Preschool Socio-cognitive and Language Development in the Context of the Sibling Environment

by

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A thesis submitted in conformity with the requirements for the degree of Doctor of Philosophy

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Abstract

Children’s socio-cognitive and language development occurs in the context of social interactions, including those involving siblings. Using data from a longitudinal birth cohort study, the current thesis investigated the contributions of structural and process-based features of sibships to children’s socio-cognitive and language development.

Using a cross-sectional design, Study One \((N = 385)\) explored sibship size (i.e., number of children in the home) and older sibling cognitive sensitivity as contributors to younger siblings’ receptive vocabulary \((M = 3.15 \text{ years}, SD = .27)\). Results indicated that children from large sibships (i.e., 3+ children) had lower receptive vocabulary scores in the absence of a sensitive older sibling.

Using a longitudinal design, Study Two \((N = 385)\) investigated these same variables in predicting younger siblings’ theory of mind development approximately a year and a half later \((M = 4.77 \text{ years}, SD = .26)\). A similar pattern emerged wherein children from larger sibships had lower theory of mind scores in the absence of a sensitive older sibling, after controlling for earlier theory of mind.
Using a within-family design, Study Three \((N = 288)\) explored birth order and sibling prosocial behavior as predictors of younger siblings and older siblings cooperative abilities when they were the same age \((M \text{ age} = 3.33 \text{ years}, SD = .39)\). Laterborn children demonstrated enhanced cooperative abilities, particularly if their siblings showed higher levels of prosocial behaviour.

The current findings demonstrate the utility of investigating the ways in which sibling factors combine to influence children’s social cognition and language. The relationship of receptive vocabulary, theory of mind and cooperation to one another, as well as the ways in which they shape and are shaped by their social environments are discussed. Implications of the findings for intervention studies designed to promote sibling responsivity are also discussed.
Acknowledgments

When 5-year-old Avery smirked and said, “We are thinking about our thoughts”, I was reminded of the delight that comes with watching children grow. To Jenny, I am grateful to you for fostering my passion and skills for studying the complex world of children and families. What better way to motivate us than to couple your structure and challenge with pure warmth and encouragement. Mark and Dillon – you inspire me, and you make me laugh! I will look back on graduate school as some of the best years of my life and I have you two to thank for that. To Mira, thank you for being dependable and teaching me about first class project management. To everyone else in the Jenkins’ lab, past and present, I am grateful for our time together, and I look forward to collaborating for years to come. To Michal and Joan, thank you for sharing your expertise and for your continued warmth. Finally, to my dear friends in psychology – McGill girls, my SCCP cohort, and my favourite neighbours Ashley and Sharon – I am thrilled to have built lasting friendships with such thoughtful, intelligent, and determined people. Here is to years more of laughter, conversations about mental health and well-being, and peer supervision!

I would also like to extend my sincerest love and gratitude to my family – my parents, big brother and sister, and Scott. You have taught me about the power of compassion for others, and for myself, a gift that connects me with my work and my relationships. And a super special thank you and kiss for Scott, for your infinite support and unflattering belief in me.
# Table of Contents

Acknowledgments.......................................................................................................................... iv

Table of Contents ............................................................................................................................ v

List of Tables ................................................................................................................................ vii

List of Figures ................................................................................................................................ viii

Chapter 1 General Introduction ...................................................................................................... 1

  1.1 Siblings as agents of socialization ...................................................................................... 1

  1.2 Structural and process-based features of sibships............................................................... 2

  1.3 Contingent effects ............................................................................................................... 4

  1.4 The current thesis: A snapshot............................................................................................ 4

Chapter 2 Study 1: Sibship size, sibling cognitive sensitivity, and children’s receptive vocabulary .................................................................................................................................. 9

  2.1 Note ..................................................................................................................................... 9

  2.2 Abstract ............................................................................................................................... 9

Chapter 3 Study 2: Sibship size, sibling cognitive sensitivity, and children’s theory of mind: A longitudinal analysis ............................................................................................................. 10

  3.1 Abstract ............................................................................................................................. 10

  3.2 Background ....................................................................................................................... 11

  3.3 Current study ..................................................................................................................... 13

  3.4 Methods ............................................................................................................................ 15

  3.5 Results ............................................................................................................................... 20

  3.6 Discussion ......................................................................................................................... 23

  3.7 References ......................................................................................................................... 28

Chapter 4 Study 3: Birth order and children’s cooperative abilities: A within-family analysis... 33

  4.1 Abstract ............................................................................................................................. 33

  4.2 Background ....................................................................................................................... 34

  4.3 Current study ..................................................................................................................... 37
List of Tables

Table 1 ............................................................................................................................................ 8

Table 2 .......................................................................................................................................... 21

Table 3 .......................................................................................................................................... 22

Table 4 .......................................................................................................................................... 44
List of Figures

Figure 1......................................................................................................................................... 23

Figure 2......................................................................................................................................... 45
Chapter 1
General Introduction

1.1 Siblings as agents of socialization

A child’s readiness to enter and appropriately engage with the schooling system is highly dependent on their cognitive, language and social-emotional development (Mashburn & Pianta, 2006). It is through these skills that they are able to self-regulate and partake in successful interpersonal interactions, thus allowing for engagement in the learning process. The importance of social relationships (e.g., parent-child, teacher-child and sibling-child) to the development of cognitive and socio-emotional indicators of school readiness has been well documented (Mashburn & Pianta, 2006).

Sibling relationships are among the most lasting in individuals’ lives and are unique in their high levels of intimacy, familiarity and emotionality (Dunn, 2002). Sibling relationships comprise a natural power imbalance and assumed roles, while also maintaining features of reciprocity, which can be likened to peer relationships (Howe, Ross, & Recchia, 2011). Such qualities afford siblings with heightened opportunities for social interactions that promote early development, such as pretend play, teaching, conflict and caregiving (Howe et al., 2011).

Laterborn children, in particular, have unique childhood experiences. First, they grow up with siblings from birth, during years of rapid brain development with paralleled advances in cognitive development (Casey, Tottenham, Liston, & Durston, 2005). Second, older siblings are positioned to scaffold the development of younger siblings, rather than the reverse, given their older age, more developed cognitive skills, and experience in the teacher role (Howe, Della Porta, Recchia, & Ross, 2015; Prime, Perlman, Tackett & Jenkins, 2014; Recchia, Howe & Alexander, 2009). Relatedly, children are most likely to imitate models that are warm and nurturing, high in status, and similar to themselves (Bandura, 1977); to this end, older siblings represent prime candidates from which children may learn. Despite the majority of individuals having siblings, their influence on one another’s development across social and cognitive domains is understudied, albeit growing. The current dissertation will explore the influence of structural and process-based features of sibships on the socio-cognitive and language development of preschool children, with an emphasis on the experience of laterborn children.
1.2 Structural and process-based features of sibships

There are two main lines of research investigating the ways in which siblings influence children’s socio-cognitive and language development: one that looks at structural features of sibships and one that looks at process-based features (Arranz, Artamendi, Olabarrieta, & Martin, 2002). Structural features of sibships include factors such as size, birth order, gender composition, age gap and so on. Several studies have investigated the ways in which children’s developmental outcomes vary as a function of sibship size and birth order. Patterns of findings have been inconsistent both within and across the domains of language and socio-cognitive development. Whereas there has been a negative correlation observed between sibship size and cognitive measures such as intelligence, academic achievement, and language development (Downey 1995; 2001; Harrison & McLeod, 2010), numerous studies have shown a sibling advantage in socio-cognitive skills, specifically theory of mind development (e.g., Jenkins & Astington, 1996; Perner, Ruffman, & Leekam, 1994). Notably, the relationship between sibship size and theory of mind has itself been shown to vary as a function of age and position of siblings (i.e., older vs. younger; Peterson, 2000; Ruffman, Perner, Naito, Parkin, & Clements, 1998) as well as socioeconomic status of families (Hughes & Ensor, 2005). Differentiation between developmental domains is seen in birth order studies, too, with laterborn children being disadvantaged linguistically (Hoff, 2006; Pine, 1995), and advantaged in social domains (Kitzmann, Cohen, & Lockwood, 2002). These inconsistencies across domains of language and socio-cognitive development are surprising given the evidence for the behavioural overlap between language and social cognition, as well as their shared dependence on the social environment (Austingon & Baird, 2005; Milligan, Astington, & Dack, 2007; Wade, Moore, Astington, Frampton & Jenkins, 2015).

Another way that researchers have studied sibling effects investigates process-based features of sibships; that is, the analysis of sibling interactions and how they relate to developmental outcomes. These process-based studies have demonstrated links between aspects of sibling interactions (e.g., reciprocity, affection and talk) and measures of children’s social cognition such as mental state talk (i.e., talk about perceptions, desires, feelings and cognitions; Hughes, Fujisawa, Ensor, Lecce, & Marfleet, 2006; Jenkins, Turrell, Kogushi, Lollis, & Ross, 2003) and theory of mind development (Hughes & Ensor, 2005). Fewer studies have explored links
between sibling behaviour and individual differences in language development (Hughes & Ensor, 2005).

One characteristic of sibling interactions that may influence children’s preschool development is siblings’ responsivity to one another’s internal states (Browne, Leckie, Prime, Perlman, & Jenkins, in press; Prime, Perlman et al., 2014). It has been demonstrated that interaction partners who show positivity and attunement to children’s internal states foster their development of language, theory of mind, and cooperative abilities (Laranjo, Bernier, Meins, & Carlson, 2010; Meins, 2012; Prime et al., 2015; Ruffman, Slade, Devitt, & Crowe, 2006). This type of connected, responsive behavior has been a construct primarily applied to parents, though is relevant to siblings, too. Children demonstrate responsive and affiliative behaviour early in development (Hay & Cook, 2007), for example, showing signs of instrumental helping and empathic responding as early as the second year of life (Vaish & Warneken, 2012). As children get older, there are individual differences in children’s prosocial behavior (e.g., helping/comforting, responding to distress; Knafo & Plomin, 2006), including in the context of sibling relationships (Volling & Belsky, 1992). In addition to emotional responsivity, children as young as 3.5-years-old demonstrate nascent attempts at providing information that is attuned to others’ cognitive competencies (Ashley & Tomasello, 1998; Strauss, Ziv & Stein., 2002). During sibling interactions, in particular, there are individual differences in the extent to which older siblings engage in learner-centered strategies during teaching episodes (Recchia et al., 2009), which are related to younger siblings’ learning (Klein, Feldman & Zarur, 2002). For example, some siblings facilitate learning by providing instructions, involving the learner in the task, and using less ambiguous language. Contrastingly, other siblings have teaching styles that are characterized by a high proportion of controlling behaviours, while reducing learner involvement as well as autonomy during problem-solving (Recchia et al., 2009). Thus, older siblings vary in the degree to which they identify and respond to their younger siblings’ emotional and cognitive needs, creating varied experiences across sibling dyads (Garner, Jones & Palmer, 1994; Prime, Perlman et al., 2014). Though links have been made between parental responsivity and children’s socio-cognitive and language skills, this has not yet been explored in sibling dyads.

In summary, investigations into the effect of siblings on children’s socio-cognitive and language development have looked at both structural and process-based features of sibships. Studies on structural features of sibships have been inconsistent, with some suggesting that
having siblings is advantageous and others showing poorer developmental outcomes for children with siblings. Studies looking at process-based elements of sibships have demonstrated that sibling interaction quality varies across siblings, which is meaningfully linked to children’s socio-cognitive and language skills. The effect of sibling responsivity has not yet been explored in the context of children’s socio-cognitive or language development. This represents an important avenue of research given the wealth of evidence supporting this process in parent-child dyads.

1.3 Contingent effects

Factors that influence children's development do not occur in isolation; rather, contingencies occur within and across developmental periods wherein multiple factors interact to influence individual trajectories over time (Jenkins, 2008). The result is that there is marked variability in individuals’ responses to environments, which is dependent on person-, environment- and time-related factors (Rutter, 2006a, 2006b). The literatures that look at structural and process-based features of sibships have been largely explored in parallel. It is possible that by focusing on one of these features to the exclusion of the other, variations in the ways in which children respond to seemingly similar environments may be masked.

To explore how sibling interactions and sibling structure interact to influence children’s socio-cognitive and language development, contingency analyses are required. Specifically, one can investigate how the strength and direction of an effect of one variable (e.g., sibship size or birth order) on another (e.g., socio-cognitive and/or language development) is moderated by the presence of third variable (e.g., characteristics of sibling interactions; Baron & Kenny, 1989; Rose, Holmbeck, Coakley & Franks, 2004). The current thesis investigated how structural and process-based sibling variables operate independently and contingently with one another to influence children’s early socio-cognitive and language development.

1.4 The current thesis: A snapshot

Measuring both structural and process-based variables related to sibships, the current thesis investigated the socio-cognitive and language development of laterborn children in the context of and compared to older siblings. Specifically, I was interested in how the relationship between
sibling structural variables and children’s preschool development varied as a function of sibling responsivity. Findings from three studies will be presented using outcome data from children ranging from 3 to 4.5 years, each measuring a component of socio-cognitive or language development. Notably, the studies have been written up and submitted for publication as they have been completed. Study One was published in Pediatrics (Prime, Pauker et al., 2014), and Study Two was published in Cognitive Development (Prime, Plamondon, Pauker, Perlman, & Jenkins, 2016). Study Three is currently under review for publication.

1.4.1 Sample

Subjects come from the Kids, Families and Places Study (KFP), a longitudinal birth cohort study that was initiated in 2007 and has had four waves of data collection (PI: Jennifer Jenkins). The goals of the KFP study were to examine genetic and environmental influences on children’s socio-emotional development through the investigation of within-family differences. Recruitment occurred through the Healthy Babies Healthy Children program, run by Toronto and Hamilton Public Health, which contacts the parents of all newborn babies within days of the newborn’s birth. Inclusion criteria included families having a newborn singleton > 1500 grams (i.e., younger siblings), with an older child within four years of the newborn (i.e., next in age older siblings). Thus, all families had a minimum of two children. Additional criteria included English-speaking mothers who agreed to be videotaped. Five-hundred and one families were enlisted into the study, with non-enlistment a result of an inability to contact families, families not meeting criteria and refusals. Younger siblings were approximately 2 months old at Time 1 and families were followed up at ages 18-months (Time 2; N=397), 3-years (Time 3; N=385) and 4.5-years (Time 4; N=323). Questionnaire data were collected on up to four children per family at all waves. In addition, intensive data collection (i.e., observational data and direct testing) was carried out on younger siblings and their next in age older siblings at all waves. The KFP sample was similar to the general population of Toronto and Hamilton (2006 Canada Census Data) in terms of number of persons in the household and personal income, though the KFP families had a lower proportion of non-intact families, fewer immigrants and more educated mothers (Meunier, Boyle, O’Connor, & Jenkins, 2013).
1.4.2 Study variables

**Child outcomes.** The thesis investigates preschool skills known to foster adaptive learning trajectories. Three constructs were included, each of which have been previously linked to later school success: verbal ability, theory of mind and cooperation. School-aged children’s academic skills are supported by their early theory of mind (Blair & Razza, 2007; Lecce, Caputi, & Hughes, 2011; Peskin, Comay, Chen, & Prusky, in press) and linguistic development (Duncan et al., 2007). Additionally, children’s abilities to cooperate in a classroom context are related to positive social and academic outcomes (Ladd, Birch, & Buhs, 1999; McClelland, Acock, & Morrison, 2006). Cooperative problem solving, wherein children collaborate with a peer to solve an external problem, is related to task enjoyment and success in school-aged children (see Ramani & Brownell, 2014), further supporting the idea that individual differences in children’s cooperation skills have implications for their learning.

Though these outcomes are related constructs, they are usually independently studied, with each having a different literature with respect to sibling effects. Research questions, selection of covariates, and study designs have been drawn from each of these literatures and thus vary between studies. The final discussion will integrate the different pathways, across outcomes.

**Sibling process (i.e., responsivity).** The construct of parental responsivity to child emotion has been extensively investigated and causally linked to children’s behavioural development (Bakermans-Kranenburg, Van IJzendoorn, & Juffer, 2003). With colleagues, I previously extended this construct of partner responsivity from one that focused largely on responsivity to child emotion to one that focused on responsivity to child cognition, demonstrating its validity in both parents and siblings (Prime et al., 2015; Prime, Perlman et al., 2014). The construct, called cognitive sensitivity, is defined as a person’s ability to identify and respond to the inferred cognitive states of their partner. Specifically, it describes the extent to which individuals engage in communication that is tailored to the level of the child, are responsive to the child’s cognitive needs and requests for help, and promote mutual and reciprocal interactions during a joint task. Studies One and Two utilized this measure in the sibling dyad (i.e., next in age older siblings’ cognitive sensitivity towards the younger siblings), with the goal of determining whether this explained patterns of socio-cognitive and language development in interaction with factors
related to sibship structure. However, for Study Three, an alternative measure was used due to methodological restrictions, described below.

The goal of Study Three was to examine birth order differences in the development of cooperation using direct assessment. Direct assessments of cooperation have been primarily used in the context of demonstrating age related changes in children’s ability to cooperate. Indeed, Ashley and Tomasello (1998) have shown a clear developmental trajectory of cooperative problem solving abilities among toddlers and preschoolers, which they noted parallel growing socio-cognitive abilities during that time period. Thus, these are developmental phenomena with strong influences of cognitive maturation. My question was whether birth order differences would be evident in the development of strongly maturational tasks of this nature. In order to address this, I used an age-snapshot technique (Dunn & Plomin, 1986; Wichman, Rodgers, & MacCallum, 2006), wherein children from the same family are tested at different time points to obtain a ‘same-age’ sample of siblings. A sample of siblings at age 3 years was obtained by testing the younger siblings at Time 3 and their next in age older siblings at Time 2. In order to get a sibling process measure that included the older siblings of both the younger siblings and their next in age older siblings, questionnaire data was required (as observational data were not collected for the older siblings’ older siblings). Thus, a parent-reported measure of sibling prosocial behaviour was used as the sibling responsivity measure in lieu of the observational measure of cognitive sensitivity. Prosocial behaviour is, like cognitive sensitivity, an other-oriented behaviour that requires identification and response to another’s internal state. There is evidence that both prosocial behavior and cognitive sensitivity have underlying affective and socio-cognitive elements (Prime, Perlman et al., 2014; Vaish & Warneken, 2012). Thus, sibling prosocial behavior was considered a prime candidate for use as the sibling process variable.

1.4.3 Design

Table 1 presents an overview of the study variables and methodologies of each study, described in detail in the following chapters. Study One explored sibship size (i.e., number of children in the home) and next in age older sibling cognitive sensitivity as contributors to younger siblings’ receptive vocabulary. Study Two investigated these same variables in predicting younger siblings’ theory of mind development, while controlling for earlier levels of theory of mind. Study Three explored birth order and sibling prosocial behavior as predictors of
children’s (i.e., younger siblings’ and next in age older siblings) cooperative abilities. All three studies investigated sibling effects after controlling for several family-, sibship-, and child-level variables based on their demonstrated associations with the outcome or hypothesized predictor variables.

**Table 1**
Overview of study variables and methodologies

<table>
<thead>
<tr>
<th>Study</th>
<th>Sibship structure</th>
<th>Sibship process</th>
<th>Outcome</th>
<th>Child(ren) measured on outcome</th>
<th>Sibling(s) measured on process</th>
<th>Design</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Sibship size</td>
<td>Cognitive sensitivity</td>
<td>Receptive Vocabulary</td>
<td>Younger siblings</td>
<td>Next in age older</td>
<td>Cross-sectional</td>
</tr>
<tr>
<td>2</td>
<td>Sibship size</td>
<td>Cognitive sensitivity</td>
<td>Theory of Mind</td>
<td>Younger siblings</td>
<td>Next in age older</td>
<td>Longitudinal (2-points)</td>
</tr>
<tr>
<td>3</td>
<td>Birth order</td>
<td>Prosocial behaviour</td>
<td>Cooperation</td>
<td>Younger and next in age older siblings</td>
<td>Up to 4 siblings</td>
<td>Within-family cross-sectional</td>
</tr>
</tbody>
</table>
Chapter 2

Study 1: Sibship size, sibling cognitive sensitivity, and children’s receptive vocabulary

2.1 Note

The current manuscript is Copyrighted Material. The article is currently freely accessible through the American Academy of Pediatrics website, and will remain so for the next 4 years (2019). In lieu of including the full article, I have included a link to the article as it appears on the Pediatrics website in order to follow copyright laws for the American Academy of Pediatrics: http://pediatrics.aappublications.org/content/133/2/e394.full

2.2 Abstract

The aim of the present study was to examine the relationship between sibship size and children’s vocabulary as a function of quality of sibling interactions. It was hypothesized that coming from a larger sibship (i.e., 3+ children) would be related to lower receptive vocabulary in children. However, we expected this association to be moderated by the level of cognitive sensitivity shown by children’s next in age older siblings. Data on 385 children (mean age = 3.15 years) and their next in age older siblings (mean age = 5.57 years) were collected and included demographic questionnaires, direct testing of children’s receptive vocabulary, and videos of mother-child and sibling interactions. Sibling dyads were taped engaging in a cooperative building task and tapes were coded for the amount of cognitive sensitivity the older sibling exhibited towards the younger sibling. Hierarchical regression analyses were conducted and showed sibship size and sibling cognitive sensitivity interacted to predict children’s receptive vocabulary; children exposed to large sibships whose next in age older sibling exhibited higher levels of cognitive sensitivity were less likely to show low vocabulary skills when compared to those children exposed to large sibships whose siblings showed lower levels of cognitive sensitivity. Children who show sensitivity to the cognitive needs of their younger siblings provide a rich environment for language development. The negative impact of large sibships on language development is moderated by the presence of an older sibling who shows high cognitive sensitivity.
Chapter 3
Study 2: Sibship size, sibling cognitive sensitivity, and children’s theory of mind: A longitudinal analysis

3.1 Abstract

Inconsistent findings regarding the association between sibship size (i.e., number of children in the home) and children’s theory of mind led us to hypothesize a moderating role for quality of sibling interactions. In line with a parental resource dilution framework, it was expected that coming from a large sibship (3+ children) would be associated with lower theory of mind scores in the absence of a cognitively sensitive older sibling. Data were collected from 385 children and their next in age older siblings: at Time 1 children were 3.15 years ($SD = 0.27$) and their older siblings were 5.57 years ($SD = 0.77$). Children were, on average, 1.65 years older at Time 2. A longitudinal design, wherein theory of mind (Time 2) was predicted while controlling for earlier theory of mind (Time 1), was used to support directionality of effects. Results indicated that sibship size was negatively related to theory of mind at low but not high levels of sibling cognitive sensitivity. Findings suggest a compensatory role for cognitively sensitive older siblings in large families and highlight the need to consider process-based features of sibships.
3.2 Background

A child’s ability to represent their own and others’ mental states and identify how they relate to behavior is critical to their ability to engage in meaningful social exchanges. Preschool represents a developmental period of substantial growth in mental state understanding and, despite a similar trajectory of development in typically developing children, individual differences in the speed of attainment are evident (Hughes et al., 2005; Wellman & Woolley, 1990). Different accounts for observed variability in theory of mind (ToM) development have been offered, including child- (e.g., language and executive functioning; Astington, 2001; Hughes & Ensor, 2005) and family-level (e.g., social disadvantage; Cutting & Dunn, 1999), as well as genetic (Hughes & Cutting, 1999) influences.

Children's social understanding is constructed within social interactions (Carpendale & Lewis, 2004; Fernyhough, 2008). Given that siblings afford children with heightened exposure to social contexts related to socio-cognitive growth (i.e., pretend play, conflict, conversations; Dunn, 2002), there has been interest in children’s ToM development in the context of their sibling environments. Perner, Ruffman, and Leekam (1994), as well as Jenkins and Astington (1996), showed a linear progression in false belief understanding with increasing sibship size (i.e., number of children in the home), suggesting that children learn about the effects of beliefs on behavior through interactions involving siblings. Since that time, however, findings with respect to sibship size and ToM have been inconsistent. Some studies indicate that it is older and not younger siblings that are particularly important for children’s ToM (Ruffman, Perner, Naito, Parkin, & Clements, 1998; McAlister & Peterson, 2013), while others suggest that the effect lies in the presence of more knowledgeable partners (e.g., older peers, parents, grandparents) rather than older siblings specifically (Lewis, Freeman, Kyriakidou, Maridaki-Kassotaki, & Berridge, 1996). Some studies have suggested that exposure to child-like minds (i.e., ages 12 months to 12 years) accounts for the sibling advantage rather than the total number of older and younger siblings in the household (Cassidy, Fineberg, Brown, & Perkins, 2005; McAlister & Peterson, 2007; Peterson, 2000). Finally, there are studies that have failed to show any advantage of having siblings in ToM development (Arranz, Artamendi, Olabarrieta, & Martin, 2002; Carlson & Moses, 2001; Hughes & Ensor, 2005; Pears & Moses, 2003; Peterson & Slaughter, 2003), and others that have indicated a disadvantage of having siblings (Cole & Mitchell, 2000; Tompkins,
Farrar, & Guo, 2013). Thus, the current status of the association between sibship size and children’s ToM abilities remains unclear.

Previous studies on this topic have focused on the structural features of sibships, which may be contributing to the observed inconsistencies in the literature (Arranz et al., 2002; Cutting & Dunn, 1999). Assessing mere exposure to social input is not sufficient, as it is not just the amount but also the nature of children’s social interactions that influence children’s mental state understanding (Carpendale & Lewis, 2004; Dunn, 2002). For instance, affective quality is an important feature of social exchanges, functioning as it does to promote engagement, conversation and further interaction (Carpendale & Lewis, 2004). Additionally, cognitively-attuned input assists children in their internalization of social interactions, a key process in children’s ToM development (Fernyhough, 2008). Indeed, sensitive qualities of parental behavior (i.e., affectionate and cognitively-attuned) have been linked to gains in children’s social understanding (Laranjo, Bernier, Meins, & Carlson, 2010; Meins et al., 2002; Stevens, 2008).

Given the evidence for the relationship between cognitively-attuned and positively valenced input and children’s ToM found in the parenting literature, the current study sought to look at sibling sensitivity as a potential moderator of the relationship between sibship size and ToM. Typical processes explored in sibling dyads include affective quality (Dunn, Slomkowski, & Beardsall, 1994), teaching and scaffolding behaviour (Howe & Recchia, 2009; Klein, Feldman, & Zarur, 2002), as well as provision of mind-related input such as internal state talk (Dunn, Brown, Slomkowski, Tesla, & Youngblade, 1991; Howe, Petrakos, & Rinaldi, 1998; Jenkins, Turrell, Kogushi, Lollis, & Ross, 2003). Previously, a measure called cognitive sensitivity was developed to gauge the extent to which social partners (i.e., parents and siblings) engage in behaviours that promote the development of children’s social and cognitive development (Prime et al., 2015; Prime, Perlman, Tackett, & Jenkins, 2014). The measure integrates elements of affective (i.e., positively valenced turn-taking), communicative (i.e., provision of readily understandable information) and mind-reading (i.e., assessing and responding to verbal and nonverbal cues) behavior to measure partner sensitivity to children’s inferred cognitive states. There is demonstrated variability in the extent to which siblings can identify and sensitively respond to children’s levels of cognitive functioning (Prime, Perlman et al., 2014). The current study utilized this measure to index a potential moderating factor.
In thinking about the ways in which the relationship between sibship size and ToM development might change as a function of sibling cognitive sensitivity, it is useful to consider previous studies on sibship size and children’s cognitive development. Children growing up with siblings have been shown to demonstrate poorer language skills, IQ, and academic achievement (Downey, 1995, 2001; Zubrick, Taylor, Rice & Slegers, 2007). This pattern of findings has been explained primarily through a process of resource dilution; as families grow, a finite amount of parental resources (both economic and interpersonal) are diluted so that each individual child receives less from their parents (Downey, 1995, 2001; Lawson & Mace, 2009). There is evidence to suggest that sensitive older siblings can compensate for this effect. In a recent study, children from large sibships were at risk for poor receptive vocabulary development when they had siblings with low levels of sensitivity. This effect was not observed in children whose siblings were high in sensitivity (Prime, Pauker, Plamondon, Perlman, & Jenkins, 2014). We would expect a similar pattern in ToM development, given the significant behavioural overlap between ToM and other measures of cognitive development, including language (Wade, Browne, Plamondon, Daniel & Jenkins, 2015). That is, children with more siblings may be at risk for poor development of ToM, by way of diluted parental resources, if they do not have older siblings who themselves engage in ToM-promoting (i.e., sensitive) behaviours. Older siblings, in particular, are better able to respond sensitively to their preschool sibling’s inferred mental states than younger siblings. This is likely related to their older age and, thus, heightened skill-set (Prime, Perlman et al., 2014), and/or the power differential inherent to sibling dyads (Perlman, Siddiqui, Ram, & Ross, 2000). Thus, we were interested in looking at older, as opposed to younger, siblings’ cognitive sensitivity as a potential moderating factor.

3.3 Current study

The current study utilized a longitudinal design to investigate older sibling cognitive sensitivity as a moderator of the relationship between sibship size and preschool children’s ToM development. Previous studies on siblings and theory of mind have been primarily cross-sectional (with some exceptions; McAlister & Peterson, 2007, 2013). A longitudinal design was used to allow for the direction of effect between predictors and the outcome to be disambiguated. This facilitates a stronger conclusion about causality than is possible using a cross-sectional design. It was hypothesized that coming from a larger sibship (i.e., 3+ children) would be associated with lower ToM. However, we expected that this would be qualified by an interaction
between sibship size and older sibling cognitive sensitivity; children from larger sibships will show enhanced ToM when they have older siblings with high versus low levels of cognitive sensitivity. That is, siblings with high levels of cognitive sensitivity will play a compensatory role in large sibships.

A number of further considerations informed the study design. First, past studies exploring sibship size and ToM have exclusively compared only children to varying sibship sizes. Given that the large majority of individuals grow up with one or more siblings, and that our question related to sibling interactions, the current study explored the phenomenon in children that had at least one older sibling. Thus, we compared children from 2-child families (“small sibships”) to those from families with 3+ children (“large sibships”). Second, we only observed interactions between target children and their next in age older siblings, as opposed to all older siblings in the home, to reduce burden on families. The next in age older sibling was chosen as a way to standardize across small and large sibships (i.e., children from small sibships only have a next in age older sibling). Third, in defining sibship size, we sought to capture the parental resource dilution process that has been documented with increasing family size (Lawson & Mace, 2009). To do this, we included all children in the home less than 18 years old to index all sources of potential resource dilution. This is in line with the majority of previous studies examining the relationship between sibship size and cognitive, linguistic and/or ToM outcomes (e.g., Harrison & McLeod, 2010; Tompkins et al., 2013; Wright & Mahfoud, 2012). Supplemental analyses were conducted controlling for the number of child-aged siblings (i.e., 12 months to 12 years), as some studies have found this to be an important indicator in the relationship between sibship size and children’s ToM (Cassidy et al., 2005; McAlister & Peterson, 2007; Peterson, 2000).

Data from two home visits were used in the current study. Specifically, in the first visit, we videotaped 385 preschool children interacting with their next in age older siblings during a collaboration task and subsequently coded the interactions for the level of cognitive sensitivity displayed by the older siblings. Additionally, children were directly assessed on a previously validated assessment of ToM (Wellman & Liu, 2004) at both home visits. Standard regression analyses were used to explore the associations of sibship size and sibling cognitive sensitivity to later ToM, controlling for earlier levels of ToM.
A number of additional measures were obtained during the home visits and were included in the analysis as covariates for theoretical and methodological reasons. First, we controlled for socioeconomic status as this has been shown to be associated with ToM (Cutting & Dunn, 1999). Child gender was included, as females have been previously documented as outperforming males on ToM (Charman, Ruffman, & Clements, 2002; Cutting & Dunn, 1999). Further, families varied in the age spacing of target children to their next in age older siblings, as well as the age spread of the entire sibship, and thus sibling age-related factors were included to standardize across diverse family structures. Maternal sensitivity to children’s internal states has previously been linked to children’s ToM (Meins et al., 2002). A measure of maternal sensitivity, based on videotaped observations of mother-child interactions, was included to allow us to isolate the relationship between sibling behavior and children’s ToM. Further, given that children’s development of language and ToM are intricately connected (Astington & Baird, 2005), we included a measure of children’s language skills (i.e., receptive vocabulary) and controlled for the ethnic diversity in the sample. Finally, we controlled for older sibling ToM scores so that we could isolate the effect of older sibling behaviour from that associated with older sibling ToM. Inclusion of these covariates allowed us to draw conclusions about the specific processes occurring between siblings and their relationship to theory of mind.

3.4 Methods

3.4.1 Original Sample

The sample used in the current study is a subset of the Kids, Families, and Places (KFP) study, which is a longitudinal birth cohort study examining biological and social influences on early socio-emotional development using a within-family design. Recruitment occurred through the Healthy Babies Healthy Children program (Toronto and Hamilton Public Health), which contacts the parents of all newborn babies within days of the newborn’s birth. Inclusion criteria included families having a newborn singleton (termed ‘target child’) > 1500 grams, with an older sibling within four years of the newborn (termed ‘next in age older sibling’). Additional criteria included English-speaking mothers who agreed to be videotaped. Five-hundred and one families were enlisted into the KFP study (reasons for non-enlistment included inability to contact families, families not meeting criteria and refusals). Children were approximately 2 months old.
at Wave 1 and these families were followed up at ages 18 months, 3 years and 4.5 years. All data were collected during home visits. Observational data and direct testing were carried out on the target child and the next in age older sibling at all waves. The KFP sample was similar to the general population of Toronto and Hamilton in terms of number of persons in the household and personal income, but had a lower proportion of non-intact families, fewer immigrants and more educated mothers (Meunier, Boyle, O'Connor, & Jenkins, 2013).

3.4.2 Current Sample

Data came from the third and fourth waves of the larger study. Attrition from the first to third wave was 23.2%. Dropout was significantly related to indices of social disadvantage, which is typical for longitudinal studies (Stouthamer-Loeber & Van Kammen, 1995): lower income/assets, $t(470) = -2.69$, $p < 0.001$, lower maternal education, $t(498) = -2.88$, $p < 0.05$, younger maternal age of first pregnancy, $t(494) = -3.89$, $p < 0.001$, and ethnicity, $\chi^2 (1) = 7.27$, $p < 0.05$. These variables were included in the data analysis as covariates or auxiliary variables. Henceforth, the third and fourth wave will be referred to as Time 1 and Time 2, respectively, for the purposes of the current study. Data included demographic questionnaire measures from mothers, child testing of receptive vocabulary and theory of mind, and videos of mother-child and sibling interactions during the home visit. The full sample at Time 1 consisted of 385 children and their next in age older siblings. Of the participating families, 60.8% had two children living in the home; the remainder had three or more children in the home. For the purposes of this study, sibship size (i.e., the number of children aged 0<18 in the household) was recoded as a dummy variable with small sibships as the reference category (0=2 children in the home; 1 = 3+ children). The mean age of target children was 3.15 years ($SD = 0.27$; range = 2.5-4.5) and 51.7 % were male. The mean age of their next in age older siblings was 5.57 years ($SD = 0.77$; range = 4.0-7.67) and 51.2 % were male. The mean age gap was 2.42 years ($SD = .072$; range = 0.83 – 4.17). Children were on average 1.65 years older at Time 2. The sample was diverse; 57.1% of mothers were European, 13.0% were East / South East Asian, 14.0% were South Asian, and 7.0% were Black (8.8% were classified as ‘Other’). Families reported their income based on predetermined ranges; the mean family income was in the range of $65,000 - $74,999. Mothers had a mean of 15.53 years ($SD = 2.46$) of education.
3.4.3 Measures

**Older sibling cognitive sensitivity (T1).** Sibling pairs were filmed engaging in a cooperative building task (Aguilar, O'Brien, August, Aoun, & Hektner, 2001). Dyads were instructed to sit on a yoga mat and use Duplo building blocks to replicate a design presented in a picture in five minutes. Each sibling was only allowed to touch two of the four colours of Duplo blocks to ensure collaboration for completion. If children finished the design before the end of five minutes, they were given a second model to replicate. All children were stopped after five minutes, regardless of completion.

Videotapes of sibling interactions were coded using a measure of cognitive sensitivity, defined as the three inter-linked capacities of mind-reading, mutuality, and communicative clarity (Prime, Perlman et al., 2014). Individuals who score higher on the scale are considered to be more adept at providing cognitively-attuned input to their partners; that is, picking up on the cues of the child and adjusting their own verbal and nonverbal behavior to accommodate the child’s cognitive needs. In addition to this cognitive attunement, individuals who score high on the scale demonstrate a positively valenced interaction style. An emphasis was placed on both the affective quality and cognitive attunement of partners’ behaviours, as such qualities promote cooperative interactions that facilitate socio-cognitive growth (Carpendale & Lewis, 2004).

Coders watched the 5-minute film clip in its entirety and then rated the older sibling on a 5-point likert scale, ranging from ‘Not at all true’ (1) to ‘Very true’ (5) on eleven cognitive sensitivity statements. Items started with ‘This person is…’ and examples included: sensitive to what his/her partner knows and/or understands; good at rephrasing what his/her partner does not understand; gives positive feedback to reinforce his/her partner; clear in his/her requests for help (a full list is available from Prime, Perlman et al., 2014). The mean was taken across items and internal consistency of the composite was $\alpha = 0.89$ (item–total correlations ranged from 0.43 to 0.79). The cognitive sensitivity scale has been previously demonstrated to have good convergent validity (Prime, Perlman et al., 2014). The coding approach presented in the current paper provides comparable psychometric properties to a more time intensive observational coding method while reducing resources (Ambady, 2010; Prime, Perlman et al., 2014).

An expert coder (first author) trained two coders to criterion with the expert ($\alpha > 0.80$), at which point they coded all remaining videos independently. Inter-rater reliability with the expert
coder was checked regularly to prevent coder drift. Inter-rater reliability was tested using Cronbach’s alpha (Cronbach, Rajaratman, & Gleser, 1963), with a final estimate (based on 10% overlap in videotapes independently coded) of $\alpha = 0.72$. All coders were blind to the hypotheses of the study.

**Child and older sibling theory of mind.** At Time 1, target children’s and older siblings’ ToM scores were included in the model as covariates. At Time 2, target children’s ToM was used as the dependent variable. The scale described by Wellman and Liu (2004) was used to measure ToM. This scale presents a series of ToM tasks ordered in terms of difficulty: diverse desires and beliefs, knowledge access, contents false-belief, explicit false belief, belief-based emotion, and real-apparent emotion. For all ToM tasks, stories were enacted for children with the use of toy figures and picture cards. For the diverse desires task, children answered a target question that required them to distinguish between their own desires (e.g., cookies) and that of a toy doll (e.g., carrots). On the belief-based emotion task, children answered a target question that required them to understand that a toy doll's emotions stem from their beliefs; that is, that the toy will be happy when they get their favourite snack (i.e., a box of cereal) and sad when they see that it's not really cereal (i.e., a cereal box full of rocks). For descriptions of other items, see Wellman and Liu (2004). For each of the tasks, the child was given a score of 0 (fail) or 1 (pass). Testing was discontinued and final scores were calculated once children failed two consecutive tasks, based on the Guttman scaling analysis presented by Wellman & Liu (2004) for the ToM measure used in the current study. A mean was taken across tasks at each of Time 1 and Time 2 for target children, and at Time 1 for next in age older siblings. To carefully control for children’s age in the calculation of their ToM scores at each time point, the mean ToM score was regressed on age and the standardized residuals were saved and used as the final ToM score.$^1$

Internal consistency of the scales was good ($\alpha = 0.76$ for target children and $\alpha = 0.80$ for next in age older siblings). The original scale was developed with children ranging from 2 years 11 months to 6 years 6 months (Wellman & Liu, 2004). Given that a small group of children in

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$^1$ Analyses were conducted both with the age-residualized ToM scores as well as with the raw ToM scores (with and without age as a covariate). Results went unchanged and the age-residualized scores were used for the final analysis.
our sample (approximately 10%) fell outside of this age range at their point of ToM measurement, additional analyses were conducted to demonstrate the validity of the scales in our sample’s age range (available from authors upon request).

**Additional covariates.** In addition to target children’s and older siblings’ ToM at Time 1, a number of other covariates were included in the regression model. Demographic covariates included dyad age gap (age of next in age older sibling – age of target child), and sibship age spread (standard deviation of age across all siblings in the home). Child gender was entered as a dummy variable with girls as the reference category (girls=0, boys=1). Income/assets were examined through questions regarding family assets and annual household income (items were standardized and a mean was computed). Dummy variables were created for mother-reported ethnicity: European, Black, South Asian, East / South East Asian, and Other.\(^2\) Child receptive vocabulary (Time 2) was measured using the Peabody Picture Vocabulary Test, which yields a standardized summary score (Dunn & Dunn, 1997). Maternal sensitivity (Time 1) was measured through mother-child interactions during the home visit using two observational tasks: free-play and cooperative building (same as described above for siblings). Interactions were coded for maternal sensitivity (e.g., awareness of child’s needs, sensitivity to child’s signals, autonomy support), positive control (i.e., use of open-ended questions, explanations and praise) and mother-child mutuality (e.g., affect sharing, reciprocity in conversation, joint engagement) using the Coding of Attachment-Related Parenting (Matias, Scott, & O’Connor, 2006) and Parent-Child Interaction System (Deater-Deckard, Pylas, & Petrill, 1997). All scales were coded on a 7-point-scale and a mean of the three scales across the two tasks was computed (internal consistency \(\alpha = 0.79\)). Coders were trained similarly to that described above for older sibling cognitive sensitivity. Notably, coders were different than those who rated cognitive sensitivity. Inter-rater reliability was similarly assessed and the final estimate was \(\alpha = 0.90\).\(^3\)

\(^2\) Analyses were also conducted with maternal education as an additional demographic covariate. The pattern of results remained unchanged.

\(^3\) Analyses were also conducted substituting maternal cognitive sensitivity (Prime et al., 2015) for maternal sensitivity. Both child-specific and family average measures of maternal cognitive sensitivity were tested. The pattern of results remained unchanged.
3.4.4 Data Analysis

**Missing data.** Demographic variables, maternal sensitivity and children’s receptive vocabulary had minimal missing data (<5%). Children’s ToM and sibling cognitive sensitivity and ToM were also low (<15 %). Excluding cases with missing data from the analyses can reduce the statistical power and bias the estimates of parameters (Allison, 2003). Full Information Maximum Likelihood Estimation (FIML), which estimates model parameters and standard errors using all available information, was utilized for handling missing data. FIML estimates yield superior performance to traditional ad hoc methods in regression analyses (i.e., listwise deletion, pairwise deletion, and multiple imputation), both in terms of bias and efficiency (Enders & Bandalos, 2001). Auxiliary variables that were correlated with variables in our analysis model and with variables that predicted attrition were included in our FIML to yield more accurate and stable estimates (Acock, 2005; Collins, Schafer, & Kam, 2001; Graham, 2003).

**Procedure.** Multiple regression analyses were conducted using Mplus 7.0 (Muthén & Muthén, 2012) to examine the relationship between sibship size and sibling cognitive sensitivity in the prediction of children’s ToM at Time 2, controlling for ToM at Time 1. Covariates, predictor variables, and the interaction of interest were included in the analysis model. Prior to conducting the analyses, continuous variables were centered to reduce multicollinearity and allow for testing of simple slopes (Aiken & West, 1991; Holmbeck, 2002). Interaction terms were computed using the centered variables.

3.5 Results

Table 2 presents descriptive statistics for non-demographic covariates (demographics are described in the methods section), older sibling cognitive sensitivity, and child ToM at Time 1 and Time 2, as well as the bivariate correlations between these variables. Associations were in the small to medium range, in the expected directions. An examination of the bivariate relationships between main study variables indicates that children’s later ToM was higher when their siblings demonstrated higher levels of cognitive sensitivity and was not significantly related to the size of the sibship ($r = -0.05, ns$).
Table 2

Descriptive statistics and bivariate correlations for study variables and selected covariates

<table>
<thead>
<tr>
<th>Variable (scale)</th>
<th>2.</th>
<th>3.</th>
<th>4.</th>
<th>5.</th>
<th>6.</th>
<th>n</th>
<th>Mean (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Child ToM T1 (0-7)</td>
<td>.18*</td>
<td>.02</td>
<td>.15**</td>
<td>.26**</td>
<td>.12*</td>
<td>356</td>
<td>1.39 (0.90)</td>
</tr>
<tr>
<td>2. Child ToM T2 (0-7)</td>
<td>.22**</td>
<td>.23**</td>
<td>.35**</td>
<td>.15†</td>
<td></td>
<td>268</td>
<td>3.62 (1.53)</td>
</tr>
<tr>
<td>3. Sibling ToM T1 (0-7)</td>
<td></td>
<td>.19**</td>
<td>.23**</td>
<td>.21**</td>
<td></td>
<td>335</td>
<td>4.44 (1.93)</td>
</tr>
<tr>
<td>4. Maternal sensitivity T1 (0-7)</td>
<td></td>
<td>.35**</td>
<td>.28**</td>
<td></td>
<td></td>
<td>369</td>
<td>4.11 (0.82)</td>
</tr>
<tr>
<td>5. Child vocabulary T2 (SS)</td>
<td></td>
<td></td>
<td></td>
<td>.11†</td>
<td></td>
<td>278</td>
<td>103.91 (13.65)</td>
</tr>
<tr>
<td>6. Sibling CS T1 (0-5)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>349</td>
<td>2.73 (0.71)</td>
</tr>
</tbody>
</table>

Note: n = Number of participants with valid scores; SS = Standardized Score; T1 = Time 1; T2 = Time 2; CS = Cognitive sensitivity; ** p < 0.01; * p < 0.05; † p < 0.10.

Table 3 presents the results of the regression analyses in the prediction of later ToM. The overall regression, including covariates, predictors and the interaction term, was statistically significant, $R^2 = 0.240$, $p < 0.001$. Children’s Time 2 ToM scores could be predicted from this set of variables, with approximately 24.0% of the variance in ToM scores accounted for by the regression. Neither sibship size nor sibling cognitive sensitivity were significantly related to children’s ToM as independent predictors, after controlling for covariates, but the hypothesized interaction was significant, $\beta = 0.157$, $p < 0.05$. The majority of the variance was accounted for by model covariates, with 3.4% of the variance attributable to the main predictors (sibship size and sibling cognitive sensitivity) and their interaction. Specifically, being a girl, a smaller age gap between the target child and older sibling, and higher concurrent receptive vocabulary were significantly predictive of higher ToM scores. Higher levels of maternal sensitivity, and Time 1 child and sibling ToM were marginally significant predictors of children’s later ToM scores.\(^4\)

Supplementary analyses were conducted controlling for child-age siblings (i.e., number of siblings in the home aged 12 months to 12 years), as some previous studies have found this to be

\(^4\) Across Studies 1-3, the presence of a curvilinear effect of sibship size on the outcome was investigated by entering a quadratic term into the regression. In all studies, the inclusion of the quadratic term did not change the pattern of the hypothesized interaction.
an important indicator in the relationship between sibship size and children’s ToM. This variable was not a significant predictor of children’s ToM and its inclusion did not affect the pattern of results (results not presented).

Table 3

Summary of regression analysis examining the role of sibship size and older sibling sensitivity in predicting Theory of Mind

<table>
<thead>
<tr>
<th>Child ToM (T2)</th>
<th>b</th>
<th>S.E.</th>
<th>β</th>
</tr>
</thead>
<tbody>
<tr>
<td>Covariates</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ethnicity 'South Asian'</td>
<td>0.051</td>
<td>0.184</td>
<td>0.051</td>
</tr>
<tr>
<td>Ethnicity 'Black'</td>
<td>-0.126</td>
<td>0.279</td>
<td>-0.125</td>
</tr>
<tr>
<td>Ethnicity 'East / SE Asian'</td>
<td>-0.213</td>
<td>0.171</td>
<td>-0.211</td>
</tr>
<tr>
<td>Ethnicity 'Other'</td>
<td>-0.091</td>
<td>0.201</td>
<td>-0.089</td>
</tr>
<tr>
<td>Income/Assets</td>
<td>-0.058</td>
<td>0.082</td>
<td>-0.046</td>
</tr>
<tr>
<td>Maternal sensitivity (T1)</td>
<td>0.148</td>
<td>0.080</td>
<td>0.119 †</td>
</tr>
<tr>
<td>Sibship age spread (SD)</td>
<td>0.083</td>
<td>0.084</td>
<td>0.086</td>
</tr>
<tr>
<td>Dyad age gap</td>
<td>-0.227</td>
<td>0.098</td>
<td>-0.162 *</td>
</tr>
<tr>
<td>Older sibling ToM (T1)</td>
<td>0.116</td>
<td>0.062</td>
<td>0.114 †</td>
</tr>
<tr>
<td>Child gender (boys)</td>
<td>-0.300</td>
<td>0.111</td>
<td>-0.296 **</td>
</tr>
<tr>
<td>Child vocabulary (T2)</td>
<td>0.017</td>
<td>0.005</td>
<td>0.232 **</td>
</tr>
<tr>
<td>Child ToM (T1)</td>
<td>0.106</td>
<td>0.062</td>
<td>0.105 †</td>
</tr>
<tr>
<td>Predictors</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Large sibship</td>
<td>-0.197</td>
<td>0.158</td>
<td>-0.157</td>
</tr>
<tr>
<td>Older cognitive sensitivity (T1)</td>
<td>0.011</td>
<td>0.109</td>
<td>0.008</td>
</tr>
<tr>
<td>Interaction</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sibsize * cognitive sensitivity</td>
<td>0.344</td>
<td>0.170</td>
<td>0.157 *</td>
</tr>
</tbody>
</table>

* Reference group for all ethnicity variables was European;
† Reference group was girls;
** p < 0.01, * p < 0.05, † p < 0.10.

To probe the nature of the significant interaction, we plotted the association between sibship size (small vs. large) and children’s later ToM scores as a function of sibling cognitive sensitivity scores. For sibling cognitive sensitivity, this was done at one standard deviation above and below the mean following normal practice for plotting continuous variables (Holmbeck, 2002). Figure 1 shows that sibship size is more strongly associated with ToM when siblings show low levels of cognitive sensitivity. Testing of simple slopes revealed that the association between sibship size and ToM was significant at low levels of cognitive sensitivity, $\beta = -0.430, p < .05$, but not at high
levels of sibling cognitive sensitivity, $\beta = 0.046, ns$. Thus, coming from a large sibship is associated with poor ToM development in the absence of cognitively sensitive siblings.

**Figure 1**

Children’s theory of mind as a function of sibship size and older sibling cognitive sensitivity

![Graph showing the relationship between sibship size and children's ToM](image)

*Note:* Regression lines for relations between sibship size and children’s ToM as moderated by sibling cognitive sensitivity (one standard deviation above and below the mean). Slope of low cognitive sensitivity line is significant, $\beta = -0.430, p < 0.05$, high cognitive sensitivity line is not $\beta = 0.046, ns$.

### 3.6 Discussion

The relationship between sibship size and ToM development in preschool children has been found to be inconsistent, suggesting the presence of a moderator. This study tested the hypothesis that this association is moderated by the processes occurring within sibling dyads, specifically, older siblings’ cognitive sensitivity. Sibship size, alone, did not predict children’s ToM. However, a small but significant portion of variance was accounted for by the interaction between sibship size and older sibling cognitive sensitivity. The relationship between sibship size and children’s ToM abilities was dependent on the older siblings’ cognitive sensitivity.
Children from larger sibships showed poorer ToM than those from smaller sibships, but only if their older siblings demonstrated low levels of cognitive sensitivity. The largest portion of variance accounted for in children’s ToM scores came from our covariates, speaking to the social and developmental processes that have been previously linked to children’s ToM development. By using a longitudinal design wherein we controlled for earlier levels of ToM, the results suggest that earlier sibling processes contribute to the development of ToM when children are in large sibships. As the study is observational rather than experimental, such a finding is, of course, only suggestive. To our knowledge, this is the first study to longitudinally examine sibling interaction quality as a moderator of the relationship between sibship size and ToM.

The differential effect of sibship size on ToM indicates that it is not the mere exposure to more interactions that is important for promoting ToM (Jenkins & Astington, 1996; Perner, Ruffman, & Leekam, 1994). Rather, these findings support the notion of a social constructivist explanation wherein older siblings scaffold younger into learning about others’ mental states (Lewis et al., 1996). This adds to previous literature demonstrating the importance of partner attunement to children’s cognitive states in the facilitation of their socio-cognitive abilities. Children’s integration of self-other perspective differences has been described as the process through which children’s interpersonal experiences foster their understanding of minds (Fernyhough, 2008; Moore, 2006; Tomasello, Carpenter, Call, Behne, & Moll, 2005). Responsiveness to children’s needs and abilities and provision of input that is cognitively appropriate allows for children to more readily internalize their social interactions. For instance, mothers’ mind-mindedness (i.e., their abilities to read and understand the internal states of their children) has been shown to be an important contributor to social understanding in both infants and children (Laranjo et al., 2010; Meins et al., 2003; Meins et al., 2002). Another example is parental mental state talk, which refers to how much and in what ways parents and siblings talk about the mind to children (Jenkins et al., 2003). Parents adjust children’s exposure to mental state talk in a developmentally-appropriate fashion and this scaffolding process facilitates children’s understanding of the mind and emotions (Taumoepeau & Ruffman, 2006, 2008). Although sibling behaviour (i.e., reference to mental states, pretend play) has been related to ToM in the past, this is the first study to demonstrate that older siblings’ cognitive sensitivity can positively influence children’s ToM development.
Notably, siblings’ cognitive sensitivity was only important when children came from large sibships. One way to understand these findings is through the lens of a resource dilution model. There is evidence that parent-child interactions suffer as the size of a sibship increases. For example, using a multilevel longitudinal design, Lawson and Mace (2009) found that, as sibship size increases, a cost is incurred to the quality of care provided to each individual child in social (i.e., playing, cuddling), caregiving (i.e., feeding, bathing) and cognitive (i.e., reading) domains. This dilution of resources has been proposed as the mechanism through which children from large sibships are disadvantaged in terms of cognitive, academic, and intellectual measures (Downey, 1995, 2001). It may be, then, that children from larger sibships are receiving less of the necessary parental scaffolding that is instrumental in the development of ToM. There does not appear to be a detrimental effect of sibship size on children’s theory of mind when older siblings are able to identify their younger siblings’ needs, respond to their cues and provide cognitively-attuned input during social interactions. In this way, older siblings may be playing a compensatory role for children in large sibships.Sibling cognitive sensitivity is not related to children’s ToM in small sibships.

Importantly, the current study’s sample was socioeconomically and ethnically diverse. Previous studies demonstrating a sibling advantage have primarily used samples made up of middle/upper income families. The current findings are in line with previous studies using socioeconomically diverse samples that did not demonstrate a sibling advantage (Hughes & Ensor, 2005; Tompkins et al., 2013). It may be that there is greater variability in the quality of sibling interactions in socioeconomically diverse samples. For example, in less educated families there is less talk about beliefs than in higher educated families (Degotardi & Torr, 2007), suggesting that the types of interactions involving siblings may vary between these families. In the current study, sibship size alone was not predictive of children’s ToM, owing to the range in quality of interactions found in our sample.

Further, the current study differed from previous studies in that all children in the sample had at least one older sibling. There is evidence that the largest contribution of the “sibling advantage” lies in the shift from only children to those with at least one sibling (Peterson, 2000). As such, the current sample might be considered advantaged, in that all children had at least one sibling. Having 2 or more siblings in the current sample, however, was related to lower ToM scores for those children with less sensitive siblings. It may be that it is most beneficial to have
one sibling, at which point a threshold is reached (Downey & Condron, 2004). At this point, the (dis)advantage of additional siblings may depend more on the quality of interactions occurring (e.g., older sibling sensitivity). We could not test this in the current study, as we did not have any only children for this analysis.

3.6.1 Limitations and Future Directions

The current findings should be considered in light of limitations. First, to reduce burden on families we only collected observational data on the next in age older sibling. In future work, it would be valuable to examine the cognitive sensitivity of all children in the home. This would allow for an understanding of different sibling processes: the effect of mean levels of sibship cognitive sensitivity as well as the role of different dyads varying on characteristics such as age gap. Second, as discussed, our participants all had at least one sibling so our sibship size variable pertained to one versus more than one sibling. Given that this strays from previous designs in the literature (e.g., Jenkins & Astington, 1996; Perner et al., 1994; Peterson, 2000), we are not able to directly compare the role of sibship size across studies. Finally, it should be noted that although the hypothesized interaction of sibling cognitive sensitivity and sibship size was significant, it only explained a small amount of the variance in children’s ToM. As others have described, a large number of genetic and environmental processes, as well as their interaction, contribute to complex human skills (Blair & Raver, 2012; Cicchetti & Rogosch, 1996).

Together with the growing literature demonstrating the protective role of positive sibling relationships (Conger, Stocker, & McGuire, 2009; Gass, Jenkins, & Dunn 2007), this study highlights the potential role of intervention studies targeting the sibling relationship. Specifically, family-based interventions designed for vulnerable children may include interactive elements of the sibling relationship as a target for change. To date, interventions for siblings have been utilized to target affective behaviour (e.g., relationship quality; Feinberg, Sakuma, Hostetler, & McHale, 2013; Kennedy & Kramer, 2008) and conflict resolution skills (Siddiqui & Ross, 2004). However, there have not been reported interventions designed to engage siblings in behaviour that may enhance one another’s cognitive abilities. This will be an important area for future investigation.

The present findings highlight the need to explore both process-based and structural components of sibships in order to gain an understanding of the dynamics within the home and,
thus, the impact on individual children. It is evident that mere sibship size is not explanatory of children’s development of ToM but rather how this interacts with the quality of siblings’ behavior. Continued investigation into the processes by which siblings confer advantage or disadvantage to one another’s ToM is important to our understanding of environmental contributions to children’s socio-cognitive development.
3.7 References


Chapter 4
Study 3: Birth order and children’s cooperative abilities: A within-family analysis

4.1 Abstract

There is evidence for a laterborn sibling advantage in some social skills, though this has not been investigated in children’s early capacities for cooperative interactions. Using a within-family design, the current study compared firstborn and laterborn siblings on their cooperative abilities when they were each around 3-years-old. Further, the study investigated whether the association between children’s birth order and cooperative abilities was dependent on the prosocial behaviour of other siblings in the home. The sample included 288 ethnically and sociodemographically diverse children clustered within 144 families. Cooperation was directly assessed using a problem-solving paradigm requiring two simultaneous and complementary actions of the child and adult tester to achieve a joint goal. Parents reported on the prosocial behavior of up to four siblings in the home. Results of a multilevel analysis indicated that laterborn children were more advanced in their cooperative abilities, particularly when their siblings showed higher levels of prosocial behavior. The analysis accounted for a number of potential family-wide confounds, providing evidence that this is a child-specific effect related to birth order. Findings are discussed from a social constructivist perspective with an emphasis on the sibling relationship as a context for cooperative interactions that facilitate socio-cognitive development.
4.2 Background

It has been argued that cooperation, marked by collaboration in the pursuit of shared goals, represents a species-specific skill in humans (Tomasello, 2009). Tomasello and Hamann (2012) describe a two-step process of cooperative development that unfolds from birth to approximately age four. By around 2-years-old, children have developed the capacity to form joint goals and joint attention, as well as the accompanying roles and perspectives involved in coordinated activity (Carpenter, Tomasello, & Striano, 2005; Warneken, Chen & Tomasello, 2006). Over the third year of life, more sophisticated forms of collaboration are achieved as children come to represent and integrate their partner’s roles and perspectives with that of their own (Fletcher, Warneken & Tomasello, 2012). Cooperative problem solving, marked by the integration of problem-solving and cooperative skills, is a subset of cooperative activities that develop between the ages of 2 and 4 years (Ashley & Tomasello, 1998; Brownell & Carriger, 1990).

In addition to age-related changes in children’s capacities for cooperation, there is also inter-individual variation as a function of temperamental disposition and social understanding (Brownell, Ramani, & Zerwas, 2006; Endedijk, Cillessen, Cox, Bekkering, & Hunnius, 2015). Another source of inter-individual variation is children’s social environments. It has been suggested that children’s cognitive, moral and social knowledge is constructed in the context of their social interactions. Across childhood, children build their social understanding through engaging in triadic interactions between the self, another and objects in the world (Carpendale & Lewis, 2004; Moore, 2006). Research on the socio-contextual sources of inter-individual variation in cooperation has been scarce, focusing primarily on the contribution of parents and peers (Kochanska, Aksan, & Carlson, 2005; Schuhmacher & Kärnert, 2015). The need for further investigation of sibling influences on socio-cognitive skills such as cooperation has been highlighted (Howe, 2004).

Growing research points to sibling relationships as a key platform from which children build their interpersonal and social skills. Through both reciprocal (e.g., play, conflict) and complementary (e.g., teaching, caregiving) interactions, siblings provide one another with opportunities to learn about appropriate and effective ways to interact with the world (Howe, Ross, & Recchia, 2011). Indeed, children who grow up with siblings tend to be more adept in social situations. For example, using the Avon Longitudinal Study of Parents and Children,
Lawson and Mace (2010) demonstrated that having siblings was related to a reduction in peer problems across early to middle childhood. Similarly, when teachers were asked to rate children on their social and interpersonal skills, kindergarteners with one or two siblings fared better than those with no siblings (Downey & Condron, 2004). These findings suggest that children learn how to navigate social relationships, in part, through their exposure to interactions involving their siblings.

Laterborn children, in particular, appear to be advantaged socially. For example, laterborn siblings when compared to only children are more accepted by peers (Kitzmann, Cohen, & Lockwood, 2002). Other studies comparing firstborns and laterborns demonstrate that laterborn children have enhanced conversational skills (Hoff-Ginsberg, 1998; Oshima-Takane, Goodz, & Derevensky, 1996). Birth order effects are present in adults, too, with laterborn adult children demonstrating higher levels of reciprocity during an anonymous investment game than firstborns (Courtiol, Raymond, & Faurie, 2009). Thus, there is some evidence that being a laterborn child is particularly advantageous to children’s social development.

These birth order effects, however, are modest and inconsistent. Though some studies demonstrate a benefit of being a laterborn child, others do not show differential benefits of having older versus younger siblings (Downey & Condron, 2004; Lawson & Mace, 2010). One reason for these inconsistent findings may be that previous studies investigating birth order have not considered the social climate of the sibship within which children are developing. Notably, it has been argued that cooperative or equal interactions, as opposed to hierarchical, facilitate development. That is, it is not the mere exposure to social interactions that broadens a child’s knowledge about the social world, but rather their participation in mutually-reinforcing interactions (Carpendale & Lewis, 2004). This has been supported by studies demonstrating that the quality of interactions between siblings, rather than the number of siblings, is important to children’s social and cognitive development (Hughes, Fujisawa, Ensor, Lecce, & Marfleet, 2006; Prime, Pauker, Plamondon, Perlman & Jenkins, 2014). It follows, then, that laterborn children may not benefit merely by having one or more older siblings. Rather, we must consider the qualities of the older siblings that may lend themselves to mutually-reinforcing sibling interactions.
One such quality is the prosocial or other-oriented behavior of siblings. Siblings who themselves are more responsive and warm in their approach to social interactions are likely to provide a social climate for children that facilitates a broadening of their social understanding. Indeed, individual differences in the cooperative interactions between siblings have been previously linked to measures of social understanding such as use of mental state talk and false belief understanding (Brown, Donelan-McCall, & Dunn, 1996; Hughes et al., 2006). Further, children with sensitive older siblings living in low resource family settings have been found to show better language than children without such sibling support (Prime, Pauker et al., 2014). Thus, sibling interactional quality, and in particular sibling prosocial behavior, may influence the extent to which laterborn children are advantaged in their social development.

The aim of the current study was to assess sibling factors as potential sources of inter-individual variation in preschool children’s capacities for cooperative interactions. Using a problem-solving paradigm adapted from Ashley and Tomasello (1998), children were directly assessed on their ability to coordinate their behaviour with that of an adult tester to achieve a joint goal. The task required two simultaneous and complementary actions of the adult tester and child to obtain a toy from a box. We were interested in how children’s abilities to coordinate the complementary roles in the joint task, as measured by their success on the cooperation task, varied as a function of their birth order status (i.e., firstborn versus laterborn). Further, our aim was to investigate how sibling prosocial behavior influenced the strength of the relationship between birth order and children’s capacity for cooperative activities.

A number of further considerations influenced the design of the current study. The majority of studies exploring birth order effects have utilized between-family designs (i.e., comparing individual children from different families). There is an inherent risk to between-family designs that observed associations between variables of interest are occurring spuriously as a result of some unmeasured family-level factor (Wichman, Rodgers, & MacCallum, 2006). The result is that family-wide effects can be misattributed as birth order effects. For example, birth order may be an indirect measure of family-level functioning (e.g., socioeconomic status, maternal health, and so on; Rodgers, Cleveland, van den Oord, and Rowe, 2000) rather than a measure specific to an individual child within a family. To address this, one can include multiple children per family (i.e., a within-family design). This controls for family-wide factors, measured or not, enhancing the ability to draw conclusions about child-specific effects (Lahey & D’Onofrio, 2010). Notably,
Rodgers and colleagues (2000) found that within-family studies on birth order and intelligence yielded strikingly different results from between-family designs (i.e., the former found no effect of birth order). The current study used a within-family design to ensure that effects attributed to birth order were not confounded by between-family influences.

Second, there is a strong maturational effect in the emergence of children’s cooperation wherein children learn to coordinate complementary behaviours with another between the ages of two and four years old (Ashley & Tomasello, 1998). Longitudinal within-family data can be used to obtain samples of siblings at fixed ages (i.e., an age-snapshot technique; Wichman et al., 2006). Such a technique allows one to carefully control age and model the remaining individual differences in children’s development. Further, it minimizes age-related confounds that threaten the validity of birth order findings (Wichman et al., 2006). Thus, in addition to using a within-family design to partition child-specific and family-wide influences, an age-snapshot technique was used to assess birth order differences during a period of rapid development.

4.3 Current study

The current study used a developmentally sensitive within-family design to assess birth order differences in preschool children’s cooperation. It was hypothesized that laterborn children (i.e., those with older siblings) would be advantaged in their ability to cooperate in a problem-solving context. Additionally, we expected that this would be qualified by an interaction between birth order and sibling prosocial behaviour; laterborn children will show enhanced cooperative abilities in homes with higher levels of sibling prosocial behaviour. That is, the benefit of being a laterborn child will be potentiated by the presence of prosocial siblings.

Covariates were included in the model to allow for conclusions about the specific processes involving birth order and sibling prosociality, independent of family context. We controlled for child age and gender, sibship size and maternal ethnicity to standardize across diverse family demographics. Further, we controlled for socioeconomic status due to its demonstrated influence on children’s cognitive and social-emotional development (Blair & Raver, 2012). Maternal sensitivity towards each child was also included as a covariate to control for potential period effects associated with using an age-snapshot technique (Wichman et al., 2006). Further, maternal behavior has previously been linked to children’s cooperation (Kochanska et al., 2005).
and, thus, its inclusion also helped us to isolate the relationship between sibling prosocial behavior and cooperation.

4.4 Methods

4.4.1 Original Sample

A subset of participants was taken from a longitudinal birth cohort study examining genetic and environmental influences on children’s socio-emotional development through the investigation of within-family differences. Recruitment occurred through the Healthy Babies Healthy Children program, run by Toronto and Hamilton Public Health, which contacts the parents of all newborn babies within days of the newborn’s birth. Inclusion criteria included families having a newborn singleton > 1500 grams (i.e., younger siblings), with an older child within four years of the newborn (i.e., next in age older siblings). Thus, all families had a minimum of two children. Additional criteria included English-speaking mothers who agreed to be videotaped. Five-hundred and one families were enlisted into the KFP study, with non-enlistment a result of an inability to contact families sent by public health, families not meeting criteria and refusals. Home visits took place at four time points: younger siblings were approximately 2 months old at Time 1 and families were followed up when they were 18-months (Time 2), 3-years (Time 3) and 4.5-years old (Time 4). Intensive data collection (i.e., observational data and direct testing) was carried out on younger and next in age older siblings at all waves. In addition, questionnaire data were collected on up to four children per family (the youngest of which were the ‘younger siblings’) at all waves.

4.4.2 Current Sample

The current study utilized a cross sectional, within-family design with younger and next in age older siblings as the ‘target children.’ To examine whether patterns of development were the same in children with and without an older sibling, holding age constant, we compared target children who were oldest children (termed ‘firstborn’) to children who were middle or youngest children (‘laterborn’) at around 3 years of age (Dunn & Plomin, 1986; Wichman et al., 2006). Inclusion criteria for the current subsample were that sibling pairs were assessed on cooperation at their respective measurement points and that they were within one year of age at their
respective measurement points. The resulting sample had 288 children clustered within 144 families with a mean age of 3.33 years (47.9 % male). The majority of children (64.2%) came from small sibships (i.e., 2 children in the home). Laterborn children made up the majority of the sample (63.9 %). The sample was diverse; 64.6% of mothers were European, 11.1% were East / South East Asian, 11.8% were South Asian, and 4.9% were Black (7.6% were classified as ‘other’). At Time 1, the mean family income was in the range of $65,000 - $74,999 and mothers had an average of 15.5 years of education.

4.4.3 Procedure

Measurement occurred at the 3-year measurement points for younger siblings (Time 3) and next in age older siblings (Time 2), respectively. Parents reported on the prosocial behaviour of up to four children in the home at both measurement points. Home adult interviewers, which we will refer to as “adult testers,” directly assessed cooperative abilities.

4.4.4 Measures

Cooperation. The cooperation task used in the current study was adapted from Ashley and Tomasello’s (1998) collaborative problem-solving task, in which children are asked to coordinate complementary roles with peers to solve an external problem. The current study utilized an adult tester rather than peers for the assessment of cooperation. By removing the peer component, we controlled the variability in partner behaviour to allow for a standardized assessment of children’s capacities for cooperative interactions. The task was further adapted because the apparatus needed to be small enough to transport to home visits.

A finger puppet was wrapped so that the child could not identify the object and was then placed in a transparent box. The box required two people operating it simultaneously to open it: one person needed to hold the levers down while the other person simultaneously opened the drawer. A coding system was applied that gave credit to children when they were able to coordinate their action in time with the experimenter’s complementary behaviour to achieve the joint goal. Children were not taught how to open the box. Thus, children were required to use independent problem-solving while also coordinating their behavior with that of the adult tester. Following a practice period to ensure that the child could carry out the separate actions of the task (i.e., hold the levers down simultaneously, pull the drawer) the tester dictated the goal by
saying, “This is a special box that needs both of us to open it. There’s a surprise inside so let’s try to see what is inside. You can touch the box whenever you like, but I am a robot and sometimes I am touching the box and sometimes I am not touching it. Watch me.” Next, the tester pulled on the drawer handle for 4 seconds and then bent their elbow so that their hand was off the drawer handle (holding this for an additional 4 seconds). At this point, the test trials began. Two trials were administered wherein the tester started with the most difficult level and, if the child did not succeed, regressed to easier levels (i.e., ‘medium,’ ‘easiest without instruction,’ and ‘easiest with instruction’). For the ‘difficult’ level, the tester pulled the handle of the drawer for 4 seconds on and off (for a maximum of 30 seconds), requiring the child to coordinate their action of pressing on the levers with the timing of the interviewer’s pulling of the drawer. In the ‘medium’ level, the tester pulled the drawer for 1 minute continuously. For the ‘easiest without instruction’ level, the tester turned the box around and manipulated the levers, requiring the child to pull the drawer. For the ‘easiest with instruction’ level, the tester explained to the child that they would press the levers and that the child needed to pull the drawer. Following completion of the first trial, the tester administered a second trial, starting at the next most difficult level (e.g., if a child successfully completed the ‘medium’ level on trial one, then the interviewer administered the ‘difficult’ level for the second trial). Assessments were videotaped and each trial was subsequently scored on a scale of 1 (successful on easiest with instruction) to 4 (successful on difficult) and a mean was taken across the two trials. Coders were trained to criterion with an expert coder, at which point they coded all remaining videos independently. Inter-rater reliability with the expert coder was checked regularly to prevent coder drift, with a final estimate (based on 10% overlap in videotapes) of \( \alpha = .94 \). All coders were blind to the hypotheses of the study. The project manager monitored videotapes to ensure adequate administration of the task.

**Sibling prosocial behaviour.** Mothers and fathers reported on the prosocial behavior of up to four siblings in the home at the same measurement point as target children’s cooperation. The prosocial scale came from the Ontario Child Health Study (Boyle et al., 1993) and was based on five items (i.e., Shows sympathy to someone who has made a mistake; Will try to help someone who has been hurt; Offers to help others who are having difficulty with a task; Comforts someone who is crying or upset; Helps others who are feeling sick) rated on a scale of 1 (Never) to 3 (Often). For each child, parents’ mean scores across all items were standardized and
combined to create a composite score. We wanted to have a measure of sibling prosociality rather than sibling age characteristics and thus we residualized prosociality for age before calculating the sibship mean.

Target children’s sibling prosociality scores were computed by taking a mean of their siblings’ prosocial behaviour (excluding the child’s own score). For 2-child families, sibling prosociality was the single sibling’s prosociality score. For families with more than 2 children, sibling prosociality included the prosocial behavior of up to three siblings per child.

**Covariates.**

**Family demographics and child characteristics.** Mothers reported on child age (in years and months) and gender (1=male; 0=female), as well as their own education (in years). Household income/assets were examined when families entered the study through questions regarding family assets (e.g., house size, ownership status, cars) and annual household income (16 categories from ‘no income’ to ‘$105,000 or more’). Assets and income items were well correlated ($r = .70$). They were standardized and a mean was computed, with higher scores indicating higher income/assets. Sibship size was dichotomized into large (3+ children) versus small (2 children; reference group). Dummy variables were created for mother-reported ethnicity: European (reference group), Black, South Asian, East / South East Asian, and Other.

**Maternal sensitivity.** Mothers were videotaped interacting with each target child for 10 minutes total across two tasks: (a) *free play with no toys*, where mothers were instructed to play with children as they normally would, (b) *structured task*, where dyads were required to complete a challenging task that was developmentally beyond the capabilities of the child. Interactions were coded for maternal sensitivity, positive control, and mother-child mutuality using the Coding of Attachment-Related Parenting (Matias, Scott, & O’Connor, 2006) and Parent-Child Interaction System (Deater-Deckard, Pylas, & Petrill, 1997). All scales were coded on a 7-point-scale and a mean of the three scales across the two tasks was computed. Elaboration of these tasks, including validity and reliability using the KFP sample, can be found elsewhere (Meunier, Boyle, O’Connor, & Jenkins, 2013; Prime et al., 2015).
4.4.5 Data analytic plan

**Missing data.** Covariates and the dependent variable (i.e., cooperation) had no missing data. Sibling prosociality had minimal missing data (< 2%). Full Information Maximum Likelihood Estimation (FIML), which estimates model parameters and standard errors using all available information, was utilized for handling missing data.\(^5\)

**Procedure.** Given that we had a clustering of children within families, the assumption of statistical independence among observations was violated (Boyle & Douglas Willms, 2001). Thus, traditional ordinary least squares (OLS) regression analysis may have lead to biased results such as an underestimation of the standard errors of model parameters (e.g., regression coefficients; Geiser, 2012). Multilevel modeling, which accounts for the nested structure of the data set (i.e., children within families), was used for the current study. Multilevel modeling is similar to OLS but allows us to account for variance and assess the role of predictors both within and between families. Predictors can be child-specific (e.g., birth order) or family-wide (e.g., socioeconomic status) and are differentiated as such in the results section.

The current multilevel model is a two-level model with children as the level-1 units and families as the level-2 units. Mplus 7 (Muthén & Muthén, 2012) was used. The analysis started with the null model, controlling for age, to allow for variance partitioning as well as subsequent computation of an estimate of the variance accounted for by predictors in Model 2. Next, Model 2 included covariates (child-specific and family-wide), main effects of birth order and sibling prosocial behavior, and the interaction between birth order and sibling prosocial behavior. Fixed effects can be interpreted as they would be in a regression (i.e., an estimate that is approximately twice the size of its standard error is significant at the \(p < .05\) level). Parameters that are significant at \(p < 0.05\) are bolded in Table 4.

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\(^5\) Supplementary analyses explored study questions by removing the restriction that both siblings needed cooperation assessments (i.e., allowing children with missing cooperation scores into the sample) and using FIML/listwise deletion to account for missing data. The pattern of results remained unchanged.
4.5 Results

Preliminary correlational analyses indicated that children’s cooperation ($M = 3.04, SD = .79$) was significantly associated with age ($M = 3.33, SD = .39$); older children had more developed cooperation skills ($r = 0.14$). Sibling prosocial behavior ($M = .05, SD = .89$) was not associated with other variables included in the model. Laterborn children came from larger families ($r = 0.53$) and were younger at the 3-year measurement point ($r = -0.47$).  

The results of the multilevel analyses showed that the majority of the variance was within families (see the null model in Table 4), indicating minimal clustering within families. Model 2 in Table 4 presents the role of predictors explaining the variance in children’s cooperation, which accounted for 8.2% of the variance (total variance of the null model minus total variance of the final model/total variance of the null model; $.613-.563/.613$). Being a laterborn child was positively associated with cooperation scores, $b (SE) = .43 (.12)$, as was the interaction between birth order status and sibling prosocial behavior, $b (SE) = .22 (.10)$. Of the included covariates, child age and sibship size were related to cooperation scores; children who came from a larger sibship had weaker cooperative abilities.

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6 Bivariate associations were also examined accounting for clustered data and patterns did not change.

7 Across Studies 1-3, the presence of a curvilinear effect of sibship size on the outcome was investigated by entering a quadratic term into the regression. In all studies, the inclusion of the quadratic term did not change the pattern of the hypothesized interaction.
Table 4

Multilevel model predicting children’s cooperation at Age 3 (N = 288)

<table>
<thead>
<tr>
<th></th>
<th>Fixed Effects</th>
<th>Null Model</th>
<th>Model 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td></td>
<td>3.04 (.05)</td>
<td>2.86 (.12)</td>
</tr>
<tr>
<td>Child-specific</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Child age</td>
<td></td>
<td>.27 (.11)</td>
<td>.50 (.12)</td>
</tr>
<tr>
<td>Child male</td>
<td></td>
<td>.09 (.09)</td>
<td></td>
</tr>
<tr>
<td>Maternal sensitivity</td>
<td></td>
<td>-.04 (.06)</td>
<td></td>
</tr>
<tr>
<td>Large sibship</td>
<td></td>
<td>-.24 (.10)</td>
<td></td>
</tr>
<tr>
<td>Laterborn child</td>
<td></td>
<td>.43 (.12)</td>
<td></td>
</tr>
<tr>
<td>Sibship prosociality</td>
<td></td>
<td>-.05 (.07)</td>
<td></td>
</tr>
<tr>
<td>Laterborn*prosocial</td>
<td></td>
<td>.22 (.10)</td>
<td></td>
</tr>
<tr>
<td>Family-wide</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Income/assets</td>
<td></td>
<td>.05 (.09)</td>
<td></td>
</tr>
<tr>
<td>South Asian</td>
<td></td>
<td>-.08 (.18)</td>
<td></td>
</tr>
<tr>
<td>Black</td>
<td></td>
<td>-.13 (.20)</td>
<td></td>
</tr>
<tr>
<td>East/SE Asian</td>
<td></td>
<td>.10 (.16)</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td>-.12 (.15)</td>
<td></td>
</tr>
<tr>
<td>Maternal education</td>
<td></td>
<td>-.01 (.02)</td>
<td></td>
</tr>
</tbody>
</table>

To probe the nature of the significant interaction, we plotted the association between birth order status (firstborn vs. laterborn) and children’s cooperation scores as a function of sibling prosocial scores. Cooperation scores were plotted at one standard deviation above and below the mean following normal practice for plotting continuous variables (Holmbeck, 2002). Figure 2 shows that birth order is more strongly associated with cooperation when siblings show high levels of prosocial behavior. The effect of birth order is weaker when sibling prosociality is low. Testing of simple slopes revealed that being a laterborn child predicted higher cooperation scores for children with prosocial siblings, $b (SE) = .62 (.16)$, with only marginal significance when
siblings are low on prosocial behavior, \( b (SE) = .24 (.14) \). Further, laterborn children with more prosocial siblings did significantly better on cooperation than did laterborn children with less prosocial siblings, \( b (SE) = .17 (.07) \). Taken together, these findings indicate that being a laterborn child advantages a child in their cooperation abilities and that this effect is more pronounced for laterborn children with prosocial siblings.

*Figure 2*

Children’s cooperative abilities as a function of birth order status (i.e., firstborn vs. laterborn) and sibling prosocial behavior

![Diagram showing the relationship between birth order and cooperative abilities](attachment:diagram.png)

*Note*: Regression lines for relations between birth order status (i.e., laterborn vs. firstborn) and children’s cooperative abilities as moderated by sibling prosocial behaviour (one standard deviation above and below the mean); **\( p < 0.01 \); † \( p < 0.10 \).

### 4.6 Discussion

The current study provided evidence that laterborn children are better able to represent and coordinate two complementary roles in order to achieve a joint goal. Among laterborn children, those with siblings who were reported to be more prosocial fared better than those whose siblings were reported to be less prosocial, after accounting for differences in sibling age. Further, cooperation was strongly associated with children’s age, which is congruent with previous findings indicating that children gradually gain competence in cooperation in a
problem-solving context between the ages of 2 and 4 years (Ashley & Tomasello, 1998; Brownell & Carriger, 1990, 1991). An additional finding was that coming from a large sibship was associated with lower cooperation scores, which is in line with previous work demonstrating that the benefits of having siblings, to children’s social development, decline as family size increases (Downey & Condron, 2004). The longitudinal within-family design allows us to draw specific conclusions about the effect of birth order by reducing age-related and family-wide confounds. These findings have implications for how we understand the development of children’s capacities for cooperative activities.

The current study joins a growing body of literature using direct assessment to speak to inter-individual differences in children’s early collaborative abilities (Brownell et al., 2006; Endedijk et al., 2015; Schuhmacher & Kartner, 2015). This was the first study to directly assess children’s cooperation in the context of birth order, showing that these developmentally sensitive skills are impacted by the birth order of a child as well as their siblings’ behavior. Success on the cooperation task indicated a coordinated approach to the joint goal, as opposed to independently operating the apparatus. The age-related shift from individualistic to coordinated approaches to a collaborative task parallels changes in children’s socio-cognitive skills, including more sophisticated perspective taking and understanding the behaviours of others in terms of mental states (Ashley & Tomasello, 1998). It may be that the observed advantage in laterborn children’s cooperative capacities are a result of enhanced socio-cognitive faculties. To our knowledge, only one previous study has looked at the association between the sibling environment and toddlers’ collaborative abilities and did not find an effect ( Endedijk et al., 2015). However, this study did not differentiate between older versus younger siblings, nor did they consider the behaviour of siblings in the home.

Various theorists have discussed the importance of symmetrical (rather than hierarchical) and cognitively-attuned interactions to children’s socio-cognitive development (Carpendale & Lewis, 2004; Fernyhough, 2008; Piaget, 1950). Though parent-child interactions can achieve such interactions through open, warm and responsive parenting, sibling interactions are naturally more symmetrical and often take on characteristics of peer interactions. Such reciprocity allows for heightened opportunities for interactions through which learning and development may occur, such as pretend play and conflict (Dunn, 2002; Howe et al., 2011). During both pretend play and conflict, children are encouraged to understand, monitor and negotiate their own mental
states in relation to the other so as to arrive at a place of mutual understanding and/or resolution. These contexts also serve as a platform for children’s use of mental state talk (Howe, Petrakos, & Rinaldi, 1998; Howe, Rinaldi, Jennings, & Petrakos, 2002), a key ingredient of social interactions that promotes social understanding (Carpendale & Lewis, 2004). Thus, sibling interactions serve as a potential training ground for early socio-cognitive development.

In the current study, laterborn children demonstrated greater success on the cooperation task than firstborn children, suggesting that there are differential benefits to having older versus younger siblings. There are various reasons why exposure to siblings may be particularly beneficial to laterborn, as opposed to firstborn, children. First, laterborn children grow up with older siblings during years of rapid development of socio-cognitive abilities. In contrast, their firstborn counterparts spend their early years growing up without siblings and, thus, can be likened to only children. As such, laterborn children are exposed to the benefits of having siblings (e.g., pretend play, mental state talk) throughout their early years. The presence of older siblings during these years may promote enhanced development of early foundational skills required for later cooperative development (e.g., self-awareness and perspective taking; Taumoepeau & Reese, 2014).

Additionally, older siblings are positioned to scaffold the development of younger siblings, rather than the reverse. That is, given the older age and, thus, more developed competencies of older siblings, the quality of the input (e.g., responsivity, mental state talk, teaching) directed towards laterborn children is enhanced (Davis-Unger & Carlson, 2008; Hughes et al., 2006; Prime, Perlman, Tackett, & Jenkins, 2014). Thus, it is both the timing and quality of input that laterborn children are exposed to that may put them at an advantage.

Finally, social learning theory tells us that individuals are most likely to imitate models that are warm and nurturing, high in status, and similar to themselves (Bandura, 1977). Thus, laterborn preschool children may be particularly positioned to learn from their earlier born siblings, given the inherent power differential in the relationship and enhanced skill level of their older siblings (Whiteman, Becerra, & Killoren, 2009).

In addition to shedding light on birth order differences, this study adds to a growing research base demonstrating that the effect of siblings on children’s early development is, in part, dependent on the types of interactions occurring between siblings (Prime, Pauker et al., 2014).
Indeed, siblings vary in the extent to which they engage in other-oriented behaviours, as shown in previous studies (Browne, Leckie, Prime, Perlman, & Jenkins, in press; Prime, Perlman et al., 2014) as well as the current study. In the current study, this variability was meaningfully related to the extent to which laterborn children benefited from having older siblings. Thus, though there was a trend towards a laterborn advantage in general, it was the laterborn children with prosocial siblings that were the most advantaged. It may be that older siblings who are other-orientated are promoting cooperative and/or constructive interactions, providing an optimal environment through which children can build their understanding of the social world (Carpendale & Lewis, 2004).

A few notes about the task used in the study are warranted. First, children who succeeded in the current task demonstrated an ability to coordinate complementary roles during a joint task, a componential part of partaking in cooperative activities. Other contributors to children’s involvement in cooperative exchanges in more naturalistic settings are important to consider, too, such as temperamental characteristics and previous experiences of success during collaborative activities (Schuhmacher & Kärtner, 2015). Further, the adult tester did not assert influence at any point during the task, reducing demands on children’s communication and negotiation skills, as compared to other studies using peer tasks (e.g., Ashley & Tomasello, 1998; Brownell & Carriger, 1990). In contrast, the current task may be considered more difficult in that children lacked potentially helpful input from their partners. This is unlikely, however, as preschool aged children do not benefit from working with a peer to solve a problem in the same way as school-aged children, in terms of motivation or performance (Ramani & Brownell, 2014).

A potential limitation in the current study is that, by using an age-snapshot approach, there are potential period effects (Wichman et al., 2006). We attempted to account for period effects by controlling for maternal behavior at each child’s respective measurement points. Also, the current study did not include any only children. Although findings indicate a disadvantage of being firstborn compared to laterborn, we cannot speak to firstborn children’s abilities in comparison to only children. Firstborns may be expected to outperform only children in their early cooperative abilities, related to their participation in beneficial sibling interactions in general (e.g., pretend play and conflict, described above), as well as their unique roles within sibling dyads. In their role as teachers, older siblings must monitor and integrate dynamic information about the knowledge of their younger siblings. This requires continuous reasoning.
about the mental states underlying the learners’ behaviours, a process that itself contributes to socio-cognitive growth (Wellman & Lagattuta, 2004). There is evidence that firstborn children benefit from their habitual role as a teacher, as indicated by more sophisticated and collaborative teaching strategies that come with age (Recchia, Howe & Alexander, 2009). Future work may consider whether firstborn children are advantaged over only children in their capacities for collaboration.

The current study provides evidence for a laterborn advantage in children’s development of cooperation in a problem-solving context. Laterborn children demonstrated advanced cooperative abilities as compared to firstborn children. Laterborn children with prosocial older siblings fared better than those whose siblings were reported to be less prosocial. Future work should continue to investigate the dynamic interplay between structural factors (e.g., birth order status) and the sibling social climate as both are necessary to gain a full understanding of how siblings influence children’s cooperative development.
4.7 References


Chapter 5
Discussion

5.1 Summary

The current thesis investigated the dynamic interplay between the structural and process-based features of children’s sibling environments as they influence children’s development across social and cognitive domains. Structural components of sibships (i.e., sibship size and birth order), alone, did not predict children’s early development. Rather, there were contingent effects operating wherein the association between the number and placing of siblings was dependent on the quality of the interactions occurring between siblings. Taken together, the findings indicate that children grow up in a variety of different sibling environments, which is meaningfully related to children’s development of key competencies, including receptive vocabulary, theory of mind and cooperation in a problem solving context.

Studies One and Two yielded similar patterns of findings to one another, wherein coming from a larger sibship was associated with poorer language and theory of mind abilities, respectively, for children with less sensitive siblings. These results support the hypothesis of paralleled processes between the sibling environment and socio-cognitive and linguistic development, respectively. The overlap between these developmental domains is well established (elaborated below in section 5.3; Milligan, Astington, & Dack, 2007). Further, both linguistic and socio-cognitive skills have been shown to be negatively related to social disadvantage (Cutting & Dunn, 1999; Hughes et al., 2005) and positively related to sensitive parenting (Landry, Smith, Swank & Guttentag, 2008; Meins et al., 2002), suggesting that they are similar to one another in their associations to both proximal and distal environmental influences. Studies One and Two are consistent with this account in showing that the pattern of interaction between sibship size and sibling cognitive sensitivity in predicting development is consistent across the domains of ToM and language. While Study One utilized a cross-sectional design, Study Two was able to provide information regarding directionality of effects through its use of a longitudinal design.

Study Three demonstrated that laterborn children had enhanced cooperative abilities when compared to children without older siblings. Laterborn children with prosocial siblings were particularly advantaged, demonstrating higher scores on cooperative problem solving than all
other groups. Consistent with the other two studies, Study Three demonstrated that children who came from larger sibships had weaker cooperative abilities. This study was novel in its use of a within-family design, allowing for conclusions regarding child-specific as opposed to family-wide influences on cooperation. Further, by using an age-snapshot technique, the study was able to model birth order influences independent of maturational processes during a period of rapid development.

To summarize across studies, among children with at least one older sibling, cognitively sensitive older siblings had a buffering effect against poor developmental outcomes for children from large sibships. Further, after controlling for sibship size, a comparison of children with older siblings to those with only younger siblings indicated a development-enhancing effect of having older siblings, particularly when siblings were themselves responsive social partners. Consistent across studies is the notion that responsive older siblings contribute to children’s developing socio-cognitive and linguistic competencies. Findings across studies are novel in their demonstration that sibling behaviour can influence the strength of the relationship between sibling structural factors and children’s development.

5.2 Contingent effects in school readiness and early learning

Previous studies highlight the utility of investigating contingent effects between structural and process-based elements of children’s environments in the prediction of children’s linguistic, social and emotional competence. Specifically, processes such as parenting behaviour, peer and sibling relationships have been shown to moderate the influence of more distal factors such as socioeconomic status, ethnicity, parental psychopathology and family structure on children’s school readiness and adjustment (Criss, Pettit, Bates, Dodge & Lapp, 2002; Hill, 2001; Keeton, Teetsel, Dull & Ginsburg, 2015; Wade, Prime, Browne & Jenkins, 2013). For instance, Raver, Gershoff, & Aber (2007) demonstrated that the pattern of results between income and cognitive competence, and parenting and social competence, respectively, differed as a function of ethnicity. Indeed, income was a stronger predictor of child cognitive competence for Black children than it was for White or Hispanic children. Further, the association between positive parenting behaviour and children’s social competence was larger for White families than it was for Hispanic or Black families. In another study by Wade and colleagues (2013), sibship size and English language exposure in the home combined to predict children’s receptive vocabulary and
early print skills, respectively. Children were at particular risk for poor skill development if they came from a large sibship and had low exposure to English; however, coming from a large sibship was not related to pre-academic skills in children who had high levels of English exposure in the home. Thus, by examining the influence of multiple, contingent effects in child development, it is possible to consider the influences on children’s school readiness within specific sociodemographic contexts.

For Studies One and Two, specifically, we see a protective effect wherein sibling cognitive sensitivity confers competence despite exposure to a disadvantageous family structure (i.e., has a buffering effect; Luthar, Cicchetti, & Becker, 2000). Sibling processes have been previously shown to alter children’s responses to risky environments. Indeed, positive sibling relationships have been shown to protect children from stressful life events, parental psychopathology, and marital conflict in both childhood and adolescence (Jenkins & Smith, 1990; Keeton et al., 2015; Kempton, Armistead, Wierson, & Forehand, 1991). For instance, Gass and colleagues (2007) demonstrated that the effect of negative life events in the previous 12-month period (e.g., accidents, illnesses, deaths etc.) on children’s emotional problems was moderated by sibling affection. Additionally, this protective effect of sibling affection was independent of the mother-child relationship. Though siblings have been shown to protect children against maladjustment (see Conger, Stocker, & McGuire, 2009), these are the first studies demonstrating that responsive siblings can play a protective role for children who are at risk for poor socio-cognitive and/or language development.

The pattern of findings for Study 3 indicated that exposure to both a favourable position in the birth order and positive sibling environment was particularly advantageous to children’s cooperative development, beyond the advantage of being a laterborn child, alone. This pattern of findings, wherein exposure to one positive environment potentiates the benefit of another, has been previously shown. For example, Wade and colleagues (2013) demonstrated that the children with the highest receptive vocabulary skills at age 3 years were those who had strong language skills and responsive mothers at age 18 months. Thus, the presence of both early positive adaption and responsive parenting was most beneficial, rather than either independently.
5.3 Interrelatedness of children’s preschool abilities

Though children’s receptive vocabulary, theory of mind and cooperative problem solving were studied independently in the current thesis, it can be helpful to consider their interrelatedness. All three skills go through a period of rapid development in the preschool years, which, it has been suggested, may be partially influenced by a child’s paralleled development of intention understanding (Moore, 2006). Indeed, early indicators of intention understanding have been linked to developments in cooperative problem solving, language and theory of mind (Brownell, Ramani, & Zerwas, 2006; Wade, Browne, Plamondon, Daniel, & Jenkins, 2015). In a recent study, Wade, Browne and colleagues (2015) demonstrated that a child’s language abilities at age 3 mediated the relationship between early intention understanding and subsequent theory of mind abilities. The way in which cooperative problem solving fits into this picture has yet to be investigated. It may be that developments in cooperative problem solving facilitate participation in social exchanges that stimulate language development (Carpendale & Lewis, 2004). Or, alternatively, advances in language development may provide the cognitive faculties that support cooperative problem solving abilities (Fernyhough, 2008). Similarly, a child’s ability to engage with a partner cooperatively to solve a problem may promote greater theory of mind abilities through exposure to and reasoning about alternative beliefs and perspectives (Fernyhough, 2008; Wellman & Lagattuta, 2004). Alternatively, through development of a theory of mind, children’s notions about the effects of beliefs on behaviour may enable them to successfully collaborate with a partner to achieve a joint goal. Though the relationship between these variables within and across time cannot be modeled using the available data, due to methodological restrictions related to measurement time points, it is a fruitful area for future research.

These preschool abilities also share the characteristic that they both shape and are shaped by the social interactions in which they partake. That is, a child’s ability to engage with the environment via their development of shared attention, goals and intentions with others is influenced by their early experiences with responsive social partners (Wade, Moore et al., 2015). This engagement with the social world facilitates subsequent gains in socio-cognitive and language development (Carpendale & Lewis, 2004), which are linked to later academic and social success (Caputi, Lecce, Pagnin, & Banerjee, 2012; Duncan et al., 2007; Lecce et al.,
Thus, preschool socio-cognitive and language development are reciprocally related to meaningful social exchanges throughout early childhood. The interrelation between these three constructs, independently as well as in the context of sibling environments, represents an important direction for future research.

Notably, there are additional preschool abilities that have been identified as particularly important for children’s later school success that were not addressed in the current thesis. In a meta-analysis of six longitudinal datasets, math ability at school entry was the strongest predictor of later academic performance (Duncan et al., 2007). Inattention has also been robustly related to academic achievement in elementary school years (Duncan et al., 2007), for example, in predicting both math calculation and fluency (Gray, Rogers, Martinussen & Tannock, 2015), as well as basic word-level reading skills and reading comprehension (Dally, 2006; Martinussen, Grimbos, & Ferrari, 2014). There has been recent interest in studying the role of siblings in socializing math skills, with Howe and colleagues (2016) demonstrating that approximately 30% of sibling teaching episodes include concepts of math such as measurement, numbers and geometry. With respect to attention, a recent longitudinal study provided evidence for a link between having siblings and children’s executive functions (McAlister & Peterson, 2013), which are inherently linked to behavioural attention (Willcutt, Doyle, Nigg, Faraone, & Pennington, 2005). Further investigation into the ways in which siblings may contribute to preschool children’s attention and math skills is warranted.

5.4 Implications for interventions involving siblings

Given the increasing evidence for the prominence of sibling behaviours in children’s preschool development, investigation into the efficacy of interventions in promoting sibling responsivity is warranted. Parental attunement to children’s mental states can be enhanced through direct intervention, with subsequent gains observed for child outcomes (Bakermans-Kranenburg, Van Ijzendoorn, & Juffer, 2003). Interventions designed to promote cognitively attuned behaviours between siblings will likely benefit from targeting both the social-affective and cognitive components of the construct.

The social-affective component of cognitive sensitivity is characterized by positively valenced and reciprocal interactions between sibling dyads. For this target, it can be useful to
consider the literature on interventions designed to enhance prosociality in the sibling relationship. Kramer and colleagues (Kennedy & Kramer, 2008; Kramer & Radey, 1997) have developed two programs targeting sibling-relevant social skills with the goal of improving prosociality in sibling relationships in dyads aged 4-8 years old. They have demonstrated positive intervention effects on sibling perspective-taking, positive responding to siblings’ requests to play, and emotion regulation, which are linked to changes in the sibling relationship (i.e., particularly warmth and closeness). Treatment effects for enhancing positive qualities of sibling relationships have been demonstrated in elementary school-aged children, as well (Feinberg et al., 2013). The effect of sibling relationship interventions on children’s socio-cognitive and/or language outcomes has yet to be explored. This represents an important area for future consideration.

The second component of cognitive sensitivity requires children to use mind-reading to assess their siblings’ cognitive needs and abilities. In the original study that developed and validated the cognitive sensitivity measure (Prime, Perlman et al., 2014), individual differences in children’s theory of mind abilities were strongly associated with the amount of cognitive sensitivity they displayed towards their siblings. Children’s socio-cognitive abilities are also related to the sophistication of their understanding of teaching (i.e., transfer of knowledge) as well as the teaching strategies they employ (Howe, Recchia, Della Porta & Funamoto, 2012; Strauss et al., 2002). Thus, strategies typically used to enhance children’s theory of mind skills may also serve to promote their responsivity to siblings’ cognitive needs. Several researchers have demonstrated that children’s theory of mind can be improved through the use of naturalistic adult-child storybook interactions that focus on characters’ mental states (Guajardo & Watson, 2002; Ornaghi, Brockmeier & Gavazzi, 2011; Tompkins, 2015). In a recent study with low-income preschoolers, Tompkins (2015) compared children from three groups: (i) Experimental group – storybook interactions included an introduction to the topic of the story, several statements and questions throughout the story pertaining to mental states, and a summary statement regarding the nature of the false beliefs in the story; (ii) Storybook control group – this group was read the same false-belief themed storybooks, but there was no introduction, embedded statements/questions or summary; (iii) non-treatment control group – this group did not engage with the experimenter in the training phase (i.e., no story reading). The experimental group made significant gains in theory of mind understanding over both control groups, which
did not differ from one another, demonstrating that incorporation of a discussion, rather than story-reading alone, represents a critical component to theory of mind training programs. This is in line with previous studies demonstrating that storybooks with an emphasis on mental states, alone, are not effective in training false belief understanding (Ornaghi et al., 2011; Peskin & Astington, 2004). Active engagement of children in discussing the effect of mental states on behaviour has the potential to improve their theory of mind understanding.

Taken together, there is evidence for the effectiveness of intervention programs designed to target both the sibling relationship as well as children’s theory of mind understanding. When developing interventions designed to promote sibling cognitive sensitivity, it may prove useful to combine components from these divergent intervention literatures so as to target both the cognitive and social-affective dimensions of cognitive sensitivity.

5.5 Conclusion

Siblings have the potential to afford children with exposure to a number of development-enhancing situations, including pretend play, conflict, and conversation. Like parents, siblings vary in the degree to which they can identify and sensitively respond to the internal states of others. This variability has implications for the quality of children’s environments and, as such, the development of competencies across social and cognitive domains. The current thesis highlighted the ways in which sibship size and birth order, respectively, combine with sibling responsivity to influence children’s preschool development. These findings contribute theoretically to our understanding of how environments shape early development. Investigation into whether siblings can be trained to be sensitive to one another will shed light on causal pathways as well as inform family-based work for children with strained sibling relationships and/or those at risk for poor developmental outcomes.
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