



## Social reasoning abilities in preterm and full-term children aged 5–7 years

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### ABSTRACT

**Background:** Literature has evidenced behavioral and socio-emotional problems in preterm children, as well as long-term difficulties to establish and maintain social relationships in preterm population. Several studies have shown relations between behavior and social reasoning abilities in typically developing children and adults.

**Aim:** The present study aimed to investigate the social understanding and social reasoning abilities in preterm children aged between 5 and 7 years in comparison to their full-term peers.

**Study design:** A social resolution task (SRT) was used to assess abilities to judge, identify and reason about others' behavior in relation to conventional and moral rules knowledge.

**Subjects:** 102 preterm children and 88 full-term children were included in the study.

**Results:** Compared with their full-term peers, preterm children exhibited difficulties to understand and reason about inappropriate social behavior, particularly for situations related to the transgression of conventional rules. They used more irrelevant information and exhibited less social awareness when reasoning about the transgression of social rules.

The only significant predictor for global SRT and social reasoning scores was the mental processing composite of the K-ABC, but the part of the variance of the SRT that could be explained by the general cognitive abilities was relatively small.

**Conclusion:** Preterm children demonstrated poorer social knowledge and social reasoning abilities compared with full-term children at early school age. Improving such abilities may reduce behavioral difficulties and peer relationship problems often described in the preterm population. These findings emphasize the need to early identify children at risk for impaired social development.

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### 1. Introduction

Children born preterm, before 37 weeks of gestation, are at particular risk for long-term developmental difficulties [1,2] that seems to increase with lower gestational age (GA) and/or birth weight (BW) [3,4]. A negative impact of prematurity on neuronal [5,6], cognitive [7], behavioral, and socio-emotional development [8–13] has frequently been reported. Specific difficulties in executive function and attention abilities have been outlined in preterm children [14,15] and related to their later behavioral problems [11]. The presence of both externalizing (conduct problems, hyperactivity/inattention problems, aggressive behavior) and internalizing problems (emotional symptoms, social

withdrawal and anxiety) has been evidenced by parents and teachers of preterm children [3,13,16,17]. According to Johnson [18], there is little consensus regarding the prevalence of these two types of behavior, but most studies have reported an excess of attention and social problems in very preterm children.

Developmental studies have pointed out that adapted social functioning depends largely on high order socio-cognitive abilities [19] used to decode social and emotional information, and to develop representation and knowledge of the social world [20]. The theory of mind (ToM), defined as the ability to make inference about other people's minds, intentions, emotions and thoughts, is essential for building awareness of self in relation to others [21]. Social knowledge allows to reason about social situations and plays an important role for the understanding of how the social world works and is regulated. These socio-cognitive abilities are also crucial for the understanding and the judgement of one's and others' behavior, permitting to select the most adapted behavioral response to a specific situation [22]. Thus

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implementing positive social interactions relies on the ability to understand and build representation of social context [23], take others' points of view, and think through problem situations [24].

Recent studies on social understanding have highlighted the continuous development of these socio-cognitive and meta-reflexive abilities throughout the primary school years [25]. Moreover, a lack of these skills have been associated with internalizing and externalizing behaviors, and peer rejection [26–28] and more specifically with aggression, social anxiety and low popularity with peers [29]. Despite a growing literature on the presence of these social difficulties, only few studies assessed socio-cognitive abilities in preterm children [30].

Emotional and behavioral difficulties were already observed in preterm toddlers, compared with their full-term peers. They were described as less approachable, more distractible and presenting a high level of negative affect [31–33], with poor attention to social cues and social initiation behaviors [33,34]. At preschool age, self-regulation difficulties, low adaptability and difficulties in peer interaction have been evidenced [35–38]. Specific difficulties in facial emotion recognition were noticed in 42-month-old [39] and in 8-year-old preterm children [40], and errors in decoding emotional information were considered as a possible explanatory factor for poorer social skills showed in 8-year-old preterm children. Jones et al. [35] reported that compared to 4-year-old full-term peers, very preterm children ( $GA < 28$  weeks) presented poorer emotional and behavioral adjustment, lower level of positive peer play and poorer social competences. At school age, very preterm children were reported to have a high rate of sibling conflict and peer victimization [37] that persists into young adulthood where they show greater difficulties to establish and maintain social relationship, compared with their full-term peers [41]. Difficulties in social behavioral adjustment seem to persist during childhood [13,37,42,43], and adolescence [44] with a greater level of peer rejection [3] and lower social competences [30,45].

To our knowledge, only one study assessed the understanding and reasoning about a social situation in relation to social knowledge in preterm children [5]. In that structural brain connectivity study, even though we note the absence of a comparison group of full-term peers, 6-year-old preterm children performed the social resolution task (SRT) [23,46]. Interestingly, correlations between extremely preterm children's weaker strength of connections belonging to medial and orbitofrontal networks and lower performances in understanding social context, in social reasoning abilities, in cognitive abilities, as well as higher externalizing behaviors (high hyperactivity symptoms) were found. These networks have been identified as important for social cognition abilities [47], suggesting that altered maturation of the orbitofrontal cortex reported in preterm children and adolescents [48] might be responsible for lower social competences observed in this population [49]. At school age, preterm children remain at risk for socio-emotional and learning difficulties that demand higher order cognitive skills [35], including difficulties to process complex information that needs logical reasoning [50]. The specific difficulties in the ability to perceive, integrate and simultaneously process the complex stimuli [51], together with the attention deficit evidenced in very preterm children, may underlie their behavioral, social and academic difficulties [18,35].

Finally, studies have reported an impact of neonatal biological risk factors, such as low birth weight, GA, cerebral white matter abnormalities, as well as gender, on very preterm children's social outcome. A lower family socio-economic status has also been identified as a predictor for their social and behavioral problems [30,52]. In order to better understand the mechanisms underlying preterm children's socio-emotional difficulties, it is of great importance to study the socio-cognitive abilities by assessing their social understanding and reasoning in comparison with their full-term peers. In this perspective, the SRT [46] with pictures illustrating daily social situations will be used. Considering the relation observed between social reasoning and general cognitive abilities [5] in very preterm children, as well as their poor performances on a variety of tasks measuring visual attention abilities [18],

the influence of these abilities on preterm children's results will be considered. The influence of some neonatal and social risk factors will be also taken into account.

In this context, the aims of the present study were: (1) to assess social reasoning abilities in a large sample of preterm children aged between 5 and 7 years in comparison to full-term born peers, with the SRT; (2) to examine in details abilities to judge, identify and reason about the transgression of social rules; (3) to control for the influence of visual attention ability on performances on the SRT; (4) to investigate the predictive value of general cognitive abilities and perinatal factors on preterm children's social reasoning abilities.

## 2. Method

### 2.1. Participants

Eighty-eight full-term children and 102 preterm children aged between 5 and 7 years were included in the study. The participants were recruited between 2007 and 2011. The preterm children, born between 28 and 32 weeks of GA, were part of a larger cohort study and were recruited at the University Hospitals of Geneva and Lausanne. Preterm children with severe neuro-motor and sensory disabilities (cerebral palsy, visual and hearing loss), and with congenital malformations, or with major brain lesions on cerebral ultrasound (intraventricular hemorrhage grade III–IV or periventricular leukomalacia) in the neonatal period were excluded from the study. All preterm children selected to participate to the study presented IQ scores within the normal range on the Kaufman Assessment Battery for Children (K-ABC). Full-term healthy children born after 38 weeks of GA and free of developmental (cognitive, motor or sensory) problems and learning difficulties were recruited through local public schools. Their receptive language ability was assessed with the standardized EVIP vocabulary scale, a French adaptation of the Peabody Picture Vocabulary Test – Revised [53]. Five children were excluded because they obtained a score below the range expected for their chronological age on this task. All children were educated in mainstream schools.

An overall description of the preterm and full-term population is shown in Table 1. The family's SocioEconomic Status (SES) was calculated using the 12-point scale described by Largo et al. [54]: from 2 - the highest SES to 12 - the lowest SES. General cognitive abilities of preterm born children were assessed with the K-ABC. There was no difference in sex ratio and in chronological age between the 2 groups,  $p > 0.05$ .

All tasks were administrated in a quiet room by a trained psychologist. The study was approved by the local ethical committees and parents gave written informed consent for the participation of children.

**Table 1**  
Population characteristics.

Characteristics	Full-term group	Preterm group
	N = 88	N = 102
	n (%) or mean (SD)	n (%) or mean (SD)
Gestational age (weeks)	–	28.4 (2.7)
Birth weight (g)	–	1102 g (412)
SGA	–	22 (22%)
Gender		
Girls	53 (60%)	60 (59%)
Boys	38 (40%)	42 (41%)
Chronological age (years)	6.06 (0.43)	6.06 (0.38)
SES	–	5.2 (2.3)
K-ABC		
Mental processing composite	–	98.6 (13.3)
Sequential processing scale	–	98 (14.2)
Simultaneous processing scale	–	99.9 (12.9)

Note. SGA, small for gestational age (<10th percentile for birth weight as a function of gestational age and gender); SES, the family's SocioEconomic Status; K-ABC, Kaufman Assessment Battery for Children.

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