual to pass false-belief tasks without having a deep insight into underlying mental states. This phenomenon has been observed, for example, in children and adults with autism. While participants with autism spectrum disorder were able to solve explicit, verbally presented Theory-of-Mind tasks, they lacked an implicit understanding of social situations assessed via eye movements [48,49]. The assumption that preterm children's approach to Theory-of-Mind tasks differs from that of full-term children is supported by findings of a study investigating differences on a neural level: When confronted with a false-belief task, preterm children's pattern of neural activation showed a lower distribution compared to the patterns of full-term children. Furthermore, they showed weaker activation in the right temporoparietal junction (rTPJ), a region typically involved in solving Theory-of-Mind tasks. These differences even emerged for false-belief tasks on which preterm children performed equally as well as full-term children on a behavioral level [18]. Future research is needed to determine the similarities and differences in the development of explicit and implicit false belief understanding in preterm children.

Impaired Theory-of-Mind abilities in an early stage of development may be related to preterm children's social problems. Awareness of these difficulties should be considered in terms of intervention. In this respect, efforts should be made to enable preterm children to predict the actions of social partners earlier in development. Fostering these skills might help preterm children to find their way in social interaction more easily.

In sum, the present study indicates that preterm and full-term children differ in their performance in Theory-of-Mind tasks only in early stages of development. By the age of 5, preterm children had closed the initially existing gap, indicating a developmental delay rather than a general deficit.

Acknowledgments

This research was supported by the Forschungsförderung der Medizinischen Fakultät an der Ruhr-Universität Bochum (F794-2013). The authors would like to thank Ina Breitkopf, Larissa Dreier, Stefanie Kleinschmidt, Lena Lohkämper, Sabine Quick and Susanne Röttgers for their assistance with the recruitment of children, data collection and data analysis. We also thank all of the families who participated in this study.

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5 Study 2 – Witt, S., Seehagen, S., & Zmyj, N. (2022). The influence of group membership on false-belief attribution in preschool children. *Journal of Experimental Child Psychology*

The influence of group membership on false-belief attribution in preschool children

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Published in *Journal of Experimental Child Psychology*, 2022, 222, 105467.
https://doi.org/10.1016/j.jecp.2022.105467

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The authors have no conflicts of interest to declare. This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

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The authors would like to thank Lilo Huber-Bach, Lena Lohkämper, Tamara Feiten, Karin Recht and Helen Andrzejczak for their assistance with recruitment of children, data collection and data analysis. We also thank all the families who participated in this study.

Abstract

The ability to infer beliefs and thoughts in interaction partners is essential in social life. However, reasoning about other people's beliefs might depend on their characteristics or our relationship with them. Recent studies indicated that children's false-belief attribution was influenced by a protagonist's age and competence. In the current experiments we investigated whether group membership influences the way children reason about another person's beliefs. We hypothesized that 4-year-olds would be less likely to attribute false beliefs to an ingroup member than to an outgroup member. Group membership was manipulated by accent (Experiment 1-3) and gender (Experiment 4). The results indicated that group membership did not consistently influence children's false-belief attribution. Future research should clarify if the influence of group membership on false-belief attribution is either absent or depends on other cues that we did not systematically manipulate in our study.

Keywords: false belief, group membership, ingroup, outgroup

The ability to infer beliefs and thoughts in interaction partners is essential in social life. However, reasoning about what other people believe might depend on their characteristics or our relationship with them. In the current study we investigated whether social group membership influences the way children reason about another person's beliefs.

The ability to attribute mental states to oneself and others is frequently referred to as Theory of Mind (Premack & Woodruff, 1978). More specifically, a Theory of Mind allows perceiving beliefs as representations of reality which may be true or false (Perner, 1991). The attribution of false beliefs is often considered to be a direct result of an individual's Theory of Mind. Some typical false-belief tasks (e.g., Baron-Cohen et al., 1985; Wimmer & Perner, 1983) show a protagonist who leaves a room soon after he or she has placed an object in one container. In the absence of the protagonist, children observe another person who enters the room and transfers the object to a different container. Afterwards, children are asked to indicate where the protagonist will look for the object on his or her return. This question is based on the assumption that children only indicate the empty container when they represent the protagonist's false belief of the object's current location. Typically, 3-year-olds predict that the protagonist will look for the object at its current location. In contrast, a majority of 4-year-olds predicts that the protagonist will look for the object at its former location which is interpreted as false-belief understanding. Most studies on children's Theory of Mind investigate the developmental onset of this concept (for an overview, see Wellman et al., 2001) or potential shortcomings of the standard false-belief task (for an overview, see Scott, 2017). Verbal false-belief tasks were primarily criticized for their high processing demands. For example, children need to apply executive processes like inhibitory control, working memory and response-selection to pass the task described above. Several researchers assumed that children younger than four years of age failed those verbal tasks because of high processing demands rather than missing false-belief understanding (Baillargeon et al., 2010; Bloom & German, 2000). Therefore, they developed less demanding non-verbal paradigms like anticipation tasks (e.g., Southgate et al., 2007), violation of expectation tasks (e.g., Onishi & Baillargeon, 2005), or helping tasks (e.g., Buttelmann et al., 2009). These were passed by children within their third or second year of life, respectively. However, several researchers proposed to differentiate between implicit looking behavior in non-verbal tasks and explicit inferences about beliefs in verbal tasks, since both types address different representational systems (Low, 2010; Perner & Ruffman, 2005). Therefore, the current study focused solely on explicit tasks and tested 4-year-olds who typically meet the processing demands of these tasks.

Children's reasoning about mental states is not only influenced by linguistic and executive functioning demands but also by the protagonist's characteristics whose mental states they aim to infer. For example, 3-year-olds' perception of a protagonist's knowledgeability was influenced by a former description of the protagonist's traits (Lane et al., 2013). Children found it more likely that a "smart", "honest", or "kind" protagonist who had not looked into a box before knew what was inside the box than a "not smart", "dishonest", or "mean" protagonist who had looked into the box before. Therefore, children may tend to overgeneralize positive traits to specific situations even if those traits (e.g., kindness) are not relevant for the domain at hand (e.g., knowledgeability). Additionally, 4-year-olds' false-belief understanding is influenced by the protagonist's age. Young children were less likely to attribute false beliefs to an adult than to a peer protagonist (Seehagen et al., 2018). In both studies, the authors assumed that the protagonist's general knowledge affected children's inference about his or her specific knowledge in a situation: In Lane et al.'s (2013) study, the protagonist's general knowledge let children believe that he or she knew what was inside a box. Similarly, in Seehagen et al.'s (2018) study, the protagonist's adult status presumably caused children to believe that she was knowledgeable and would not err even if she could not know what the child participant knew.

There is converging evidence that children divide and evaluate their social world based on group membership like gender (e.g., Miller et al., 2006), race (e.g., Kowalski & Lo, 2001), age (French, 1987), and language (Kinzler et al., 2010). Accent and language in particular are reliable indicators for group membership throughout infancy and childhood. Infants and children preferred to look at, accept toys from, and to be friends with a speaker of their own language compared to a speaker of a foreign language (Kinzler et al., 2007). Furthermore, infants and toddlers were more likely to imitate a model that previously spoke in their own language than a model that previously spoke another language (e.g., Buttelmann et al., 2013). The importance of language in children's social preferences becomes apparent in combining two conflicting group memberships in one person. When, for example, race and language indicated ingroup membership in one of these domains but outgroup membership in the other domain, children preferred to be friends with other-race children who spoke with the same accent rather than own-race children who spoke with a foreign accent (Kinzler et al., 2009).

The preference for members of the own group (ingroup) over members of other groups (outgroup) is referred to as *ingroup bias* (Brewer, 1979). The ingroup bias is present in several social systems and occurs from childhood throughout adulthood. While evaluation of ingroup members is characterized by positive attributes, outgroup members are evaluated less favorably or even negatively (Bigler et al., 1997; Doise et al., 1972).

The current study focused on the effect of a model's group membership on the attribution of false beliefs. Inferring desires or beliefs helps to predict interaction partners' behavior and facilitates adequate reactions in social interaction. If belief attribution differs when children observe ingroup or outgroup members, this difference may also be reflected in their behavior towards ingroup and outgroup members. For example, children's Theory-of-Mind competencies were associated with prosocial behavior (Imuta et al., 2016). If they differently attribute beliefs to ingroup and outgroup members, it may also influence their prosocial behavior towards members of those groups.

Recent studies indicate that children differently infer mental states depending on whether the protagonist is an ingroup or outgroup member. However, the results are inconsistent regarding the direction of the effect. Two studies revealed better mental reasoning in favor of ingroup protagonists, while two other studies revealed better mental reasoning in favor of outgroup protagonists. On the one hand, McLoughlin and Over (2017) asked 5-6-year-old children to describe the actions of two animated triangles (Abell et al., 2000) that were announced to be part of either children's ingroup or outgroup in terms of gender or geographic origin. The results indicated that children used more mental state words when describing an ingroup member compared to describing an outgroup member. In line with this finding, 9-13-year-old children's mindreading in a modified version of the Strange Stories Task (White et al., 2009) was more accurate for ingroup members than for outgroup members (Gönültaş et al., 2020). This effect was especially pronounced if outgroup members were the target of prejudice and were perceived as a threat. On the other hand, there is evidence that 4-5-year-old children who showed high ingroup affiliation performed better in false-belief tasks with an outgroup protagonist than an ingroup protagonist (Sudo & Farrar, 2020). In line with this finding, a study in young adults revealed higher rates of false-belief attribution to outgroup targets compared with ingroup targets (Todd et al., 2011). Reasoning about ingroup member's beliefs was more often biased by the participants' own privileged knowledge.

The contradictory results in studies addressing the influence of group membership on mental reasoning may derive from different task characteristics. In McLoughlin and Over's (2017) study, as well as Gönültaş et al.'s (2020) study inferring others' mental states was independent of the participants' own mental states. However, in Sudo and Farrar's study (2020) as well as Todd et al.'s (2011) study participants had to deal with their own mental states conflicting the protagonists' mental states. Therefore, tasks independent of the participants' own mental states resulted in more accurate mindreading for ingroup members than for outgroup members while tasks that required inhibition of own mental states resulted in more accurate mindreading for outgroup members than for ingroup members. Following the latter point, successful differentiation might be more likely when reasoning about outgroup members who are perceived as different per se than when reasoning about ingroup members.

To investigate whether 4-year-olds' false-belief attribution is influenced by a protagonist's group membership, we conducted tasks with protagonists who were either a member of the child's ingroup or outgroup. We used accent manipulation to define group membership (Experiment 1-3). In a fourth experiment, we considered group membership in terms of gender. Since gender is an important social category from early childhood (Bigler & Liben, 2006), it may influence the way children reason about other people's mental states. Moreover, Experiment 4 addressed a broader range of mental reasoning, not only focusing on false-belief attribution but also on considering diverse desires or beliefs. All of these tasks involved a conflict between the participants' and the protagonists' mental states. We assessed 4-year-olds because their false-belief understanding is still emerging and therefore presumably more susceptible to contextual factors. Since our participants had to deal with their own mental states conflicting the protagonists' mental states, we expected results in accordance with those of Sudo and Farrar (2020). Therefore, we hypothesized that children would be less likely to attribute false beliefs to an ingroup protagonist than to an outgroup protagonist (Experiment 1-3). Since the attribution of a false belief is the pass criterion for the tasks we used, we expected children in the ingroup condition to fail those tasks more often than children in the outgroup condition. Accordingly, we hypothesized that children in the ingroup condition would also fail other Theory-of-mind tasks more often that children in the outgroup condition (Experiment 4).

Experiment 1

Method

Participants. The final sample consisted of 42 (17 female) healthy, full-term children from monolingual German speaking families. Children were aged four and a half years (*M* = 4 years; 4 months; 24 days, *SD* = 47 days). They were recruited from a database of parents who had previously agreed to participate in child development studies. Four additional children were excluded due to refusal to participate in the study (*n* = 3) and parental interference (*n* = 1). Most of the parents (66 %) had either a university degree or university entrance-level qualifications. Parents received 5 Euros as expense allowance and children were given a certificate of participation as well as a small gift. Prior to participation, a parent of each child signed informed consent.

Design. The study was conducted in a between-subjects design. Children were randomly assigned to either an ingroup condition or an outgroup condition. The experiment consisted of two parts. In the first part, children were familiarized with the protagonists' group membership via accent manipulation. In the second part of the experiment, four false-belief tasks were conducted with either the ingroup or the outgroup protagonist.

Materials and procedure. Familiarization of the protagonists' group membership and false-belief tasks were both administered via video presentation. Children were seated in front of a 17" monitor (distance approx. 60 cm). A remote control enabled the experimenter to pause and continue the presentation at predefined time windows. The whole session was video recorded.

Familiarization of the protagonists' group membership. At the beginning of the video presentation, children saw a still image of two male middle-aged protagonists. These men were sitting next to each other at a table and facing the camera. To facilitate naming and differentiation of the protagonists, they wore a blue and a green T-shirt, respectively. The experimenter told the children that the two men would like to tell a story they should listen to carefully (adapted from Kinzler et al., 2011). Additionally, they were instructed to look out for one of the men speaking in a strange manner. The video was continued and both protagonists told the same story one after another. The story lasted 15 seconds and dealt with Winnie the Pooh walking through the forest and watching squirrels.

Story telling of the protagonists differed in use of accent. One of the protagonists spoke German with Polish accent, thereby indicating outgroup membership. The other protagonist spoke German without any accent, thereby indicating ingroup membership. Both actors were bilingual speakers (German/Polish) and were hence able to speak with and without an accent on demand. The group membership of the protagonists was counterbalanced across participants, as well as the position of the outgroup protagonist, the speaking order, and the color of the protagonists' T-shirts.

Manipulation check. After both protagonists told the story, the video was paused again showing a still image of the protagonists. The experimenter asked three questions to check if group membership was successfully recognized. First, children were asked which of the two protagonists had spoken in a strange manner (MC_1). Children who chose the protagonist previously talking with accent were assumed to have correctly identified group membership. Next, children were asked which protagonist they preferred either for further story-telling (MC_2) or for playing together (MC_3). Children, who chose the protagonist previously talking without any accent were assumed to prefer the ingroup protagonist for social interaction. When a child hesitated to answer one of these questions, the experimenter encouraged the child to choose one of the protagonists.

False-belief tasks. Four video sequences were used to assess false-belief attribution. These sequences followed the same pattern and differed only in the objects to hide and the locations where the object could be hidden. For better understanding, actions were explained by a prerecorded female voice. Each of the four tasks started with one of the protagonists (either ingroup or outgroup member) from the familiarization phase sitting at a table and facing the camera. The table was equipped with one object (e.g., a banana) and two locations (e.g., backpack and basket; see Figure 1). The video then showed the protagonist placing the object at one location and leaving the scene afterwards. While the protagonist was outside, a woman, wearing a white shirt entered the room and transferred the object to the other location. After the woman left the scene again, the offstage voice emphasized that the protagonist had not seen the woman transferring the object to another location.

Figure 1

Starting position of the first false-belief task

At the end of each false-belief task, the experimenter asked two control questions and two test questions (adapted from Wimmer & Perner, 1983; cf. Fig. 1). Control questions were as follows: “Where did the blue one put the banana?” and “Where did the white one put the banana?” Asking these questions should ensure that children correctly remembered relevant story information. If a child answered a control question incorrectly, the experimenter repeated crucial parts of the story. Then, the experimenter asked the control question again. This was repeated until the child answered the control question correctly. Test questions were as follows: “Where does the blue one think the banana is?” (FB_1; *belief*) and “Where will the blue one look for the banana when he comes back?” (FB_2; *behavior*). The experimenter did not comment on the answers to the test questions. At the end of each sequence the narrator gave reasons why the protagonist would not return to the scene. Thereby she led to the next scene. The color of the protagonist’s T-shirt, the first location of the object, and the order of test questions were counterbalanced across children.

Coding. Children’s responses were coded for manipulation check and false-belief attribution separately offline. The coding system (see Table 1) was dichotomous providing scores of either 1 or 0 for each question. Percentages were calculated for the amount of false-belief attribution shown in 8 test questions. An independent second rater reviewed and coded the videos. Cohen's kappa revealed almost perfect agreement among raters (κ = .946-1.000, all *p*-values < .001 for manipulations check; κ = .952-1.000, all *p*-values < .001 for false-belief tasks).

Table 1

Coding System for Manipulation Check and False Belief Tasks

Question		Response	Score
		Manipulation check	
MC1	Who has spoken in a strange manner?	Child chooses the protagonist who spoke with accent.	1
		Child chooses the protagonist who spoke without accent.	0
		Child does not choose any protagonist.	-
MC2	Who should tell you the end of the story?	Child chooses the protagonist who spoke without accent.	1
		Child chooses the protagonist who spoke with accent.	0
		Child does not choose any protagonist.	-
MC3	Who would you like to play with?	Child chooses the protagonist who spoke without accent.	1
		Child chooses the protagonist who spoke with accent.	0
		Child does not choose any protagonist.	-
		False-belief tasks	
FB1	Where does the blue one think the banana is?	Child indicates the initial location of the object.	1
		Child indicates the current location of the object.	0
		Child refuses to answer.	0
FB2	Where will the blue one look for the banana when he comes back?	Child indicates the initial location of the object.	1
		Child indicates the current location of the object.	0
		Child refuses to answer.	0

Note. Manipulation check was conducted once throughout the experiment while false-belief questions were asked four times adjusted to the respective task.

Results

Familiarization of the protagonists' group membership. Binomial tests were used to determine if children's choice of one of the protagonists was above chance level when they had to answer the questions MC_1, MC_2, and MC_3. When the children were asked which of the two protagonists had spoken in a strange manner (MC_1), 56% of them correctly chose the outgroup member. Forty-four percent, however, chose the ingroup member or did not choose any of the protagonists, revealing that children's choice was not different from chance (p = .533). Neither did children show a preference for one of the protagonists for further story-telling (p = .878) or for playing together (p = .108). Phi coefficients revealed a correlation between MC_1 and MC_2 (ϕ = .71, p < .001). The majority of children preferred listening to the protagonist they perceived to speak normally. No further correlations between manipulation check questions were found (all p-values > .088). Thus, children's preference for playing together did not depend on how they perceived the protagonists' language.

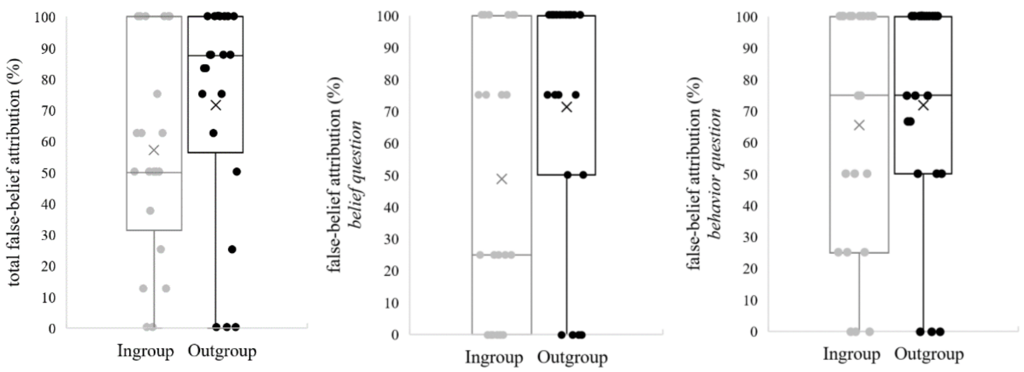
Fisher's exact test revealed that children's identification of the outgroup protagonist (MC_1) depended on the speaking order. When the outgroup protagonist spoke first, he was correctly identified by only 33% of the children. However, when the ingroup protagonist spoke first, group membership was correctly identified by 80% of the children (p = .004, OR = 8.00). Neither the position of the outgroup protagonist (p = .758, OR = .77) nor the color of the protagonists' T-shirts (p = .215, OR = 2.44) affected children's choice. Answers to MC_2 and MC_3 were not affected by any of the control variables (all ps > .121).

False-belief tasks. To assure comparability across all experiments of the study we calculated a total false-belief score across all tasks and questions of experiment 1. However, we also report results for different types of test questions (belief vs. behavior) separately. Mann-Whitney U tests were used to test for group differences. In total, the children attributed false beliefs to the protagonists in M = 64.38% (SD = 35.23) of the tasks. However, total false-belief attribution to the ingroup member did not differ from total false-belief attribution to the outgroup member (U = 167.50, p = .179, r = 0.21; see Table 2 for descriptive statistics; see Figure 2a for distributions). When the participants were asked what the protagonist might think, children tended to attribute fewer false beliefs to the ingroup protagonist than to the outgroup protagonist (U = 157.0, p = .098, r = 0.26; see Figure 2b). However, the prediction of behavior according to a false belief did not differ between the ingroup and outgroup condition (U = 206.0, p = .706, r = 0.06; see Figure 2c). A correlational analysis revealed a large effect for the relationship between belief and behavior questions (r = 0.58, p < .001). Additionally, the answers within each type of question were highly consistent (ω = .863 and ω = .822, for belief and behavior questions, respectively). The attribution of false beliefs did not differ depending on the participants' gender (U = 203.5, p = .821, r = 0.04) the first location of the object (U = 183.5, p = .352, r = 0.15), the order of test questions (U = 175.5, p = .259, r = 0.18) or the color of the protagonist's T-shirt (U = 193.5, p = .497, r = 0.11). Taking into account the possibility of decreasing memory for group membership throughout the experiment, we analyzed data from the first false-belief task separately. False-belief attribution in the first sequence did not differ between the ingroup (M = 59.52, SD = 37.48) and outgroup condition (M = 65.00, SD = 40.07; U = 191.0, p = .593, r = 0.08).

Figure 2

Scatterplots and Boxplots for False-Belief Attribution in Experiment 1: (a) Total, (b) Belief Questions, (c) Behavior Questions

(a) (b) (c)



Note. Each dot represents the score in percentage of one participant. The lower and upper box boundaries represent the lower and upper quartiles, respectively. The horizontal line inside the box represents the median. When no horizontal line is present inside a box, the upper line of the only box represents the median of 100. The cross represents the mean. The lower whiskers represent minimum scores. When no lower or upper whisker is present, the lower and upper lines of the box represent the minimum and maximum score, respectively.

To take into account the possibility that selective false-belief attribution depends on the explicit identification of group membership, we conducted exploratory data analyses. Descriptive statistics for exploratory analyses are depicted in Table 3. Considering only those children who had correctly identified the group membership of the protagonists (n = 23), revealed significant differences in total false belief attribution. Children attributed fewer false beliefs to the ingroup protagonist than to the outgroup protagonist (U = 29.00, p = .020, r = 0.48). Again, the belief-question (M_{Ingroup} = 39.58%, SD_{Ingroup} = 37.62; M_{Outgroup} = 70.45%, SD_{Outgroup} = 38.44; U = 36.5, p = .067, r = 0.39) reflects the main effect more strongly than the behavior-question (M_{Ingroup} = 60.42%, SD_{Ingroup} = 36.08; M_{Outgroup} = 81.06%, SD_{Outgroup} = 32.08; U = 43.5, p = .146, r = 0.31).

Table 2

Descriptive Statistics for Proportions of False-Belief Attribution or Passed Theory-of-Mind tasks in the Ingroup and Outgroup Conditions in Experiments 1-4

	Experiment 1		Experiment 2		Experiment 3		Experiment 4	
Measure	Ingroup (n = 21)	Outgroup (n = 21)	Ingroup (n = 26)	Outgroup (n = 26)	Ingroup (n = 30)	Outgroup (n = 29)	Ingroup (n = 40)	Outgroup (n = 40)
M	57.14	71.63	76.13	68.88	64.17	69.83	50.08	55.00
SD	34.36	35.39	32.18	34.65	39.76	42.46	25.77	23.93
Mdn	50.00	87.50	88.00	87.50	75.00	100.00	50.00	66.67

Note. Experiment 1-3 consisted solely of false-belief tasks. Experiment 4 consisted of a broader range of Theory-of-Mind tasks (e.g., diverse desires, diverse beliefs, and knowledge access).

Table 3

Descriptive Statistics for Exploratory Analyses of False-Belief Attribution to Ingroup and Outgroup Members in Experiments 1-3

Measure	Experiment 1		Experiment 2		Experiment 3	
	Ingroup (n = 12)	Outgroup (n = 11)	Ingroup (n = 16)	Outgroup (n = 19)	Ingroup (n = 21)	Outgroup (n = 22)
M	50.00	75.75	79.81	67.24	67.86	76.14
SD	27.18	33.17	33.79	35.58	36.35	37.38
Mdn	50.00	87.50	100	75.00	75.00	100.00

Note. Unlike Experiment 1-3, Experiment 4 included multiple preference checks. Therefore, the results of exploratory analyses for each task are reported in the result section of Experiment 4.

Discussion

In general, the accuracy of children's false belief-attribution did not differ between the ingroup and outgroup condition. However, an exploratory analysis revealed that in case of explicit identification of the protagonists' group membership, children were – as predicted – less likely to attribute false beliefs to the ingroup member than to the outgroup member. These results call for further investigation because only half of the children identified the outgroup member correctly which is at chance level. Experiment 2 was conducted for three reasons: First, we wanted to increase the proportion of children who were able to correctly identify group memberships. Second, we intended to eliminate the effect of speaking order on group identification. Third, we intended to test the results of the exploratory analysis in a follow-up experiment.

Experiment 2

Experiment 2 followed the same procedure as Experiment 1 except that story telling was presented twice in alternating order. Therefore, all children listened to the outgroup protagonist at least once before and at least once after they had listened to the ingroup protagonist and vice versa.

Method

Participants. The final sample consisted of 52 (21 female) healthy, full-term children from monolingual German speaking families. One additional child was excluded from analyses due to experimenter error. Children were aged four and a half years (*M* = 4 years; 6 months; 19 days, *SD* = 64 days). Seventy-three percent of their parents had either a university degree or university entrance-level qualifications. Expense allowances for parents, presents for the children, as well as informed consent was identical to Experiment 1.

Materials and procedure. The procedure was identical to that used in Experiment 1, except that both protagonists told the familiarization story twice in an alternating order.

Results

Familiarization of the protagonists' group membership. Two-sided binomial tests revealed that children's choice of a protagonist significantly differed from chance level concerning MC_1. Sixty-seven percent chose the outgroup protagonist while 25% chose the ingroup protagonist (p = .002). Four children refused to choose any of them. Thus, the majority of children correctly identified group membership. Again, children did not show a preference for one of the protagonists for further story-telling (p = .322) or for playing together (p = .104). Phi coefficients revealed a correlation between MC_1 and MC_2 (ϕ = .55, p < .001) as well as between MC_2 and MC_3 (ϕ = .36, p = .028). No correlation was found between MC_1 and MC_3 (ϕ = .30, p = .078). Thus, children preferred the protagonist who they found had not spoken in a strange manner for story-telling but not for playing together.

Children's identification of the outgroup protagonist (MC_1) did not depend on the speaking order (p = .052, *OR* = 0.225), the position of the outgroup protagonist (p = .517, *OR* = 0.526) or the color of the protagonists' t-shirts (p = .335, *OR* = 2.133).

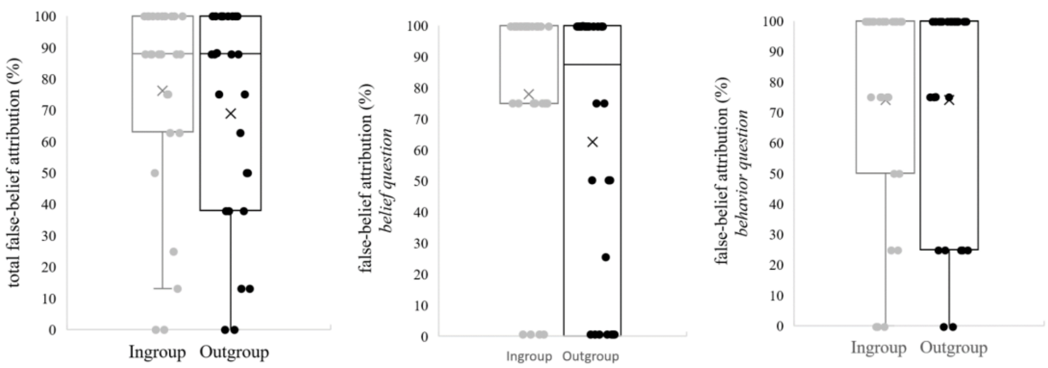
False-belief tasks. Total false-belief attribution was *M* = 72.51% (*SD* = 33.31). The false-belief attribution did not differ significantly between ingroup and outgroup conditions

(*U* = 296.5, *p* = .440, *r* = -0.11; see Table 2 for descriptive statistics; see Figure 3a for distributions). Neither belief questions (*U* = 285.5, *p* = .293, *r* = 0.15; see Figure 3b) nor behavior questions (*U* = 330.0, *p* = .874, *r* = 0.02; see Figure 3c) revealed differences between false-belief attribution to ingroup or outgroup protagonists.

Figure 3

Scatterplots and Boxplots for False-Belief Attribution in Experiment 2: (a) Total, (b) Belief Questions, (c) Behavior Questions

(a) (b) (c)



Note. Each dot represents the score in percentage of one participant. The lower and upper box boundaries represent the lower and upper quartiles, respectively. The horizontal line inside the box represents the median. When no horizontal line is present inside a box, the upper line of the only box represents the median of 100. The cross represents the mean. The lower whiskers represent minimum scores. Dots below the whiskers represent values less than the lower quartile by more than 1.5 times the interquartile range. When no lower or upper whisker is present, the lower and upper lines of the box represent the minimum and maximum score, respectively.

Focusing on data of children who identified group membership did not reveal differences in false-belief attribution between ingroup and outgroup conditions either (*U* = 115.5, *p* = .209, *r* = 0.22, see Table 3 for descriptive statistics). None of the following control variables influenced false belief attribution significantly (all *p*-values > .358): first location of the object, order of test questions, and color of the protagonist's T shirt. Exploratory data analysis indicated that girls and boys differed in false-belief attribution depending on the type of test questions. When girls were asked to reason about the protagonist's behavior (e.g., "Where will the blue one look for the banana when he comes back?") they showed more false-belief understanding (M = 90.48%, SD = 20.12) than boys (M = 62.90%, SD = 39.72; U = 194.5, p = .006, r = 0.37). No gender differences were found for questions referring directly to the protagonist's beliefs (e.g., "Where does the blue one think the banana is?"; U = 304.0, p = .667, r = 0.06).

Discussion

In Experiment 2 the familiarization paradigm was modified, presenting the protagonists' story telling twice in alternating order. Thus, we could achieve two improvements. First, the effect of speaking order on group identification was eliminated. Second, the proportion of children who correctly identified the protagonists' group membership increased from 56% to 67%. The protagonists' group membership did not influence children's false-belief attribution. This applies to the whole sample as well as to the subgroup of children who could explicitly identify group membership. Therefore, results from Experiment 1 concerning this subgroup could not be replicated.

However, exploratory data analysis revealed, that girls and boys differed when reasoning about the protagonist's behavior. In order to avoid that these differences would skew any further results, the test questions concerning the protagonist's behavior were removed from the next experiment. To test the main hypothesis again, we conducted Experiment 3, which exclusively focused on the test questions that referred to the protagonist's beliefs.

Experiment 3

Experiment 3 followed the same procedure as Experiment 2, with the exception that only one kind of test question was asked. Children were asked where the protagonist would think the object is.

Method

Participants. The final sample consisted of 59 (31 female) healthy, full-term children from monolingual German speaking families. Two additional children participated but had to be excluded because of interruption of the procedure and sudden discomfort. Children were aged four and a half years (*M* = 4 years; 5 months; 29 days, *SD* = 36 days). Seventy percent of their parents had either a university degree or university entrance-level qualifications. Expense allowances for parents, presents for the children, as well as informed consent was identical to Experiments 1 and 2.

Materials and procedure. The procedure was identical to that used in Experiment 2, except that one of the test questions was omitted in each false-belief task.

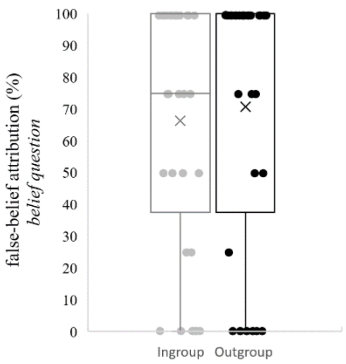
Results

Familiarization of the protagonists' group membership. Binomial tests were conducted to analyze children's preferences for the protagonists. Concerning MC_1 the majority of the children chose the outgroup protagonist (73%, $p = .001$). In addition, there was a preference for the ingroup protagonist (66%) over the outgroup protagonist (32%, $p = .012$) when children were asked which of them should go on with story-telling. One child refused to answer question MC_2. No preference was found for playing with one of the protagonists ($p = .672$). Phi coefficients revealed a correlation between MC_1 and MC_2 ($\phi = .595$, $p < .001$) as well as between MC_2 and MC_3 ($\phi = .493$, $p = .001$). No correlation was found between MC_1 and MC_3 ($\phi = .218$, $p = .206$). Again, children's rating of the protagonists' language correlated with their preference for story-telling but not with their preference for playing together.

False-belief tasks. Total false-belief attribution was *M* = 67.0% (*SD* = 40.90). False-belief attribution did not differ significantly between ingroup and outgroup conditions (*U* = 386.0, *p* = .432, *r* = 0.01; see Table 2 for descriptive statistics; see Figure 4 for distributions).

Figure 4

Scatterplot and Boxplot for False-Belief Attribution in Experiment 3



Note. There were only belief questions in Experiment 3. Each dot represents the score in percentage of one participant. The lower and upper box boundaries represent the lower and upper quartiles, respectively. The horizontal line inside the box represents the median. When no horizontal line is present inside a box, the upper line of the only box represents the median of 100. The cross represents the mean. The lower whiskers represent minimum scores. When no upper whisker is present, the upper line of the box represents the maximum score.

There was no effect of the protagonist's group membership even if only those children were considered who correctly identified group membership (*U* = 199.5, *p* = .190, *r* = 0.20; see Table 3 for descriptive statistics). Gender differences in false-belief attribution were found (*U* = 259.0, *p* = .004, *r* = 0.37), revealing that in total girls (*M* = 80.65%, *SD* = 33.98) attributed more false beliefs to the protagonists than boys (*M* = 51.79%, *SD* = 43.00).

Mini meta-analysis. We meta-analyzed data from false-belief tasks of Experiments 1-3 using fixed effects in which the mean effect size (i.e., mean *r*) was weighted by sample size. All correlations were *z* transformed for analyses and converted back to correlations for presentation. Overall, there was no effect of group membership on false-belief attribution (M_r = 0.02, *Z* = 0.37, *p* = .710). Meta-analyzing explorative data of children who explicitly identified group membership within the same experiments revealed a small but nonsignificant effect of group membership on false-belief performance (M_r = 0.12, Z = 1.33, p = .182).

Discussion

The results of Experiment 3 indicate that children do not attribute more false beliefs to a protagonist they identified to belong to their outgroup in terms of language. However, considering the total amount of false-belief attribution, girls outperformed boys. These gender differences raise the possibility that group membership in terms of gender may have influenced false-belief attribution. Experiments 1-3 dealt with two male protagonists. Therefore, we conducted Experiment 4 to find out if gender group membership influences children's false-belief attribution. Furthermore, we used a wide range of Theory-of-Mind tasks in addition to one false-belief task identical to those from Experiments 1-3. Finally, we tested children that were slightly younger than in the previous experiments. Doing this, we addressed findings from a recent study that revealed younger (mean age = 48 months) but not older children (mean age = 58 months) being susceptible for the influence of a model's group membership (Seehagen et al., 2018).

Experiment 4

Experiment 4 took into account the gender differences we found in Experiment 3 and partially in Experiment 2. It cannot be ruled out that the participants implicitly defined group membership based on the protagonists' gender, which was male in these experiments. A previous study revealed that preschoolers' gender bias was much stronger than the bias based on minimal group characteristics (Dunham et al., 2011). To examine if the protagonists' gender led to the differences we found between boys and girls, we conducted an experiment that considered male and female protagonists.

Method

Participants. The final sample consisted of 80 (40 female) healthy, full-term children. Children participated at four years of age (3 years; 11 months; 20 days, *SD* = 30 days). They were recruited from a database of parents who had previously agreed to participate in child development studies. Two additional children were recruited but had to be excluded from further analysis due to technical failures (*n* = 1) or language problems (*n* = 1). Seventy-three percent of the parents had either a university degree or university entrance-level qualifications. Expense allowances for parents, presents for the children, as well as informed consent was identical to Experiments 1-3.

Design. The study was conducted in a between-subjects design. Children were randomly assigned to either an ingroup condition or an outgroup condition. A total of six Theory-of-Mind tasks was conducted with either the ingroup or the outgroup protagonist. The protagonists' group membership was indicated by his or her gender. Prior to each of these tasks, children were familiarized with a male and a female protagonist and had to indicate their preference for one of them.

Materials and procedure. Stimulus material was presented via video on a 17" monitor. Children were seated in front of the monitor at a distance of approximately 60 cm. The experimenter used a remote control to guide through the tasks. The whole session was video recorded.

Familiarization of the protagonists' group membership. At the beginning of each video sequence, children saw two adult protagonists (male and female) sitting next to each other at a table and facing the camera. Both protagonists wore grey t-shirts. The protagonists introduced themselves one after another. The position of the outgroup protagonist and the speaking order were counterbalanced across children. New pairs of protagonists were introduced at the beginning of each of the six sequences.

Manipulation check. After both protagonists introduced themselves, the experimenter paused the video and asked the children which of the protagonists they liked the most. When a child hesitated to answer this question, the experimenter encouraged the child to choose one of the protagonists by pointing at him or her.

Theory-of-Mind tasks. Six video sequences were used to assess children's Theory-of-Mind performance. Five tasks were adapted from the German version (Henning et al., 2012) of the Extended Theory-of-Mind scale (Peterson et al., 2012). The stories we transferred to video presentation were the following: diverse desires, diverse beliefs, knowledge access, explicit false belief, and contents false belief (for a description of the tasks, see supplementary information). Finally, we included one change-of-location task we used in Experiment 3. For better understanding, actions were explained by a prerecorded voice. In each of the tasks children were presented with only one protagonist that they were familiarized with before. Depending on the type of task children were asked one or two test questions during or after the story and up to two control questions to assure comprehension of the story. If a child failed to answer a control question, the experimenter repeated the story and asked the control question again. This was repeated until the child answered the control question correctly. To answer the test questions correctly, children had to infer the protagonist's mental states. Children passed a task if they correctly answered all test questions. It was counterbalanced across children if the prerecorded voice was male or female.

Coding. Based on video recordings, children's responses were coded for manipulation check and Theory-of-Mind tasks. The coding system was dichotomous. Regarding the manipulation check children received a score of 1if they preferred the ingroup protagonist or 0 if they preferred the outgroup protagonist. Theory-of-Mind tasks were scored 1 if children answered all test questions correctly. Otherwise they received a score of 0.

Percentages were calculated for the number of passed Theory-of-Mind tasks in order to adhere to the format of results in Experiments 1-3. An independent second rater coded the videos. Cohen's kappa revealed excellent agreement among raters (κ = .966-1.000, all *p*-values < .001 for manipulations check; κ = .973-1.000, all *p*-values < .001 for Theory-of-Mind tasks).

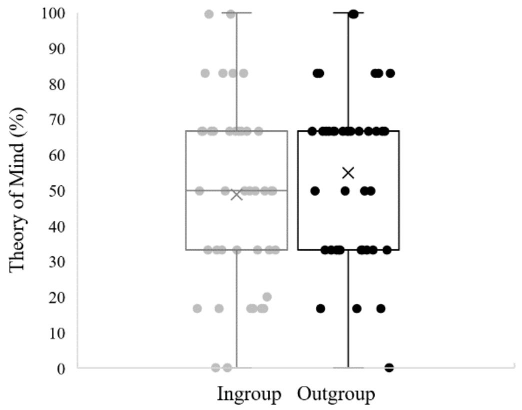
Results

Familiarization of the protagonists' group membership. Binomial tests were used to determine if children preferred one protagonist over the other. Children were asked which of the protagonists they liked the most. The results indicated that the participants preferred the same-sex protagonist across all six pairs that were presented. Ingroup preferences ranged from 65% to 77% (all *p*-values < .015).

Theory-of-Mind tasks. In total, children passed *M* = 52.54% (*SD* = 24.83) of the Theory-of-Mind tasks. The percentage of correct inferences about the protagonists' mental states did not differ between groups (U = 709.0, p = .372, r = 0.10; see Table 2 for descriptive statistics; see Figure 5 for distributions).

Figure 5

Scatterplot and Boxplot for Passed Theory of Mind tasks in Experiment 4



Note. Each dot represents the score in percentage of one participant. The lower and upper box boundaries represent the lower and upper quartiles, respectively. The horizontal line inside the box represents the median. When no horizontal line is inside a box, the upper line of the box represents the median. The cross represents the mean. The lower and upper whiskers represent minimum and maximum scores, respectively.

Again, we conducted exploratory data analyses that focused on the Theory-of-Mind performance of those children who showed a preference for the own-gender protagonist. The performance in the ingroup condition did not differ from the performance in the outgroup condition in any of the six tasks (all *p*-values > .275). Children's performance in Theory-of-Mind tasks was not affected by the gender of the prerecorded voice (U = 579.5, p = .171, r = 0.15). Moreover, gender differences from Experiment 3 were not replicated. Boys (M = 51.75%, SD = 26.53) and girls (M = 53.33%, SD = 23.33) did not differ in their accuracy of mental state reasoning (U = 781.0, p = .854, r = 0.02).

Discussion

The results of Experiment 4 indicate that children's performance in Theory-of-Mind tasks is not, in general, affected by the protagonist's group membership in terms of gender. Therefore, the protagonist's gender cannot account for gender differences found in Experiment 3.

General Discussion

Social group membership determines expectations, preferences as well as the way children interact with others. For example, group membership influences the likelihood that children will learn from others (Buttelmann et al., 2013; Kinzler et al., 2011). In the current study, we investigated the effect of group membership on preschoolers' false-belief attribution. Past research revealed that children's attribution of false beliefs is influenced by a model's age (Seehagen et al., 2018), competence (Zmyj & Seehagen, 2020), and cultural group membership (Gönültaş et al., 2020; Sudo & Farrar, 2020). The role of a protagonist's group membership indicated by accent or gender received little attention so far. Ingroup positivity might hamper children's ability to realize that members of their own group would err. Moreover, belief attribution was more prone to be biased by a participant's own knowledge when it addressed ingroup members compared to outgroup members (Todd et al., 2011). Therefore, we expected that children would be less likely to attribute false beliefs to ingroup members than outgroup members. However, in the current study, group membership indicated by a protagonist's accent or gender did not consistently influence the number of false-belief attribution in preschool children.

The expected effect was solely found in exploratory data analyses of Experiment 1 which considered only those children who had correctly identified the protagonists' group membership. In this subgroup children were less likely to attribute false beliefs to the ingroup than to the outgroup protagonist. However, we failed to replicate this effect in Experiments 2 and 3 which indicates that the influence of group membership on false-belief attribution is either absent or depends on more subtle cues (e.g., type of questions) that we did not systematically manipulate in our study. Furthermore, the participants' age might contribute to the results that differ from those of Sudo and Farrar (2020) because there might be a time window in which children are susceptible to the protagonists' characteristics when inferring their mental states. In Sudo and Farrar's (2020) study the effect of group membership on false-belief attribution interacted with children's age. It was apparent in an older (52.5 - 70.40 months) but not a younger (35.8 - 52.3 months) group. In our experiments the mean age was between 47 and 54 months, which is below or at the lower end of the age group that showed the effect in Sudo and Farrar's study. On the other hand, the influence of a protagonist's age (peer vs. adult) on children's false-belief attribution was apparent in younger (41.4 - 52.4 months) but not in older children (52.5 - 65.6 months, Seehagen et al., 2018). Taken together, it is not clear if and when there is a time window when children's mental reasoning is particularly susceptible for the influence of a protagonist's group membership.

In contrast to Experiment 1 with a single presentation of the familiarization videos, repeated presentations in Experiments 2 and 3 led to correct identification of group membership above chance level. Furthermore, presenting both protagonists twice took account of the order effect apparent in Experiment 1. Obviously, identification of group membership was facilitated by the ingroup protagonist serving as reference point. However, in a previous study familiarization of group membership via accent was successful after one-time presentation (Kinzler et al., 2011). This discrepancy may result from the different language (German) and accent (Polish) used in the current study compared to Kinzler et al's study (English with Spanish accent). Furthermore, the participants in Kinzler et al.'s study were older (mean age = 5 years) and had to indicate which person they would like to ask about the function of a novel object. In contrast to the current study, they did not ask a preference question that directly referred to the protagonists' language.

Except from Experiment 1, our study revealed group identification scores between 65% and 77% which was above chance level. This is in line with previous studies investigating group effects in 3-5-year-olds (Kinzler et al., 2009; Sudo & Farrar, 2020). Although group identification was above chance in Experiments 2 and 3, children did not consistently prefer the ingroup protagonists in these experiments for further story-telling or playing together. Therefore, it is not clear that group identification went hand in hand with an ingroup bias in these experiments. However, Experiment 4 did not reveal group effects on mental reasoning, even though children showed a consistent ingroup bias in this experiment. Therefore, the lack of an explicit and robust ingroup bias cannot explain the null results across all four experiments. Nevertheless, future research should attempt to make group membership as salient as possible. Especially in the light of high, but not low ingroup affiliation in 5-year-old children leading to worse performances in false-belief tasks with an ingroup protagonist (Sudo & Farrar, 2020). While we assessed group preferences immediately after familiarization, we do not know how salient the protagonists' group membership was during the false-belief tasks. Since all events of the false-belief tasks were explained by an offstage voice, the protagonists themselves did not speak again. Therefore, accent as the original reference to group membership was not present during the false-belief tasks in Experiment 1-3. Instead, participants could only indirectly infer it from the association between accent and T-shirt color which was introduced during familiarization. It might be challenging to recap those group membership information while simultaneously coping with processing demands of false-belief tasks. On the other hand, Experiment 4 did not reveal a group effect either, although gender group information was still present during the false-belief tasks. Thus, a lack of persistent group information cannot explain the null results across all four experiments. Nonetheless, future experiments should add a second manipulation check following the relevant tasks to minimize uncertainty about the participants' ongoing awareness of group information. To our knowledge, a second manipulation check is not a standard procedure in this line of research but could help to explain seemingly mixed evidence. Moreover, previous studies used explicit references to the relevant group categories to maintain the salience during mentalizing tasks (e.g., "What do you think the boys were doing?", McLoughlin & Over, 2017). Similar to other studies (e.g., Kinzler et al., 2011), we referred to the T-shirt color (Experiment 1-3) or the protagonists' names (Experiment 4) during the Theory-of-Mind tasks lacking explicit group labeling. Future experiments should ensure keeping group membership salient during familiarization as well as during the tasks conducted to examine group effects.

Experiment 3 revealed gender differences. Girls attributed significantly more false beliefs to the male protagonists than boys. This is in line with previous studies indicating gender differences in Theory-of-Mind performance in favor of girls (Calero et al., 2013; Cutting & Dunn, 1999; Walker, 2005) but not in favor of boys. One explanation for the results of the current study is that the participants might have implicitly allocated the protagonists to groups based on the protagonists' gender and not on their accent. Social groups can be formed on the basis of many different characteristics. We decided to use accent because the efficiency of this manipulation was widely proven in previous research (Kinzler et al., 2009; Kinzler et al., 2011). Group allocation, however, often takes place based on gender (Maccoby & Jacklin, 1987; Martin et al., 1999). In the present study both protagonists were male in Experiment 1-3. Thereby they represented outgroup membership for female participants and ingroup membership for male participants concerning gender. This applied regardless of accent manipulation. There might be an interference of different group memberships. If the children implicitly defined group membership based on gender, this might explain gender differences in false-belief attribution in Experiment 3. Girls being part of the protagonist's outgroup attributed false beliefs more frequently than boys who belonged to the protagonist's ingroup. Therefore, the influence of group membership indicated by gender was investigated in Experiment 4. The results of this experiment did not indicate differences in false-belief attribution depending on the protagonist's gender. Nor did they replicate the gender differences we found in the children's performance in Experiment 3.

There are several other characteristics that might have evoked group affiliation apart from the manipulation we intended. For example, age groups may have interfered. Four-year-olds were less likely to attribute false beliefs to an adult than a peer protagonist (Seehagen et al., 2018). Although we did not explicitly refer to the protagonists' age, we cannot rule out that our participants implicitly identified them as age-related outgroup members. As a result, half of them saw a protagonist who belonged to outgroups in terms of age and accent. The other half of them saw a protagonist who belonged to an outgroup (age) and an ingroup (accent) at the same time. Children might have processed this ambiguity differently with some of them focusing more on age while other focusing more on accent, this might have increased variability. Therefore, future research should focus on opportunities to determine cumulative or competing effects of multiple ingroup and/or outgroup characteristics present within the same protagonist (see Kinzler et al., 2009, for a similar approach).

In our four experiments on the influence of group membership on false-belief understanding, we strictly separated hypotheses-driven analyses and exploratory analyses. While exploratory analyses revealed results in line with our hypothesis, hypotheses testing in subsequent follow-up experiments did not. In sum, these results highlight that we could not find robust evidence for an influence of group membership on false-belief understanding. Our results also highlight the importance of hypotheses-driven analyses and follow-up studies on exploratory analyses which prevents reporting results that cannot be replicated.

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Supplementary

Description of Theory-of-Mind tasks used in Experiment 4

Diverse desires

The child sees an adult sitting in front of two plates with a carrot on one plate and a cookie on the other plate. *"Here is [name]. It is snack time, so [name] wants to eat a snack. Here are two different snacks: a carrot and a cookie."* The child is first asked which snack he or she would like best. If the child chooses the cookie, it is explained that the adult likes carrots best. If the child chooses carrots, it is explained that the adult likes cookies best. Afterwards the child is asked which snack the adult will choose (target question). The answer is scored as correct if it is opposite from the child's own desire.

Diverse beliefs

The child sees an adult sitting in front of a bucket and a box, both presented upside down. *"Here is [name]. He wants to find his turtle. His turtle might be hiding under the bucket or it might be hiding under the box."* The child is asked where he or she thinks the turtle is. If the child chooses the bucket, it is explained, that the adult thinks the turtle is under the box. If the child chooses the box, it is explained that the adult thinks the turtle is under the bucket. Afterwards the child is asked where the adult will look for his turtle (target question). The answer is scored as correct if it is opposite from the child's own belief.

Knowledge access

The child sees a closed and opaque drawer. Next, he or she has a guess what is inside the drawer. Afterwards the drawer is opened by a hand puppet. The puppet shows that there is a flower in the drawer. The puppet puts back the flower and closes the drawer. Next, the experimenter asks the child "What is in the drawer?" (control question). If the child answers the control question correctly, the story goes on. Otherwise, the experimenter states again what is in the drawer until the child is able to answer the control question correctly. After passing the control question, the child sees an adult entering the room and sitting down in front of the drawer. Next, the child is asked, if the adult knows what is in the drawer (first target question) and if the adult looked into the drawer before (second target question). To pass the task the child needs to answer both target questions “no”.

Explicit false belief

The child sees an adult sitting in front of a backpack and a jacket. *“Here is [name]. He wants to find his mittens. His mittens might be in his backpack or they might be in his jacket. Really, his mittens are in his backpack. But [name] thinks his mittens are in his jacket.”* The child is asked where the adult will look for his mittens (first target question) and where they really are (second target question). To pass the task the child must answer both target questions correctly.

Contents false belief

The child sees a Smarties box and has a guess what is inside the box. Next, a hand puppet shows that there is a pencil instead of Smarties inside the box and recloses it afterwards. Next, the experimenter asks the child “What is in the box?” (control question). If the child answers the control question correctly, the story goes on. Otherwise, the experimenter states again what is in the box until the child is able to answer the control question correctly. After passing the control question, the child sees an adult entering the room and sitting down in front of the box. The child is asked, what the adult thinks is in the box, Smarties or a pen (first target question). The child is also asked if the adult looked into the box before (second target question). To pass the task the child has to answer the first target question “smarties” and the second target question “no”.

6 General Discussion

The aim of the current dissertation was to systematically investigate the association between ToM performance and prematurity as an internal factor on the one hand and between ToM performance and a protagonist's group membership as an external factor on the other hand. A review of the literature on preterm infants and children revealed that they face not only a variety of intellectual and cognitive problems, but also deficits in social competencies. First, we focused on the onset and persistence of preterm children's interaction problems. The literature revealed that such problems start as early as two years of age and persist into school age. Children with medical risk factors are at particular risk of poor social competencies (Landry et al., 1990; Ritchie et al., 2015). Second, we focused on the role of parents' behavior in preterm children's social development. The literature revealed that mothers' mental health (Assel et al., 2002) as well as parent-child interaction (Landry et al., 1990) might account for preterm children's social deficits. Third, we addressed the role of social-cognitive deficits as potential predictors of preterm children's interaction problems. A summary of the literature revealed that preterm children were less capable of joint attention at the age of nine months (De Schuymer et al., 2011) as well as two years of age (De Groote et al., 2006) compared to full-term peers. Moreover, 8-11-year-old preterm children showed lower accuracy in attributing mental states to animated triangles compared to their full-term peers (Williamson & Jakobson, 2014). Therefore, preterm children's social-cognitive deficits seem to persist from infancy to school age. Previous findings that social-cognitive skills are associated with social competence in typically developing children (Peterson et al., 2007) highlighted the particular need to systematically investigate preterm children's social-cognitive development. This might be a first step towards a better understanding of the mechanisms underlying preterm children's interaction difficulties.

Study 1 revealed longitudinal data for a broad range of ToM competencies. The interaction effect between birth status and the time of measurement indicated a delay in preterm children's ToM development. More specifically, three-year-old preterm children had lower ToM scores than their full-term peers. By the age of five, preterms had closed this gap and performed similarly to full-terms. Despite a close link between ToM and social behavior (Banerjee & Watling, 2005; Slaughter et al., 2002), preterm children's social problems cannot exclusively be explained by a ToM deficit. Study 1 revealed a catch-up process in preterm children's ToM between the ages of three and five years. However, several studies revealed that their social difficulties persist far beyond the age of five years (Hille et al., 2001; Ross et al., 1990). Consequently, ToM deficits may contribute to the emergence but not to the persistence of social problems associated with prematurity.

Previous research on preterm children's social cognition focused solely on cross-sectional data and revealed mixed findings (Jones et al., 2013; Mossad et al., 2017; Mossad et al., 2021; Roldán-Tapia et al., 2017). In a study by Jones et al. (2013), no differences between preterm and full-term children's ToM performance were found. However, the authors administered the ToM tasks at the children's (corrected) age of 4 years, a time when preterm children may have already caught up in performance, as indicated by the developmental trajectory revealed in study 1. In a study by Roldán-Tapia et al. (2017), 4-5-year-old preterm children performed significantly worse in false-belief tasks than their full-term peers, although it should be noted that the two groups differed significantly in general cognitive functioning. Therefore, differences in ToM performances may represent preterm children's general cognitive deficit rather than a deficit in the social part of cognition.

To the best of our knowledge, our study was the first to provide insights into preterm children's ToM development over the course of two years. Preterm children's ToM performance in terms of catching up with their full-term counterparts is in line with the results of an eye-tracking study that provided longitudinal data on preterm children's social cognition operationalized via social attentional preference (Dean et al., 2021): At 7-9 months of age, preterm infants' looking time indicated less preference for social stimuli compared to full-term infants' preferences. While preterm children's social preference scores increased up to the age of five years, full-term children's scores remained stable over time. Therefore, by five years of age, preterm children catch up in social attentional preference as well as in ToM performance. Parallel patterns of trajectory in preterm children's social attention and ToM development fit well with results from studies of typically developing children. For instance, infants' social attention at 10-12 months of age predicted their ToM performance at four years of age (Wellman et al., 2008).

As outlined above, longitudinal studies on preterm children's social cognition are scarce. However, extended research on cognition indicates the need to understand developmental trajectories associated with prematurity. Despite the broad research interest in general cognitive performance, many questions about the developmental trajectories remained unresolved. Do preterm children's cognitive deficits remain stable over time? Do they become more pronounced? Or do they ease with increasing age? Meta-analyses revealed that school-age children born very preterm had IQ scores 11-12 points below their full-term peers (Bhutta et al., 2002; Kerr-Wilson et al., 2012). Studies on the development of preterm children's cognitive functioning yielded mixed findings raising the question of whether these children face a general deficit or a delay. A longitudinal follow-up study revealed that preterm children's cognitive performance was worse than that of their full-term peers at four years of age, but not at nine and 19 years of age, indicating a catch-up development during late childhood and adolescence (Tideman, 2000). Another study reported an increase in preterm children's IQ scores from 88 at 3 years of age to 99 at 8 years of age (Ment et al., 2003). However, these results should be treated with caution, as the lack of a full-term born comparison group prevents a clear interpretation of the data. Several studies indicated stability of cognitive deficits in preterms from childhood into adolescence (Botting et al., 1998; Mangin et al., 2017; Saigal et al., 2000; Stålnacke et al., 2019) and from adolescence into adulthood (Allin et al., 2008). By contrast, other studies revealed a decline in preterm children's cognitive performance over time (Isaacs et al., 2004; Koller et al., 1997; van Noort-van der Spek et al., 2012). There are several factors that might contribute to these inconsistent results.

First, divergent developmental trajectories in preterm children's cognitive functioning may represent cohort effects. As neonatal care has improved significantly over the past 30 years, the cognitive development of preterm cohorts born in the 1980s may lack predictive power for infants born preterm more recently. Second, preterm samples are often heterogeneous and vary in the degree of prematurity or neurological abnormalities. Therefore, when comparing results on preterm children's cognitive development, it is important to consider sample characteristics in detail. For example, a positive correlation was found between gestational age and IQ scores (for a meta-analysis, see Bhutta et al., 2002), and this association was most pronounced in children born <33 weeks of gestation (for a review, see Johnson, 2007). In other words, children with a mild degree of prematurity and medical complications are more likely to catch up in cognitive functioning than those who were born extremely preterm and/or suffered from severe neonatal complications (Luu et al., 2011). Third, preterm children's cognitive development is associated with the social environment to which they are exposed to. Preterm children from families with a low socioeconomic status face more problems than those from families with a high socioeconomic status (Potijk et al., 2013; Wild et al., 2013).

In summary, the interplay of neonatal care, gestational age, and social environment contributes to a variety of developmental trajectories in preterm children's cognitive functioning. Therefore, these factors should also be considered when interpreting the results of studies focusing on preterm children's social-cognitive development. To date, studies investigating ToM in preterm children on a behavioral level, have included children born from 1998 to 2000 (Jones et al., 2013), 2000 to 2003 (Roldán-Tapia et al., 2017), and 2008 to 2014 (study 1 of the present thesis), indicating a high quality of neonatal care in all samples. The mean gestational age of preterm participants was 28-29 weeks for all study samples, again indicating high levels of comparability. However, while two studies (Roldán-Tapia et al., 2017; study 1 of the present thesis) revealed similar educational levels of the parents of preterm and full-term children, in the study by Jones et al. (2013) the mothers of preterm participants had a lower educational level than the mothers of full-term participants. Despite this, the preterm children's ToM performance did not differ from that of their full-term peers. This is surprising given that the biological risks of preterm birth as well as the social risks of low socioeconomic status additively contribute to poor social functioning (Mangin et al., 2017).

Study 2 focused on the influence of a task characteristic on children's performance in ToM tasks. The results of four experiments revealed that children's performance did not differ depending on the protagonist's group membership. Exploratory analyses focusing on explicit group identification yielded some findings in line with the hypothesis that children attribute fewer false beliefs to ingroup members than to outgroup members. However, we failed to replicate these findings in follow-up experiments, raising the question of whether group membership has no effect on ToM performance. Alternatively, an influence of group membership on ToM performance might depend on cues that we did not consider in study 2.

Previous studies indicated that children reason differently about ingroup and outgroup members' mental states. Specifically, children ascribed more mental states (McLoughlin & Over, 2017) and showed more accurate belief reasoning (Gönültaş et al., 2020) when addressing ingroup than outgroup members. Another study found an effect in the opposite direction: Four-to-five year-old children with high ingroup affiliation were more successful at inferring outgroup members' beliefs than ingroup members' beliefs (Sudo & Farrar, 2020). Study 2 did not find that group membership affects ToM performance in favor of either ingroup or outgroup protagonists. Methodological differences in the studies reported above might have contributed to the mixed findings.

First, in the studies by Gönültaş et al. (2020) and McLoughlin and Over (2017), reasoning about the protagonist's mental states was independent of the participants' own mental states. By contrast, the study by Sudo and Farrar (2020), as well as study 2 of the present thesis, used false-belief tasks to assess mental reasoning. In these tasks, participants need to take into account that they have some information about reality that the protagonist does not have. Therefore, reasoning about the protagonist's belief bears the risk of being biased by the participant's own belief. In an adult sample, this bias was found to be more likely to occur when reasoning about ingroup members' beliefs than when reasoning about outgroup members' beliefs (Todd et al., 2011). Such differences in task demands may explain why on the one hand, Gönültaş et al. (2020) as well as McLoughlin and Over (2017) reported an effect of group membership on mental reasoning in favor of ingroup members while on the other hand, Sudo and Farrar (2020) reported an effect of group membership on false-belief attribution in favor of outgroup members. However, study 2 did not reveal any consistent effect of group membership even though we likewise used false-belief tasks.

Second, the effect of a protagonist's group membership on children's ToM performance might depend on the participants' age. Previous studies revealed group × age interaction effects. One study revealed an effect of group membership on false-belief reasoning in older (52.5 – 70.4 months) but not younger (35.8 – 52.3 months) children (Sudo & Farrar, 2020). Another study reported an influence of peer-group membership versus adult-group membership on false-belief attribution in younger (41.4 – 52.4) but not older (52.5 – 65.6) children (Seehagen et al., 2018). These findings point in opposite directions and make it difficult to conclude whether and at what age children's belief reasoning is particularly susceptible to the influence of a protagonist's group membership. It should be noted, that the age range of study 2 was 47 – 54 months, which represents the transition from the younger to the older group defined by Seehagen et al. (2018), and Sudo and Farrar (2020).

Third, the salience of group membership throughout the experiment may be crucial for its effect on mental reasoning. Previous research has proven language to be a reliable variable to evoke ingroup preference (Buttelmann et al., 2013; Kinzler et al., 2007; Kinzler et al., 2009; Kinzler et al., 2011). In study 2, however, language cues indicating group membership were present during the familiarization phase but not during the ToM tasks. On the one hand, the group identification scores in study 2 (65-77%) were above chance level and in line with previous studies focusing on group effects (Howard et al., 2015; Kinzler et al., 2009; Kinzler et al., 2011; Sudo & Farrar, 2020). On the other hand, we conducted a manipulation check only once, immediately following the familiarization. Therefore, we lack data on how persistent group membership information was during the ToM tasks. Previous studies investigated the effect of protagonists' gender and cultural groups (McLoughlin & Over, 2017), minimal and cultural groups (Sudo & Farrar, 2020), as well as political and cultural groups (Gönültaş et al., 2020) on ToM performance. All of these studies have in common that cues indicating the protagonists' group membership were present during the ToM tasks: Either the experimenter referred to the protagonist's group membership while asking the test question or the protagonist wore cues (e.g., clothes or objects) that indicated group membership. However, the study from which we adapted the accent manipulation (Kinzler et al., 2011) revealed an effect of previously familiarized group membership after presenting four silent video clips. This indicates that the children did not forget about group membership information for a period of four video clips in which the protagonists silently presented the function of different objects. Nevertheless, it should be taken into account that the effect of group membership on ToM was mediated by perceived threat and prejudice (Gönültaş et al., 2020), and was moderated by the degree of ingroup affiliation (Sudo & Farrar, 2020). Therefore, during mental reasoning, it might be helpful to retain the group information that induces feelings such as threat and affiliation.

6.1 Relevance

ToM is a powerful tool in social life, helping us to interpret, predict, and react appropriately to others' behavior (Astington & Jenkins, 1995; Mitchell, 1997). The correlation between ToM abilities and social competence in preschool children is well established (Peterson et al., 2007). Given that poor ToM is associated with less social acceptance in preschool years and early school years (Slaughter et al., 2002; Slaughter et al., 2015), it is important to be aware of factors that may foster or hamper ToM development. Despite a broad body of research on cognitive aspects and ToM development in children suffering from ASD or deafness, research on preterm children's ToM is scarce.

Prematurity is associated not only with motor deficits (de Kieviet et al., 2009) and cognitive deficits (Bhutta et al., 2002) but also with social difficulties (Ritchie et al., 2015). These problems start in early childhood (Alducin et al., 2014) and persist into school age (Reijneveld et al., 2006). Since previous studies revealed a correlation between social competence and school achievement (Malecki & Elliott, 2002; Welsh et al., 2001; Woodward & Fergusson, 2000), it is of particular relevance to identify variables that contribute to preterm children's social maladaptation. Preterm children often face cognitive deficits as well as social difficulties, and are consequently at high risk of poor academic achievement. Deficits in preterms' school achievement are well documented for the early school years (Aarnoudse-Moens et al., 2009; Pritchard et al., 2014) and for adolescence (Litt et al., 2012).

More detailed investigation of preterm children's ToM revealed a developmental delay that may contribute to their social and academic deficits. Interventions that train preterm children's early social-cognitive skills may help to reduce the developmental delay and also improve their social and academic success in the long term. A meta-analysis revealed that ToM training programs can effectively improve ToM in children (for an overview, see Hofmann et al., 2016). However, follow-up intervals to assess the efficiency of the interventions were 13 days or less. Therefore, long-term effects of ToM training programs remain unclear. Moreover, none of 32 studies included in the meta-analysis provided information about the transfer of trained skills to everyday situations. ToM training was also effective in children with ASD. For instance, one study revealed that ToM training improved children's performance in ToM tasks as well as teacher-rated and parent-rated social skills (Adibsereshki et al., 2015). In contrast, another study revealed that the training improved ToM performance in children with ASD but did not affect their everyday social skills (Begeer et al., 2011).

Early intervention to improve preterm children's social cognition may prevent a social downward spiral. Since poor ToM competencies are associated with social withdrawal (Hoy et al., 1992), preterm children may lack opportunities to experience social interactions and fail to learn how to take others' mental states into account. Therefore, encouraging and supporting preterm children's social interactions may function as everyday ToM training. Frequent social interaction inside (Jenkins & Astington, 1996; Peterson, 2000) or outside (Lewis et al., 1996) the family context is beneficial for children's ToM development.

Even in the absence of neurodevelopmental problems, children's accuracy in mental state reasoning varies due to external factors like task characteristics (Wellman et al., 2001). We wanted to find out if children's inferences about mental states depend on whether they were related to an ingroup or outgroup member. Many intergroup biases emerge before the age of five. Children prefer people who belong to the same language group (Kinzler et al., 2007), race (Baron & Banaji, 2006; Kinzler & Spelke, 2011; Kowalski & Lo, 2001), or gender (Miller et al., 2006; Shutts et al., 2010; Shutts et al., 2013). Moreover, intergroup biases become obvious in children's behavior, and they are more likely to trust (Elashi & Mills, 2014) and share with (Fehr et al., 2008) ingroup members than outgroup members. Furthermore, by the age of six years children show interests consistent with stereotypes they have learned about their gender ingroup (Bian et al., 2017). Given that children's attitudes and behavior towards ingroup and outgroup members differ in many respects, it was reasonable to assume that they also reason about ingroup and outgroup members' mental states in different ways.

However, unlike previous studies (Gönültaş et al., 2020; McLoughlin & Over, 2017; Sudo & Farrar, 2020), study 2 did not reveal differences in mental reasoning depending on the protagonist's group membership, even though we conducted a series of four experiments systematically improving methodological aspects. Meta-analyzing data from three of the four experiments did not reveal group effects either. The null findings, as well as the inconsistent results of previous studies, call the existence of a group effect on mental reasoning into question. Assuming that there is no effect of group membership on the way in which children reason about others' beliefs could have implications for their behavior. Children's performance in false-belief tasks is positively correlated with the quality of peer communication (Slomkowski & Dunn, 1996) and prosocial behavior (Imuta et al., 2016). If children reason similarly about the mental states of ingroup and outgroup members, belief reasoning will not add to the unfavorable behavior towards outgroup members.

6.2 Limitations

A methodological strength of study 1 was the matching of preterm and full-term samples regarding their parents' education. However, the level of education was high in both groups: Sixty-four percent of the mothers and 51 percent of the fathers had either a university degree or university entrance-level qualifications. Therefore, the question remains open whether a sample of preterm children from families with lower educational levels would show the same or a more delayed developmental trajectory. In particular, maternal education is associated with cognitive development in healthy full-term children (for an overview, see Sirin, 2005) as well as preterm children (for an overview, see Wong & Edwards, 2012). Therefore, preterm children of mothers with a lower educational level face multiple risks and may show a delay in ToM development that lasts longer than in the sample of study 1.

A major shortcoming of study 2 was the lack of a second manipulation check following the ToM tasks. Previous studies revealed that even minimal groups were sufficient to elicit an effect of group membership on false-belief attribution in children (Sudo & Farrar, 2020) as well as adults (Simpson & Todd, 2017). Therefore, it is unlikely that the salience of group manipulation via accent was insufficient per se. Language or accent have been frequently and successfully used as indicators of group membership in infant and child studies (Buttelmann et al., 2013; Kinzler et al., 2007). However, it remains open whether children manage to retain information about group membership throughout multiple ToM tasks without recurring cues indicating group membership of the protagonist. In study 2, false-belief attribution in the first trial did not differ from that in the following trials. Nevertheless, we cannot be certain about the persistence of ingroup preferences following the first manipulation check. Previous studies revealed that the effect of group membership on mental reasoning is particularly pronounced if there are high degrees of perceived threat and prejudice towards the outgroup (Gönültaş et al., 2020) or strong affiliation with the ingroup

(Sudo & Farrar, 2020). Therefore, it is advisable to offer cues that might cause feelings such as affiliation or threat during and not only before mental reasoning takes place.

6.3 Future Studies

Study 1 revealed that preterm children's ToM performance improved from three to five years of age. On the other hand, their social problems persist at least for another five years (McCormick et al., 1996). Therefore, future studies should address preterm children's ToM development in the early school years. As social interactions become more complex with increasing age, so too might social-cognitive demands in everyday life. Focusing on older preterm children could reveal whether their catch-up in ToM development is long-lasting or will be challenged as the complexity of social cognition increases.

Investigations of preterm children's implicit ToM would add to the results of study 1. Previous research revealed, that some children and adults with ASD were able to pass explicit ToM tasks but failed implicit tasks based on anticipatory looking (Senju et al., 2009). Moreover, a training study indicated that children with ASD improved in solving explicit ToM tasks but failed to improve social skills beyond these tasks (Begeer et al., 2011). The authors assumed that rules learned about social structures helped the children to pass explicit ToM tasks regardless of insight into mental states. The catch-up development of preterm children in study 1 might represent an improvement in applying such alternative strategies to solve explicit ToM tasks. Eye-tracking studies to assess preterm children's implicit ToM would help to uncover more about the mechanisms that contribute to the catch-up process in explicit tasks by the age of five. If prematurity is associated with implicit ToM deficits that persist into school age, this could explain social problems during this period. Eye-tracking studies would also allow for the investigation of social cognition in children younger than three years of age. In this age range, infants and children are not able to pass explicit ToM tasks (Wellman et al., 2001). A recent study, for example, used eye-tracking to assess social preferences of preterm-born children at the ages of 7-9 months and 5 years (Dean et al., 2021). In accordance with study 1, the results revealed a catch-up development in preterm children by the age of five.

The perspective paper revealed several variables that could mediate preterm children's process of catching up to the ToM of their full-term peers. As also described in section 1.2, cognitive abilities like executive functions as well as parent-child interaction are associated with ToM performance. Study 1 did not investigate preterm children's development in all of these domains. Moreover, we did not collect data on intervention programs, in which preterm children might more frequently take part than full-term peers. Therefore, future research should identify variables that contribute to a ToM improvement in children born preterm. Early interventions focusing on these variables could possibly shorten the delay of ToM development.

Study 2 put forth some research questions in the field of task characteristics and motivational aspects of ToM performance. Two previous studies revealed that the influence of group membership on false-belief attribution interacted with children's age (Seehagen et al., 2018; Sudo & Farrar, 2020). Although the results indicated an effect in different age groups, the question arises of whether there is a certain age range when children's ToM is particularly susceptible to group effects. The task difficulty may also play a role in this context. Sudo and Farrar (2020) used not only false-belief tasks but also two further measures from a ToM scale (Wellman & Liu, 2004). Children typically pass tasks addressing diverse desires first, and subsequently pass false-belief tasks. At early school age, children pass tasks dealing with differences between real and apparent emotions (Harris et al., 1986). As expected from their mean age of 4 years, children's performance in Sudo and Farrar's study (2020) was above chance level in the diverse desires task and below chance level in the real-apparent emotion task. It is important to underline that these tasks were not affected by the protagonist's group membership. By contrast, false-belief tasks, which are often passed by the age of 4, were affected by the protagonist's group membership. It appears that children are susceptible to group effects if ToM tasks show a certain level of difficulty.

Future studies should also keep in mind that the motivations underlying children's intergroup bias may change with increasing age. While children already show ingroup favoritism at preschool age, they do not show outgroup derogation until school age (Buttelmann & Böhm, 2014). Since perceived threat and prejudice towards the outgroup were found to mediate the effect of the protagonist's group membership on mental reasoning (Gönültaş et al., 2020), it is especially important for future research to consider participants' age and intergroup attitudes.

7 Conclusion

Previous studies revealed that internal factors such as clinical issues and external factors such as task characteristics should be considered in ToM research. The current thesis aimed at systematically investigating the ToM development of children born preterm as well as the influence of a protagonist’s group membership on children’s ToM performance. Since social-cognitive deficits may contribute to social maladaptation, this thesis provided important insight into the developmental pattern of preterm children’s ToM competencies. Interventions that address early social-cognitive skills may reduce the long-term consequences for preterm children’s social competence.

The investigation of the role of a protagonist’s group membership in a series of four ToM experiments yielded important implications for task designs in future ToM research. The protagonist’s language or gender group membership did not affect children’s ToM performance. Therefore, it should not make any difference whether researchers use tasks with male or female protagonists.

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Own Contribution to the Publications

Perspective – Zmyj, N., Witt, S., Weitkämper, A., Neumann, H., & Lücke, T. (2017). Social cognition in children born preterm: A perspective on future research directions.

Systematic literature search

Review and editing of the original draft

Study 1 – Witt, S., Weitkämper, A., Neumann, H., Lücke, T., & Zmyj, N. (2018). Delayed theory of mind development in children born preterm: A longitudinal study.

Data collection

Data analysis

Original draft preparation

Editing of the original draft

Study 2 – Witt, S., Seehagen, S., & Zmyj, N. (2022). The influence of group membership on false-belief attribution in preschool children.

Conceptualization (Exp. 2-4)

Data collection (Exp. 2-4)

Data analysis (Exp. 1-4)

Original draft preparation

Editing of the original draft

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Sarah Witt
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