ENVIRONMENTAL AND COGNITIVE FACTORS INFLUENCING CHILDREN’S
THEORY-OF-MIND DEVELOPMENT

by

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Abstract

To date, there is compelling evidence to show that theory-of-mind development is influenced by different environmental and cognitive factors. However, despite our understanding of the different individual processes that facilitate theory-of-mind acquisition, what remains relatively unclear is how these processes operate together during development. The goal of the present dissertation is to examine mediation (examines the relationship between two different factors and address the question of “why” or “how” one variable predicts or causes an outcome variable) and moderation (examines “when” or “for whom” a variable most strongly predicts or causes an outcome variable) processes that can help explain why and under what conditions environmental and cognitive factors are important for theory-of-mind development.

The investigation began by examining the influence of environmental factors on theory-of-mind development. Mediation analyses were used to examine “why” environmental factors such as family (i.e., family risk) and socio-linguistic factors (i.e., parental cognitive talk), may be important for theory-of-mind development. Preliminary results demonstrated possible mediated effects of both family risk and parental cognitive talk on theory of mind. That is, family risk may delay children’s theory-of-mind development by impeding the rate of language acquisition, whereas parental cognitive talk may facilitate more advanced theory-of-mind understanding by encouraging more parent-child reciprocity during conversations.
Next, the effects of cognitive factors on theory-of-mind development were explored. Moderation analysis was used to examine under what conditions children’s language abilities and conflict inhibition skills (children’s ability to inhibit a prepotent response while responding with a less salient response) are important for theory-of-mind acquisition. Although there may be limited effects of child language and conflict inhibition on early theory of mind, advanced theory-of-mind understanding such as false belief requires both. However, optimal effects of child language on false-belief understanding occurred when children also had high levels of conflict inhibition ability. These findings suggest that effects of child language on false belief are contingent on children’s conflict inhibition skills.

Finally, to investigate how environmental and cognitive factors operate together during theory-of-mind development, moderation analysis was conducted to examine whether delays in language and/or conflict inhibition can be compensated for by more exposure to parental cognitive talk (and vice versa) during theory-of-mind acquisition. Although there was no evidence to suggest compensatory effects, results demonstrated that child language and parental cognitive talk both independently contributed to theory of mind. These findings suggest that environmental (e.g., parental cognitive talk) and cognitive factors (e.g., child language) play distinct roles during theory-of-mind development.

Overall, these results demonstrate the value of understanding theory-of-mind development from a bioecological perspective where children are both directly and indirectly influenced by multiple mechanisms during theory-of-mind development.
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Table of Contents

Abstract .......................................................................................................................................ii

Acknowledgements .................................................................................................................... iv

List of Tables ................................................................................................................................xi

List of Figures ..........................................................................................................................xiii

List of Appendices .................................................................................................................... xiv

Chapter 1: Introduction and Overview .................................................................................... 1

Chapter 2: The Effects of Environmental Factors on Theory-of-mind Development ........ 5
  2.1 The Effects of Family Factors on Theory-of-mind Development .................................. 5
    2.1.1 Effects of Family Configuration on Theory-of-mind Development ...................... 6
    2.1.2 Effects of Family Environmental Risk on Theory-of-mind Development ............ 7
  2.2 Effects of Socio-linguistic Environmental Factors on Theory-of-mind Development ...... 10
    2.2.1 Effects of Quantity of Parental Mental-state Terms Used During Conversations on
         Theory-of-mind Development ....................................................................................... 10
    2.2.2 Effects of Different Types of Parental Mental-state Terms Used During Conversations on
         Theory-of-mind Development ....................................................................................... 11
    2.2.3 Effects of Parent-child Connected Mental-state Talk during Theory-of-mind Development. 13
  2.3 Summary ............................................................................................................................... 15

Chapter 3: The Effects of Cognitive Factors on Theory-of-mind Development ............... 16
  3.1 Effect of Child Language on Theory-of-mind Development ........................................... 16
    3.1.1 Effects of Semantics on Theory-of-mind Development ........................................... 18
    3.1.2 Effects of Pragmatics on Theory-of-mind Development ........................................... 18
    3.1.3 Effects of Syntax on Theory-of-mind Development ................................................... 19
  3.2 Effect of Executive Functions on Theory-of-mind Development ..................................... 20
  3.3 Summary ............................................................................................................................... 22

Chapter 4: Overview of Goals ................................................................................................. 24
  4.1 Study Design ....................................................................................................................... 25
4.2 Analytic Strategy

4.2.1 Mediation Effects

4.2.2 Moderation Effects

4.3 Model 1 - The Effect of Family-specific Factors: The Mediating Role of Child Language on the Relation between Family Risk and Theory of Mind

4.3.1 Hypothesis 1: Effects of Family Risk on Theory of Mind are mediated by Children’s Language Ability


4.4.1 Hypothesis 2: The Effect of Parental Cognitive Talk on Theory of Mind is mediated by Parent-child Reciprocity

4.5 Model 3 - The Effect of Cognitive Factors: Possible Contingency Effects between Conflict Inhibition and General Child Language Ability on Theory of Mind

4.6 Model 4 - The Joint Effect of Environmental and Cognitive Factors: Testing the Compensatory Model of Theory-of-mind Development

4.6.1 Hypothesis 3: Relations between Child Language Ability and Theory of Mind are moderated by Parental Cognitive Talk

4.7 Summary

Chapter 5: Methods

5.1 Participants

5.2 Materials and Procedure

5.2.1 Assessing Children’s Language Ability

5.2.2 Assessing Children’s Theory-of-mind Understanding

5.2.3 Assessing Children’s Understanding of Sentential Complements

5.2.4 Assessing Parent-child Mental-state Talk

5.2.5 Assessing Children’s Executive Functioning Ability

5.2.6 Family Demographic Questionnaire

Chapter 6: Coding Scheme for Parental Mental-state talk and Parent-child Interactions

6.1 Parental Mental-state Talk Coding

6.1.1 Inter-coder Reliability

6.1.2 Parental Mental-state Talk Coding

6.2 Quality of Parent-child Interaction Coding

6.2.1 Inter-coder reliability

6.2.2 The Parent Child Interaction System (PARCHISY)

Chapter 7: Descriptive Statistics

7.1 Family Demographic Questionnaire

7.1.1 Family Demographics

7.1.2 Family Configuration
7.2 Descriptive Statistics .................................................................................................................... 60
7.2.1 Parental Mental-state Talk ..................................................................................................... 60
7.2.3 Quality of Parent-child Relationship....................................................................................... 63
7.2.4 Child Outcome Measures ........................................................................................................ 64

Chapter 8: Effects of Environmental Factors on Theory-of-mind Development .............. 67
8.1 Model 1: The Mediating Role of Child Language on the Relation between Family Risk and Theory of Mind .......................................................................................................................... 67
8.1.1 Exploratory Analysis ................................................................................................................. 67
8.1.2 Mediation Analysis .................................................................................................................. 69
  8.1.2.2 Relation between family risk and child language. ............................................................... 71
  8.1.2.3 Relation between child language and theory of mind. ..................................................... 72
8.2 Model 2: The Mediating Role of Parent-child Reciprocity on the Relation between Parental Cognitive Talk and Theory of Mind .......................................................................................................................... 75
8.2.1 Exploratory Analysis ................................................................................................................. 75
8.2.2 Mediation Analysis .................................................................................................................. 76
  8.2.2.1 Relation between parental cognitive talk and theory of mind. ........................................ 76

Chapter 9: Effects of Cognitive Factors on Theory-of-mind Development .................. 82
9.1 Exploratory Analysis .................................................................................................................... 82
9.2 Moderation Analysis .................................................................................................................. 83
9.3 Testing the Significance of the Moderating Effect ...................................................................... 86

Chapter 10: The Joint Effect of Environmental and Cognitive Factors on Theory-of-mind Development ........................................................................................................................................... 89
10.1 Exploratory Analysis .................................................................................................................. 89
10.2 Moderation Analysis .................................................................................................................. 90

Chapter 11: Summary of Results ............................................................................................ 93

Chapter 12: Discussion ...................................................................................................................... 95
12.1 Effects of Environmental Factors on Theory-of-mind Development ............................. 96
  12.1.1 Mediating Role of Child Language on the Relation between Family Risk and Theory of Mind ............................................................................................................................................................. 96
  12.1.1.1 Mediating effect of child language .................................................................................. 97
  12.1.2 The Mediating Effects of Parent-child Reciprocity on the Relation between Theory of Mind and Parental Cognitive Talk ......................................................................................................................... 100
  12.1.2.1 Mediating effects of parent-child reciprocity ............................................................... 103
  12.1.3 Limitations of Mediation Models ........................................................................................ 106
12.1.4 Implication of Results: Reconceptualizing the Development of Theory of Mind with the Bioecological Model ........................................................................................................ 106

12.2 Effects of Cognitive Factors on Theory-of-mind Development ........................................ 109
12.2.1 Effects of Child Language and Conflict Inhibition on Advanced Theory-of-mind Understanding ........................................................................................................... 109
12.2.2 Multiplicative Effects of Child Language and Conflict Inhibition on False-belief Development .............................................................................................................. 109
12.2.2 Implications of Results: Unique Patterns of Development ................................................. 113

12.3 The Joint Effect of Environmental and Cognitive Factors During Theory-of-mind Development ................................................................. 113
12.3.1 The Additive Model of Theory-of-mind Development ....................................................... 114
12.3.2 The Role of Child Language and Parent-child Cognitive Talk during Theory-of-mind Acquisition ........................................................................................................... 116
12.3.3 The Role of Conflict Inhibition during Theory-of-mind Acquisition ................................ 118
12.3.4 The Distinct Role of Environmental and Cognitive Factors During Theory-of-mind Development ........................................................................................................ 120

Chapter 13: Limitations ......................................................................................................... 122

References .......................................................................................................................... 125

Appendix A: Theory-of-mind Task Protocols ........................................................................ 136

Appendix B: Comprehension of Sentential Complements Task Protocol ............................. 140

Appendix C: Executive Functioning Task Protocols .............................................................. 141

Appendix D: Family Demographic Questionnaire ................................................................. 146

Appendix E: Additional Exploratory Analyses ...................................................................... 149
  Intercorrelations between Parental Mental-state Talk and Parent-child Quality Measures ...... 149
  Intercorrelations between Family Risk and the Socio-linguistic Environment .................... 150
  Intercorrelations between Environmental Factors and Family Configuration .................... 150
  Intercorrelations between Environmental Factors and Child Age and Gender ................. 151
  Intercorrelations between Cognitive Factors ....................................................................... 151
  Intercorrelations between Cognitive and Environmental Factors .................................... 152
  Intercorrelations between Family Configuration and Child Measures .............................. 154
Intercorrelations between Cognitive Factors and Theory-of-mind Scores................................. 155
List of Tables

Table | Page
--- | ---
Table 1. Description of Theory-of-mind Tasks Used | 45
Table 2. Tasks Included in Executive Functioning Battery | 48
Table 3. Mental-state Term Categories | 52
Table 4. Focus Coding Category | 53
Table 5. Mental-state Conversational Code | 54
Table 6. Means and Standard Deviations for Parental Mental-state Term References | 61
Table 7. Means and Standard Deviations for Parental Focus Talk | 61
Table 8. Means and Standard Deviations for Parental Talk about Multiple Perspectives | 62
Table 9. Means and Standard Deviations for Parental Talk about Causality | 63
Table 10. Means and Standard Deviations for Quality of Parent-child Relationship Measures | 63
Table 11. Means and Standard Deviations for Executive Function Measures | 64
Table 12. Intercorrelations between Different Theory-of-mind Tasks | 65
Table 13. Intercorrelations between Different Indicators of Family Risk | 68
Table 14. Intercorrelations between Family Risk, Child Language, and Theory of Mind | 69
Table 15. Effects of Family Risk on Children’s Theory-of-mind Scores when Controlling for Child Age and Gender | 70
Table 16. Effects of Family Risk on Children’s TELD Scores when Controlling for Age and Gender | 71
Table 17. Effects of Family Risk on Children’s Theory-of-mind Scores after Controlling for Child Age, Gender and General Language Abilities…………………..73

Table 18. Intercorrelations between Parental Cognitive Talk, Parent-child Reciprocity, and Theory of Mind……………………………………………………………..75

Table 19. Effects of Parental Cognitive Talk on Children’s Theory-of-Mind Scores……77

Table 20. Effects of Parental Cognitive Talk on Parent-child Reciprocity Scores………..78

Table 21. Effects of Parental Cognitive Talk on Theory-of-mind Scores after Controlling for Child Age, Gender and Parent-child Reciprocity Score…………………..79

Table 22. Intercorrelations between Child Language, Conflict Inhibition, and Theory of Mind Controlling for the Effects of Age and Gender………………………….82

Table 23. Summary of Hierarchical Regression Analysis for the Moderating Role of Conflict Inhibition on the Relation between Language and Theory of Mind…. ……..84

Table 24. Intercorrelations between Child Language, Conflict Inhibition, Parental Cognitive Talk and Theory of Mind Controlling for the Effects of Child Age and Gender……………………………………………………………………………….89

Table 25. Effects of Child Language, Conflict Inhibition and Parental Cognitive Talk on Theory-of-mind Scores…………………………………………………….. ....…91
List of Figures

<table>
<thead>
<tr>
<th>Figure</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Figure 1. The mediating effect of child language on the relation between family risk and theory of mind</td>
<td>74</td>
</tr>
<tr>
<td>Figure 2. The mediating effects of parent-child reciprocity on the relation between parental cognitive talk and theory of mind</td>
<td>81</td>
</tr>
<tr>
<td>Figure 3. Children’s theory-of-mind scores as a function of language and bear/dragon scores</td>
<td>86</td>
</tr>
</tbody>
</table>
# List of Appendices

<table>
<thead>
<tr>
<th>Appendix</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appendix A. Theory-of-mind Task Protocols</td>
<td>136</td>
</tr>
<tr>
<td>Appendix B. Comprehension of Sentential Complements Task Protocol</td>
<td>140</td>
</tr>
<tr>
<td>Appendix C. Executive Functioning Tasks Protocols</td>
<td>141</td>
</tr>
<tr>
<td>Appendix D. Family Demographic Questionnaire</td>
<td>146</td>
</tr>
<tr>
<td>Appendix E. Additional Exploratory Analyses</td>
<td>149</td>
</tr>
</tbody>
</table>
Chapter 1: Introduction and Overview

Theory of mind – the understanding that behaviours are motivated by internal mental states (e.g., desires, beliefs, and intentions) – has been the focus of intense developmental research over the past several decades. An important developmental milestone in children’s theory of mind is false-belief understanding or the recognition that actions are guided by beliefs even when they are not true. To date, research suggests that theory of mind follows a general development sequence that is universal across cultures (e.g., Wellman & Liu, 2004; Wellman, Fang, Liu, Zhu, & Liu, 2006). That is, children come to understand simple desires and beliefs before false belief which is then followed by more sophisticated understanding of recursive mental states (thinking about someone else thinking about mental states). Interestingly, in comparison to the invariable developmental pattern, there appears to be more variability in the developmental timeline of theory of mind. For instance, in typically developing children, false-belief understanding has been found to develop between 3 to 5 years of age (e.g., Wellman, Cross, & Watson, 2001).

An intriguing area of research has been to understand why there are individual differences in theory-of-mind development. To date, researchers have primarily focused on examining factors related to more sophisticated false-belief understanding in children and two general types of mechanisms have been identified: 1) environmental and 2) cognitive factors. Environmental factors are those found in the child’s immediate environmental that can have a direct or indirect effect\(^1\) on development. Two important environmental factors include family

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\(^1\)The adjective indirect is used in its everyday meaning and does not refer to the statistical definition. That is, here “indirect effect” describes the mediation process whereby a predictor variable influences an outcome variable by operating through a mediating variable.
characteristics (unique characteristics of individual families) and socio-linguistic factors (communicative exchanges found in the child’s immediate social surroundings). To date, family characteristics such as family size (e.g., Lewis, Freeman, Kyriakidou, Maridaki-Kassotaki, & Berridge, 1996), socioeconomic status (e.g., Cutting & Dunn, 1999), and the presence of siblings (e.g., McAlister & Peterson, 2007) have been found to relate to more advanced false-belief understanding. Similarly, socio-linguistic factors such as specific patterns of mental-state talk children participate in with parents (e.g., Ruffman, Slade, & Crowe, 2002) and friends (e.g., Slomkowski & Dunn, 1996) have also been found to predict more sophisticated understanding. Cognitive factors, however, refer to the set of unique attributes each child possesses. To date, cognitive factors such as child language ability (e.g., Astington & Jenkins, 1999) and executive functions (e.g., Carlson & Moses, 2001) have been found to be associated with false-belief understanding.

Clearly, evidence drawn from existing research suggests that theory-of-mind development involves multiple environmental and cognitive mechanisms. However, despite our understanding of the different individual processes that relate to theory-of-mind acquisition, it remains relatively unclear how these processes operate together during development. That is, the interactive effects of these mechanisms are not well understood. Moreover, the majority of research studies have also focused primarily on factors that influence the development of false-belief understanding and to some extent, children’s understanding of emotions (e.g., Dunn, Brown, Slomkowski, Tesla, & Youngblade, 1991). However, false-belief understanding represents only one developmental milestone along the theory-of-mind spectrum and our current understanding of other theory-of-mind concepts is relatively limited.
To address these limitations, the goal of the present dissertation is to examine possible mediation and moderation processes that explain “why” and “when” environmental and cognitive factors are important for theory-of-mind development. Theory-of-mind understanding will be assessed with the theory-of-mind scale because of its ability to map the developmental progression of theory of mind (Wellman & Liu, 2004). To this end, four different models of theory-of-mind development will be tested.

First, the effects of environmental factors on theory-of-mind development will be examined. Specifically, Model 1 and 2 will use mediation analyses to examine “why” family characteristics (i.e., family environmental risk) and socio-linguistic factors (i.e., parental cognitive talk), are important for theory-of-mind development, respectively. Model 1 will test the possible mediating effects of children’s language ability on the relation between family environmental risk and theory of mind. To understand the influence of socio-linguistic factors on theory-of-mind development, the possible mediating effects of parent-child reciprocity on the relation between parental cognitive talk and theory of mind will be tested in Model 2.

Second, the effects of cognitive factors on theory-of-mind development will be explored. Model 3 will use moderation analysis to examine under which conditions child language and executive functions are important for theory-of-mind acquisition. Specifically, Model 3 will test whether the effects of child language on theory of mind are contingent on children’s conflict inhibition ability.

Last, to examine how environmental and cognitive factors operate together during theory-of-mind development, the compensatory effects of environmental and cognitive factors will be tested in Model 4. Specifically, Model 4 will test for whether parental cognitive talk can
compensate for the effects of delayed language and/or conflict inhibition abilities in children
during theory-of-mind acquisition (or vice versa) so that typical development occurs.

In the following chapters, the effects of environmental factors (Chapter 2) and cognitive
factors (Chapter 3) on theory of mind will be discussed. Chapter 4 will provide a general
overview of the analytic strategy and specific hypotheses associated with each proposed model
of theory-of-mind development examined in the current thesis. Chapter 5 will outline
procedures used during data collection followed by a discussion of the coding scheme used to
evaluate parental mental-state talk and quality of parent-child interactions (Chapter 6). General
descriptive statistics will be presented in Chapter 7 while Chapters 8, 9, and 10 will present
specific results associated with proposed models of theory-of-mind development. A summary
of results will be provided in Chapter 11 followed by a discussion of results (Chapter 12) and
limitations and conclusions (Chapter 13).
Chapter 2: The Effects of Environmental Factors on Theory-of-mind Development

To date, there is compelling evidence to suggest that theory-of-mind acquisition is affected by different factors found in children’s environment. Although numerous environmental factors can affect theory-of-mind development, family characteristics and socio-linguistic factors are perhaps the most influential during the preschool years. Thus, the current chapter will focus exclusively on these factors.

Family characteristics refer to attributes that are unique to individual families and include factors such as family’s exposure to environmental risk and family size. Socio-linguistic factors, on the other hand, refer to communicative exchanges that children engage in as participants or bystanders and include mental-state talk they are exposed to through stories, books, and conversations (Astington & Baird, 2005). In the following sections, existing research that illustrates the association between theory of mind and family characteristics and socio-linguistic factors, respectively will be discussed.

2.1 The Effects of Family Factors on Theory-of-mind Development

Existing evidence suggests that the rate at which children develop theory of mind (particularly false-belief understanding) may in part be influenced by family characteristics and experiences. Perhaps most compelling is evidence drawn from a behaviourual genetic study that examined the relative effect of common genetic and environmental influences on theory-of-mind and language development in 60-month-old monozygotic and dizygotic twins (Hughes et al., 2005). By identifying similarity in theory-of-mind scores across twin pairs, the extent to which these similarities can be explained by genetic factors and child and family experiences can be estimated. Results suggested that relative to genetic and child experiences,
family experiences accounted for 20% of the variance that explained why twin pairs were similar in their theory-of-mind scores. This suggests that exposure to common family influences partially explained why twin siblings displayed similar theory-of-mind scores. More importantly, these results support the notion that theory-of-mind development is influenced by family factors. To date, research has demonstrated that certain family configurations and demographic variables relate to theory-of-mind acquisition in children. Evidence to support this notion is discussed below.

2.1.1 Effects of Family Configuration on Theory-of-mind Development

Insofar as family characteristics facilitate theory-of-mind development, it is important to identify which family factors can explain why children show differential patterns in theory-of-mind understanding. Family configurations, such as larger families with kin family members (Lewis et al., 1996) and the presence of siblings (e.g., Jenkins & Astington, 1996; McAlister & Peterson, 2007), particularly that of older siblings (Ruffman, Perner, Naito, Perkin, & Clements, 1998), have been found to be associated with more sophisticated false-belief understanding in preschoolers. Many researchers hypothesize that with larger families (e.g., siblings and kin family members), preschoolers are provided with additional conversational experiences that further scaffold theory-of-mind acquisition (e.g., McAlister & Peterson, 2007). Such conversational experiences include more frequent discussions about false belief and more opportunities to use cognitive verbs and syntactic complements during conversations and during instances of disagreements with siblings or kin family members. Additionally, larger families may also provide preschoolers with more social interactions (e.g., tricking or hiding) that may further facilitate theory-of-mind understanding (e.g., Jenkins & Astington, 1996).
2.1.2 Effects of Family Environmental Risk on Theory-of-mind Development

Aside from family configuration, certain family-demographic characteristics may also affect the rate at which children acquire false-belief understanding. One such factor is the amount of risk families are exposed to. Family risk refers to family characteristics (including parent factors) that increase children’s rate or level of disturbance. To date, there is compelling evidence to show that the effects of risk potentiate one another. That is, regardless of the type of risk, effects of different risks are multiplied, resulting in higher levels of disturbance. For instance, Rutter (1979) found that although exposure to one single risk factor did not elevate children’s rate of disturbance, the presence of more than one risk factor increased the incidence of problems. Children experienced a fourfold increase in the level of behavioural disturbances when they were exposed to two risks. However, those who experienced four risks showed a 20-fold increase in disturbance. These patterns suggest that the effect of risk is additive where it is the cumulative effect of risk that is important in determining risk of adverse outcomes in children (e.g., Atzaba-Poria, Pike, & Deater-Deckard, 2004).

With respect to theory-of-mind development, there are several reasons to speculate why children who are exposed to more family risk are also more likely to experience a delay in development. First, children living in risky family environments are also more likely to experience more negative life events and adverse conditions (e.g., exposure to violence), all of which are consistent predictors of socioemotional maladjustment in children (McLoyd, 1998). Second, high levels of family risk may also delay children’s cognitive and verbal development, which can then further hinder the pace at which theory of mind develops.

A common indicator of family risk is socioeconomic status. Socioeconomic status is generally operationalized as a composite score comprised of different indicators of family risk.
such as family income, parental education and parental occupation. To date, studies have shown a consistent association between low socioeconomic status and delays in theory-of-mind development. With a large, socioeconomically diverse sample, despite controlling for the effects of age, socioeconomic status (as indexed by maternal education and occupation class) was found to predict children’s false-belief scores (Cutting & Dunn, 1999). Specifically, children from middle-class families with highly educated mothers displayed more sophisticated false-belief understanding than children from working-class families. More importantly, when examining the influence of family income and parental education, similar patterns of associations were found. That is, children from higher income families with higher parental education performed significantly better on false-belief tasks when compared with their less advantaged peers (Cole & Mitchell, 1998). These studies suggest that with lower socioeconomic status, children were also more likely to experience delays in their theory-of-mind understanding.

Group comparisons of theory-of-mind performance in children from high- and low-socioeconomic backgrounds also suggest that theory of mind is influenced by family risk. When compared with preschoolers from more affluent backgrounds, low-income children participating in Project Head Start were found to score lower on a variety of false-belief tasks. More importantly, on average, despite improvement with age, preschoolers from low-income families showed different rates of development (Holmes, Black & Miller, 1996). A similar lag in development has also been noted across different cultures where, despite accounting for different lexical demands in false-belief tasks, high socioeconomic status children performed significantly better than their less advantaged counterparts (Shatz, Diesendruck, Martinez-Beck, & Akar, 2003).
Taken together, these results suggest that theory-of-mind development is, in part, influenced by socioeconomic status. However, an important caveat comes from other evidence that suggests minimal effects of socioeconomic status on theory-of-mind development. For instance, when examining neurocognitive functioning in a sample of low socioeconomic status children, no significant relationship was found between socioeconomic status and false-belief scores (Noble, Norman, & Farah, 2005). However, there was a negative association between socioeconomic status and other cognitive measures such as child language. Moreover, a significant, negative association between socioeconomic status and children’s executive functioning was found (Hughes & Ensor, 2007). Surprisingly, a similar association between socioeconomic status and theory-of-mind understanding was not found. Thus, contrary to the aforementioned studies, these observations suggest that rather than theory of mind, family risk may be more related to cognitive factors that are responsible for facilitating theory-of-mind development.

These observations raise important questions about the relationship between family risk and theory of mind. On the one hand, there is evidence to suggest that exposure to family risk impedes the rate at which children acquire theory of mind. This is supported by significant findings from studies examining direct- and group-effects of socioeconomic status on theory of mind. On the other hand, despite sampling from families with low socioeconomic status backgrounds, other studies have failed to demonstrate the same association between family risk and theory of mind. Rather, family risk appears to be related to important cognitive abilities (i.e., language and executive functioning) that have been found to facilitate theory-of-mind development. Although it may be possible to attribute differences across studies to sampling (e.g., low variability between families) and measurement issues (e.g., how socioeconomic
status is defined), the nature of the relationship between family risk and theory of mind remains unclear. Perhaps these inconsistencies reflect the possibility that family risk does not directly influence theory-of-mind development. Rather, its effects on theory of mind may be mediated by another factor that is more proximal to the child. This possibility is further discussed in Chapter 4.

2.2 Effects of Socio-linguistic Environmental Factors on Theory-of-mind Development

Socio-linguistic factors refer to communicative exchanges that children engage in as participants or bystanders (Astington & Baird, 2005). To date, there are numerous studies that have examined the effects of mental-state conversations children have with parents, siblings and friends on theory-of-mind development. However, relative to siblings and friends, parental mental-state talk is perhaps the most studied socio-linguistic factor in the area of theory-of-mind research. Thus, given the focus of the present study and the relative importance of parental mental-state talk, the current review will be limited to the effects of parent-child conversations on theory of mind. The following sections examine the effect of parental mental-state term references on theory-of-mind development, with a particular focus on the amount and type of talk. This will be followed by a discussion of the effects of parent-child connected mental-state talk on theory of mind and general processes that may explain these relationships.

2.2.1 Effects of Quantity of Parental Mental-state Terms Used During Conversations on Theory-of-mind Development

Throughout the literature, parental mental-state talk has been consistently found to relate to children’s theory-of-mind understanding. This has been consistently demonstrated in cross-sectional and longitudinal studies where higher amounts of parental mental-state term references predicted more sophisticated theory-of-mind understanding in children (e.g., Adrian,
These results suggest that theory-of-mind acquisition is associated with the frequency of parental mental-state term references during parent-child conversations.

2.2.2 Effects of Different Types of Parental Mental-state Terms Used During Conversations on Theory-of-mind Development

Aside from quantity, there is also some evidence to suggest that specific types of mental-state terms are more consistent predictors of children’s theory of mind. This is seen in both performance on traditional theory-of-mind tasks and children’s own production of mental-state terms.

The type of mental-state terms parents use during conversations with their preschoolers appears to affect the rate at which theory of mind is acquired. First, there is some evidence to suggest that false-belief understanding is related to variability in parental mental-state term references where higher variability is associated with more advanced understanding (Adrian, Clemente, Villanueva, & Rieffe, 2005). Second, relative to other types of mental-state terms, parental use of cognitive terms is most consistently related to theory of mind. For instance, with a longitudinal design, it was demonstrated that mother’s use of cognitive terms during a storybook reading task predicted subsequent theory-of-mind understanding in children, even after controlling for children’s previous mental-state understanding, child age, verbal ability and maternal education (Adrian, et al., 2007). More importantly, children’s earlier understanding of mental states did not correlate with mothers’ later use of cognitive verbs after controlling for similar covariates. This suggests that children’s earlier mental-state understanding was not affecting how mothers subsequently talked about cognitive states, substantiating the causal association between maternal cognitive talk and theory of mind.
Perhaps with cognitive terms, the subjective nature of mental states between speakers can be explicitly contrasted and highlighted during conversations (Ensor & Hughes, 2008). These results suggest that the variability in the types of mental-state terms parents use during conversations are important to theory-of-mind development. Moreover, there appears to be a causal association between parental (particularly maternal) cognitive talk and theory-of-mind development.

Parent’s use of cognitive terms also appears to affect children’s own production of mental-state terms. Although children’s mental-state talk may not necessarily be indicative of their performance on various theory-of-mind tasks, some authors argue that children’s ability to mentalize may be more accurately reflected in their everyday talk about mental states and mental-state concepts (Hughes, Lecce, & Wilson, 2007). Thus, in addition to children’s performance on various theory-of-mind tasks, it is also important to consider how parental cognitive-state talk affects children’s own talk about these concepts.

Current research suggests that although both maternal talk about desire (e.g., Ruffman, et al., 2002) and cognitive states (e.g., Jenkins, Turrell, Kogushi, Lollis, & Ross, 2003; Taumoepeau & Ruffman, 2008) has been found to predict subsequent cognitive talk in preschoolers, there is some evidence to suggest that effects of parental desire and cognitive talk vary across age. Specifically, younger children may benefit more from parental desire talk whereas older children may benefit more from parental cognitive talk. This emerging theory is supported by two studies that examined maternal mental-state talk and children’s theory-of-mind development over time. First, Taumoepeau and Ruffman (2006) found that at 15 months, only maternal talk about desire states predicted children’s mental-state talk and emotion situation understanding at 24 months of age. However, in a follow up study with the same
families, maternal cognitive talk at 24 months of age emerged as a more consistent predictor of children’s cognitive talk at 33 months (Taumoepeau & Ruffman, 2008). Across both studies, child talk about mental states did not correlate with later maternal talk about mental states. This supports the notion that it is what mothers say that predicts child talk and not the reverse.

2.2.3 Effects of Parent-child Connected Mental-state Talk during Theory-of-mind Development

Another related aspect of parent-child mental-state conversations that has been found to be associated with theory-of-mind development is the extent to which interlocutors are tuned in to each others’ perspective. That is, the extent to which exchanges between two speakers are “connected” (e.g., Ensor & Hughes, 2008). Studies that have examined connectedness in conversations generally operationalize this construct as the number of speaker utterances that are semantically related to previous speaker utterances (e.g., Slowkowski & Dunn, 1996). It has been found that children who engage in more connected conversations with parents or friends are also more likely to display better false-belief understanding (Ensor & Hughes, 2008; Slomkowski & Dunn, 1996). Similar patterns have also been found with a sample of “hard-to-manage” preschoolers (Dunn & Brophy, 2005). These results suggest that in addition to examining “what” is being discussed, it is also important to consider “how” things are said within the social context (Harris, 2005; see de Rosnay & Hughes, 2006 for a review).

Interestingly, parental mental-state talk and parent-child connectedness also appears to operate together during theory-of-mind development. Not only were parents and children more likely to reference desires and cognitions during connected conversations, but the effects of cognitive terms on children’s social understanding are amplified when parents use these terms within a connected context (Ensor & Hughes, 2008). Despite evidence to suggest contingency effects between parental cognitive talk and parent-child connectedness, there is also some
reason to believe that the effects of parental cognitive talk on children’s social understanding may operate through parent-child connectedness. For instance, although parental cognitive talk was significantly related to children’s social understanding (including false-belief understanding) at 4 years of age, this relationship becomes non-significant once connected talk was controlled for. This pattern of results is intriguing since statistically, parent-child connectedness accounted for a significant amount of common variance shared between parental cognitive talk and children’s social-understanding scores. This suggests that the effects of parental cognitive talk on theory of mind may be indirect, with its effects mediated by parent-child connectedness. Evidence for this proposed model will be discussed in Chapter 4.

Insofar as the socio-linguistic environment or, more specifically, parental mental-state talk is important for theory-of-mind development, it is important to understand how parental mental-state references operate on development. It is speculated that during conversations about mental states and mental-state concepts, scaffolding of children’s theory-of-mind development occurs. Although parental mental state-talk may help children develop a vocabulary that allows them to talk about and reflect upon mental states (e.g., Bartsch & Wellman, 1995), conversations may also give parents and their children the opportunity to negotiate different perspectives, highlighting the existence of multiple perspectives. Through these interactions, children learn to appreciate the subjective nature of mental states (Harris, 2005). Indeed research examining parent-child conversations suggests that following a child’s mental-state utterance (use of “I don’t know”) or a disagreement, mothers’ are more likely to elaborate upon the child’s previous utterance by highlighting the existence of multiple perspectives (Sabbagh & Callanan, 1998). Thus, parent-child conversations about mental states
appear to play an important role in theory-of-mind development by providing children with the opportunity to learn about multiple perspectives.

2.3 Summary

In sum, the rate of theory-of-mind acquisition appears to be affected by factors found in the child’s environment. Specifically, there is evidence to suggest that both family characteristics and socio-linguistic factors are important during theory-of-mind development. Certain family configurations have been found to be related to more advanced understanding. For instance, children living in large families with more siblings and/or live-in kin family members acquire false-belief understanding more quickly than those living in smaller families. Similarly, family demographic characteristics such as family risk or socioeconomic status are also related to theory-of-mind development. Preschoolers who are exposed to more family risk are also more likely to display a lag in false-belief understanding when compared with their more affluent peers.

Aside from family-specific factors, children’s socio-linguistic experience, particularly that of parent-child conversations about mental states, also influences the rate of theory-of-mind acquisition. Existing research suggests that not only is the frequency and type of parental mental-state term references important for theory of mind, but also the extent to which parents and their children engage in connected conversations. Perhaps most interesting is that parental mental-state talk (particularly that of cognitive talk) and parent-child connectedness appears to be highly related, suggesting that these factors may operate together during theory-of-mind acquisition.
Chapter 3: The Effects of Cognitive Factors on Theory-of-mind Development

Aside from environmental factors, theory-of-mind acquisition has also been found to be associated with different cognitive factors. Cognitive factors refer to the unique set of cognitive attributes each child possesses. With respect to theory of mind, research has demonstrated a causal association between various aspects of child language and executive functions. In the following section, evidence that illustrate these relationships will be discussed.

3.1 Effect of Child Language on Theory-of-mind Development

Perhaps the most widely studied cognitive factor in theory-of-mind research is child language. The causal association between child language and theory of mind was first illustrated by a longitudinal investigation conducted by Astington and Jenkins (1999). Although authors were able to demonstrate that children’s earlier language ability predicted subsequent false-belief understanding, earlier false-belief understanding did not predict subsequent language abilities. Results of this seminal study were replicated in a recent meta-analysis that examined the influence of language on false-belief understanding. Specifically, it was found that the effect of earlier language on subsequent false belief was stronger than the reverse (Milligan, Astington, & Dack, 2007).

Converging evidence drawn from training studies and those examining theory-of-mind development in deaf children also suggest a causal association between child language and false belief. Generally, training studies have found significant improvements in theory-of-mind understanding in children who receive training that involved different aspects of linguistic input. For instance, Lohmann and Tomasello (2003) found that in training conditions that
involved language (i.e., perspective-shifting discourse and/or sentential complements) children showed significant improvements in their false-belief understanding. Similar results have been found across other training studies (e.g., Hale & Tager-Flusberg, 2003). To date, there is also evidence from deaf children that demonstrates a causal association between language and theory of mind (e.g., Peterson & Siegal, 1995, 2000; Peterson, Wellman, & Liu, 2005). It is widely accepted that delays in theory-of-mind understanding in deaf children are not due to deafness per se, but rather to language delays these children experience. Despite minimizing linguistic demands on the false-belief task, deaf children from hearing families displayed a significant lag in false-belief understanding when compared with deaf children from deaf families. It is thought that deaf children who learn sign language naturally from birth are exposed to similar linguistic experiences that are important for theory-of-mind development. This suggests that similar to spoken language, sign language is also another effective medium that is effective in facilitating theory of mind (Schick, de Villiers, de Villiers, & Hoffmeister, 2007). Thus, it is language per se, rather than the modality in which language is presented that is critical for theory-of-mind development.

Clearly, evidence suggests that language ability is a necessary condition for theory-of-mind development. The strong association between children’s language ability and theory of mind has led many researchers to examine which aspects of language are important for development. Although there is some indication that theory of mind is primarily related to children’s general language scores (Slade & Ruffman, 2005; Tardif, So, & Kaciroti, 2007), research has examined the independent effects of semantics and syntax, particularly that of sentential complements, on false-belief understanding. In the following sections, the effects of semantics and syntax will be discussed.
3.1.1 Effects of Semantics on Theory-of-mind Development

Semantics refers to aspects of language that relate to understanding the meaning of words, phrases, and sentences. Researchers hypothesize that acquiring a linguistic label for mental states provides children with the opportunity to talk about and reflect upon mentalistic concepts. Indeed, learning mental-state terms such as think, want and know plays a key role in theory-of-mind acquisition. In a study with 3- to 5-year-old preschoolers, false-belief understanding was found to emerge when children are also able to distinguish between mental-state terms such as think and know (Moore, Bryant, & Furrow, 1989). Moreover, the robust association seen between children’s receptive language ability and false-belief scores (Milligan et al., 2007) suggests that at the very least, there is some association of language with theory of mind at the semantic level.

3.1.2 Effects of Pragmatics on Theory-of-mind Development

Children’s capacity to use and interpret language appropriately in a communicative exchange, that is, their pragmatic ability, is another aspect of language that may be important for theory-of-mind development. Arguably, appropriate use of language involves some awareness of others’ perspectives (Sperber & Wilson, 2002). Thus, as children participate in conversations, particularly ones that highlight multiple perspectives, they come to appreciate the subjective nature of mental states. Although mental-state terms may be used to draw attention to different perspectives between speakers, they are not necessarily required. Harris (2005) argues that it is the awareness of differences in perspective, however this is highlighted in conversation that may be crucial for theory-of-mind development.
3.1.3 Effects of Syntax on Theory-of-mind Development

Aside from semantics, there is also evidence to suggest that theory of mind is influenced by children’s understanding of syntax (i.e., sentence structure) and grammar. In a recent meta-analysis examining the influence of language on false-belief understanding, it was demonstrated that children’s syntax scores had at least a moderate effect on their performance on false-belief tasks (Milligan et al., 2007). More importantly, compared with initial semantic scores, earlier syntax scores were found to be a stronger predictor of subsequent false-belief understanding in children (Astington & Jenkins, 1999). Perhaps the structure of language provides the necessary scaffolding for symbolic representation that is central to developing a representational theory of mind (Astington & Jenkins, 1999).

More specific aspects of syntax have also been found to relate to theory of mind. Some authors suggest that false-belief understanding can emerge only when children have a mastery of sentential complements, a specific syntactic structure that explicitly highlights the distinction between reality and a person’s mental state (e.g., de Villiers & Pyers, 2002). According to de Villiers and Pyers (2002), there is a close connection between sentential complements and mental-state terms. This is because it is possible to have a false proposition embedded under a mental-state term in a true sentence (e.g., Sarah thought that the earth was flat). This embedded proposition is characteristic of the sentential complement syntactic structure. Thus, children who are confused by these types of sentence structures may also find it very difficult to understand false beliefs within embedded propositions. Empirical data does suggest that children’s prior knowledge of sentential complements predicts later false-belief understanding independent of general language ability. In their longitudinal study, de Villiers and Pyers (2002) measured children’s false-belief understanding and different aspects of their linguistic
ability at three different time points. Results demonstrated that in addition to predicting concurrent false-belief understanding, children’s earlier knowledge of sentential complements predicted subsequent false-belief understanding whereas the reverse did not hold true. More importantly, prior false-belief scores did not predict subsequent sentential-complement understanding. Lastly, the relative importance of sentential complement understanding is also illustrated in a training study. When compared with those who did not receive training, children who received training on sentential complement understanding significantly increased their scores on a range of false-belief tasks (Hale & Tager-Flusberg, 2003). Similar results have been demonstrated by other training studies that exposed children to sentential complement syntax during training sessions (e.g., Lohmann & Tomasello, 2003).

### 3.2 Effect of Executive Functions on Theory-of-mind Development

Executive functions refer to cognitive processes that guide goal-directed behaviours and include abilities such as working memory, inhibition of a prepotent response and planning. Although numerous studies have found a correlation between executive functions and false-belief understanding (e.g., Carlson & Moses, 2001; Cole & Mitchell, 2000; Perner, Lang, & Klooi, 2002), longitudinal data suggest that this relationship is causal. For instance, after controlling for child age, verbal ability and initial theory-of-mind scores, children’s earlier executive functioning ability (particularly that of inhibitory control) was found to predict subsequent theory-of-mind scores one year later (Hughes, 1998). In contrast, associations between early theory-of-mind scores and later executive function measures were not found. These results have been replicated with younger children while controlling for child age, child gender, child language, maternal education, initial theory-of-mind scores and child mental-state talk (Carlson, Mandell, & Williams, 2004). Taken together, there is compelling evidence to
suggest that there is a causal association between children’s executive function and their theory-of-mind understanding.

Interestingly, there is also some evidence to suggest that executive function-theory of mind relations are specific in that more consistent correlations have been found between certain types of executive functioning tasks. Across multiple studies, children’s conflict inhibition has been found to relate most strongly to theory-of-mind scores (e.g., Carlson & Moses, 2001; Carlson, Moses, & Breton, 2002; Carlson, Moses, & Claxton, 2004; Hala, Hug, & Henderson, 2003). There is general consensus that it is the unique combination of inhibition and working memory involved in conflict inhibition tasks that relates more strongly to performance on theory-of-mind tasks. Carlson and Moses (2001) argue that successful performance on traditional false-belief tasks requires children to: 1) inhibit their own prepotent knowledge of current reality and 2) activate a conflicting response. The additional cognitive processing that is required for responding with the less salient representation suggests that in addition to inhibitory control, working memory is also necessary. In this sense, conflict inhibition tasks place similar cognitive demands on children as the traditional false-belief task.

Given the causal association between executive functions and theory of mind, an important question that arises is how executive functions, or conflict inhibition, operate on theory of mind. Two main theories have been proposed. First, conflict inhibition may affect the expression of pre-existing theory-of-mind capacities (e.g., Carlson & Moses, 2001). Given similar cognitive demands, it can be argued that successful performance on theory-of-mind tasks requires some level of executive functioning. Since children are required to inhibit a prepotent response while responding with a less salient representation during a false-belief task, failure to respond appropriately may reflect children’s inability to express their already present
conceptual knowledge of false beliefs because of limited executive control. However, executive functions may also affect the emergence of theory of mind (e.g., Carlson & Moses, 2001). Some argue that a certain threshold of executive functioning is required before children are able to construct mental concepts about the world. Particularly when children are unable to disengage from salient aspects of the world, it is very difficult to acquire an understanding of mental states and an appreciation of multiple perspectives. Although it remains unclear as to which account more accurately captures the observed relations between executive functions and theory of mind, there is some preliminary evidence to support the expression account of executive functions (Hughes, 1998; Carlson et al., 2002; Slade & Ruffman, 2005).

3.3 Summary

Taken together, existing research suggests that there is a strong relationship between theory of mind and both child language and executive functioning (especially conflict inhibition). With respect to child language, both children’s understanding of semantics, as well as syntax relates to more advanced false-belief understanding. Interestingly, there is also some evidence to suggest that relative to semantic understanding, syntactic scores relate more strongly to theory-of-mind development. Specifically, there is emerging evidence to support the notion that children’s knowledge of sentential complements helps facilitate false-belief development. These patterns of results suggest that language is an important mechanism related to theory-of-mind development.

Aside from language ability, children’s ability to inhibit conflicting information while responding with a less salient response (i.e., conflict inhibition) is also associated with more sophisticated theory-of-mind understanding. Specifically, it is the unique combination of working memory and inhibitory control that is crucial in helping children respond appropriately
on false-belief tasks. This relationship has been illustrated in both cross-sectional and longitudinal data. Similar to general child language ability, children’s conflict inhibition also plays an important role during theory-of-mind development.

Despite our understanding of the independent effects of child language and conflict inhibition during theory-of-mind development, it is relatively less clear how these mechanisms operate together during theory-of-mind acquisition. Although numerous studies have demonstrated that both child language and conflict inhibition both uniquely contribute to theory-of-mind acquisition (e.g., Astington & Jenkins, 1999; Carlson et al., 2004), what remains relatively unclear is how these factors influence one another during development. One goal of the present study is to examine the interactive effects of child language and conflict inhibition on theory-of-mind development. Possible models of development will be discussed in Chapter 4.
Chapter 4: Overview of Goals

Drawing from existing research, it is clear that theory-of-mind development involves multiple mechanisms. Despite our understanding of the effects of different individual processes on theory of mind (e.g., child language, parental mental-state talk), what remains relatively unclear is how environmental and cognitive factors operate together during theory-of-mind acquisition. More importantly, existing research is limited in that it has primarily focused on false-belief understanding in preschoolers from affluent families.

The goal of the present thesis is to address these gaps in the current literature by examining mediation and moderation effects underlying theory-of-mind acquisition by testing four different models of development. In addition to false-belief understanding, other aspects of theory-of-mind understanding will be examined in preschoolers from a range of socioeconomic status backgrounds.

First, to understand “why” or “how” environmental factors relate to theory of mind, two mediation models will be tested. To examine the effect of family characteristics, Model 1 will examine why family risk relates to theory-of-mind development. Specifically, mediation analysis will be used to examine whether the effect of family risk on theory of mind may be mediated by general child language ability. Next, to examine the effect of the socio-linguistic environment, Model 2 will examine why parental cognitive talk may be important for theory-of-mind development. Specifically, mediation analyses will be used to examine whether the effects of parental mental-state talk operate through parent-child reciprocity during theory-of-mind acquisition. Second, to examine “when” cognitive factors are important for theory-of-
mind acquisition, contingency effects between child language and conflict inhibition will be explored. To this end, moderation analysis will be used to examine whether the effects of both child language and conflict inhibition on theory-of-mind development are multiplicative. Model 3 will test this model of theory-of-mind development. Lastly, the joint influence of environmental and cognitive factors will be examined to understand how these factors operate together during theory-of-mind development. Specifically, Model 4 will test the compensatory model of theory-of-mind development. Prior to presenting empirical evidence to support these proposed models, an overview of the study design and analytic strategy will be discussed.

4.1 Study Design

The current cross-sectional study involves 75 monolingual English-speaking preschoolers and their parents from a range of different socioeconomic status backgrounds. Data collection involved two different types of measures: child- and family-specific measures. Child-specific measures include general child language ability (both receptive and expressive), understanding of sentential complements, executive functions, and theory-of-mind understanding. A sample of parent-child conversation was also collected with a wordless storybook reading task that was subsequently coded for parental mental-state talk and quality of parent-child interaction. Family-specific measures were collected through a questionnaire that assessed sociodemographic information (e.g., family size), exposure to family risk, and parent demographic information (e.g., place of birth). More details pertaining to materials and procedures will be given in Chapter 5.
4.2 Analytic Strategy

Mediation and moderation analyses will be conducted to examine how environmental and cognitive factors operate together during theory-of-mind acquisition. In the following sections, mediation and moderation analyses will be discussed.

4.2.1 Mediation Effects

Mediation effects examine the relationship between two different factors and address the question of “why” or “how” one variable predicts or causes an outcome variable. Thus, a mediator is defined as a variable that explains the relation between a predictor and an outcome and is the causal mechanism through which a predictor influences an outcome variable (Baron & Kenny, 1986; Fraser, Tix, & Barron, 2004). For instance, consider the following relationship:

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Family Risk (X)  -->  Child Language (M)  -->  Theory of Mind (Y)
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Child language is introduced as a mediator of the relation between family risk and theory of mind. If child language is a significant mediator in this case, the reason why high family risk is associated with delays in theory-of-mind development is because children exposed to high family risk are also more likely to experience delays in language development relative to those who are exposed to less risk. Delays in language development subsequently affect the rate at which these children acquire a theory of mind.

To test for mediation effects, three conditions must be met (Baron & Kenny, 1986). First, the independent variable (e.g., family risk) must be significantly associated with the dependent variable (e.g., theory of mind). Second, the independent variable must also be
significantly related to the mediator (e.g., child language). Third, the mediator variable must be significantly related to the dependent variable. Once these three criteria are established, there is evidence for mediation. Full or partial mediation is determined by examining the effect of the independent variable on the dependent variable once the effect of the mediator is controlled. Full mediation is suggested when 1) the previously significant relationship between the independent variable and dependent variable is shown to be non-significant once the effect of the mediator is controlled for, 2) the mediator variable contributes significantly to the dependent variable, and 3) the effect of the independent variable on the dependent variable decreases. However, if the effect of the independent variable remains significant (but effect size is reduced), there is evidence for partial mediation. In addition to these descriptive conditions, Sobel’s test can be used to determine the significance of the mediated path whereas R-squared measures can be used to estimate the effect size of the mediated path (Mackinnon, 2008). These guidelines were followed for all mediation analyses presented in the current study.

4.2.2 Moderation Effects

Moderation effects address “when” or “for whom” a variable most strongly predicts or causes an outcome variable (Frazier et al., 2004). Specifically, a moderator is a variable that alters the direction or strength of the relation between a predictor and an outcome variable (Baron & Kenny, 1986). In other words, if there is a moderation effect, the moderator and predictor variable are said to be contingent upon one another, where the effect of one variable depends on the level of another.

Statistically, a moderator effect is operationalized as an interaction term between the predictor variable and the moderator variable that specifies the appropriate conditions for its operation. There are several guidelines that should be followed to ensure a non-biased estimate
when examining moderation. First, predictor and moderator variables should not be highly correlated. This is to safeguard against spurious findings since variables that are highly correlated will share substantial amounts of variance that can create a biased interaction term. Thus, highly correlated variables should not be used to examine moderation effects. Second, to reduce multicollinearity between variables, all independent, moderating and covariate variables should be centred so that their means are equal to zero. This can be achieved by subtracting the mean score from children’s raw scores. Centering provides meaningful zero points so that results can be more accurately interpreted. Particularly in moderation analyses, regression coefficients are unique in that such relations are interpreted as “conditional” effects. Thus, with centering, first-order effects of one variable can be interpreted in relation to the effect of that variable at the zero level of the other variable (Baron & Kenny, 1986; Frazier et al., 2004). Last to evaluate the significance of the moderated effect, a test of simple slopes can be used. These guidelines were taken into consideration for all moderation analyses conducted in the present study. In the following sections, empirical evidence supporting each proposed model of theory-of-mind development will be discussed.

**4.3 Model 1 - The Effect of Family-specific Factors: The Mediating Role of Child Language on the Relation between Family Risk and Theory of Mind**

Evidence discussed in Chapter 2 suggests that the effects of family risk on theory of mind may be mediated by another variable that is more proximal to the child. Recall that although some studies have found a direct association between family risk and false belief (e.g., Cutting & Dunn, 1999), other studies have not. Rather, family risk appears to affect child-specific abilities such as language (e.g., Noble et al., 2005) and executive functions (Hughes & Ensor, 2007). This gives rise to the possibility that family risk operates on theory-of-mind
development by affecting mechanisms that are more proximal to the child. One possible 
mechanism that may mediate the relationship between family risk and theory of mind is 
children’s language ability. There is some preliminary evidence to suggest this. When 
examining theory-of-mind development in same-sex twin pairs, correlation analysis show that 
socioeconomic status is negatively related to children’s theory-of-mind scores. However, once 
the effects of verbal IQ (seen as an index of children’s general language ability) is accounted 
for, the association between socioeconomic status and theory of mind loses significance 
(Hughes, Deater-Deckard, & Cutting, 1999). This suggests that relative to socioeconomic 
status, general child language ability has a more direct effect on children’s theory of mind since 
it was able to account for a significant amount of common variance shared between 
socioeconomic status and theory of mind. Thus, the effect of family risk on theory of mind may 
be explained by children’s own language ability.

This pattern of results suggests the possibility that effects of family risk on theory of 
mind may, in part, be mediated by children’s own language ability. That is, during instances of 
high exposure to family risk, children are more likely to experience a lag in theory-of-mind 
development because of similar delays in language development. The goal of Model 1 is to test 
the possible mediating role of children’s language ability on the relationship between family 
risk and theory-of-mind development.

To establish mediation, there must be theoretical motivation to suggest that general 
child language ability is responsible for mediating the relation between family risk and theory 
of mind. Empirically, there is evidence that demonstrates an association between family risk 
and child language ability (e.g., see Hoff, 2006) and between child language ability and theory 
of mind (e.g., Astington & Jenkins, 1999). First, the adverse effects of family risk on children’s
language development have been consistently demonstrated across studies (e.g., see Hoff, 2006, for a review). A substantial amount of evidence suggests that children from low socioeconomic status backgrounds are less likely to acquire language at the same rate as their more affluent peers (e.g., Lugo-Gil & Tamis-LeMonda, 2008). This developmental pattern is consistent across different aspects of language including vocabulary and receptive and expressive language development (e.g., McDowell, Lonigan, & Goldstein, 2007; Raviv, Kessenich, & Morrison, 2004). Second, there is also compelling evidence to suggest that children’s general language ability is associated with false-belief understanding (e.g., Milligan et al., 2007; see Chapter 3 for review). To date, numerous studies ranging from those using training paradigms (e.g., Hale & Tager-Flusberg, 2003) to those involving deaf children (e.g., Peterson & Siegal, 1995) have all demonstrated a causal association between child language and false-belief understanding.

4.3.1 Hypothesis 1: Effects of Family Risk on Theory of Mind are mediated by Children’s Language Ability

To date, there is preliminary evidence to support the notion that family risk does not directly influence theory of mind. More specifically, empirical studies appear to suggest that family risk may affect theory of mind by affecting the rate at which child acquire language. With slower rates of language acquisition, children exposed to higher levels of family risk are more vulnerable to delays in theory-of-mind development. The goal of Model 1 is to test this mediating model of theory-of-mind acquisition.

Six binary markers of social disadvantage were used to assess family risk in the current study. This included indices of available family resources (i.e., access to a car, monetary government assistance, government assisted housing, family income) and parental competency
(i.e., parental education designation, parental paid employment). These specific indices were
chosen given that the objective of Model 1 was to examine the effects of family characteristics
on theory of mind development. For this reason, measures of neighbourhood quality were
excluded. Similar measures of social disadvantage have been used in other studies examining
the effects of risk and theory of mind (e.g., Hughes & Ensor, 2007).

The inclusion of a family risk variable may offer several advantages over traditional
socioeconomic status measures. Within the Canadian context, it is difficult to accurately code
parental occupation since there is no standardized system in place. For the current study,
socioeconomic status can only be estimated based on family income and parental education.
Since risk factors do not operate in isolation where their effects are cumulative (e.g., Atzaba-
Poria, Pike, & Deater-Deckard, 2004), utilizing a multi-risk indicator may provide a more
accurate assessment of the amount of risk each child is exposed to. Moreover, since risk tends
to ‘cluster’ in that experiencing a few risks increases the odds of exposure to further risk
(Hobcraft, 2004), the proposed family risk variable may be more accurate in capturing the
extent to which children are exposed to high risk environments.

It is hypothesized that the effects of family risk on theory of mind will be mediated by
general child language ability. That is, the relationship between family risk and theory of mind
will be explained by children’s language ability. However, given the exploratory nature of the
current study, no specific hypothesis is made with respect to whether child language will
partially or fully mediated the effects of family risk.

Parental mental-state talk appears to be an important mechanism responsible for facilitating theory-of-mind acquisition. Significant associations with false belief have been demonstrated for the amount (e.g., Ruffman, et al., 2002) and type (e.g., Adrian et al., 2007) of parental mental-state term utterances. A recent study also suggest that more sophisticated theory of mind emerges when parents and their children talk about mental states within a context of semantic connectedness (Ensor & Hughes, 2008).

However, despite the robust association found between parental mental-state talk and theory of mind, the process whereby mental-state talk affects theory of mind remains relatively unclear. Recall from Chapter 2 that despite a significant association with children’s theory-of-mind scores, parental cognitive talk loses significance once the effect of parent-child connectedness is controlled for. Since parent-child connectedness accounted for a significant amount of common variance shared between parental cognitive talk and children’s social understanding scores, this pattern of results suggests that the effects of parental cognitive talk on theory of mind may operate through parent-child connectedness.

Alternatively, it is also conceivable that effects of parent-child connectedness on theory of mind may be mediated by parental-cognitive talk. Particularly since significant associations between parent-child connectedness, parental cognitive talk and theory of mind have been found (e.g., Ensor & Hughes, 2008), it is difficult to establish the causal relationship between these variables. However, arguably to date, there is more theoretical and empirical evidence to
support parent-child connectedness as a possible mediator. First, significant associations between parental cognitive talk and parent-child connectedness have been demonstrated by Ensor and Hughes (2008). With a socially diverse sample, naturalistic observations of parent-interactions during meal preparation were coded. The quality of each parent-child turn was evaluated (i.e., connected, initiated, failed, conflict and unclear) during this 30 minute period. Results indicated that when compared with other types of parent-child turns, parent were more likely to use desire and cognitive terms during connected turns with their preschoolers. This suggests that parental talk about desires and cognitive states was more likely to occur within the context of connected conversations. Second, the causal association between parent-child connected conversations and theory of mind have also been demonstrated. In the aforementioned study by Ensor and Hughes (2008), authors found that connect conversations, rather than parental references to cognitive terms predicted subsequent social understanding in children. Additionally, significant associations between connected conversations and theory of mind have also been demonstrated with cross-sectional data in a sample of “hard-to-manage” preschoolers. That is, those who had experienced more frequent connected conversations with their mothers also performed significantly better on an aggregate measure of theory of mind than those who experienced less connected talk with their mothers (Dunn & Brophy, 2005). These results suggest that parent-child connectedness may facilitate theory-of-mind development in children.

In sum, existing research provides support to suggest that the effects of parental cognitive talk on children’s theory-of-mind development may be mediated by the extent to which parents and their children engage in connected conversations. The goal of Model 2 is to test this possible model of theory-of-mind development. Rather than adopting a turn-based
coding approach, parent-child connectedness was operationalized as a global measure of parent-child reciprocity. Based on the Parent Child Interaction System (PARCHISY) (Deater-Deckard, Pylas, & Petrill, 1997) the parent-child reciprocity code captured both 1) the extent to which parent-child exchanges displayed “conversation-like” qualities and 2) the extent to which parent-child dyads displayed shared positive affect (e.g., eye contact). Although the semantic relatedness of each parent-child turn was not evaluated, parent-child reciprocity scores provided a global measure of the quality of the parent-child exchanges. Conceivably, it is difficult to engage in connected conversation without a certain level of reciprocity shared between parents and children. Thus, when compared with previous studies (e.g., Slomkowski & Dunn, 1996), the current study operationalized parent-child connectedness as a more global construct of parent-child reciprocity.

The primary advantage of employing a global measure of parent-child reciprocity is that several parent-child factors can be considered simultaneously. For instance, in addition to evaluating whether conversation-like qualities are present, the current reciprocity scores also incorporate a measure of shared, positive, affect displayed between dyads. This is particularly important since previous research has demonstrated a significant association between lower levels of parental warmth (Cahill, Deater-Deckard, Pike, & Hughes, 2007), negative control and harsh parenting (Hughes et al., 1999) with delays in social understanding. These results suggest that in addition to what parents and children are discussing, the socio-emotional context in which parent-child interactions occur also matters to theory-of-mind development.
4.4.1 Hypothesis 2: The Effect of Parental Cognitive Talk on Theory of Mind is mediated by Parent-child Reciprocity

By including a more global measure of parent-child connectedness, it was hypothesized that the effects of parental cognitive talk on theory of mind will be mediated by the extent to which parents and their children engage in reciprocal interactions during the wordless storybook reading task. That is, the effects of parental cognitive talk are indirect. Higher levels of parental cognitive talk will predict higher levels of parent-child reciprocity that then is associated with more sophisticated theory-of-mind understanding in children. However, given the exploratory nature of this research question, no specific hypothesis is made with respect to whether parent-child reciprocity will partially or fully mediate the relationship between parental cognitive talk and theory of mind.

4.5 Model 3 - The Effect of Cognitive Factors: Possible Contingency Effects between Conflict Inhibition and General Child Language Ability on Theory of Mind

Children’s own cognitive abilities have also been found to affect the rate at which they acquire theory of mind. Numerous studies have shown a causal association between higher general child language ability (e.g., Astington & Jenkins, 1999), and between executive function skills (e.g., Hughes, 1998) and more sophisticated theory-of-mind understanding, particularly that of false belief. However, despite our understanding of how these individual processes contribute to development, it remains relatively unclear how these mechanisms operate together during development. Two possible ways to conceptualize their effects on theory-of-mind development include additive and multiplicative models. First, effects of different mechanisms could be additive in that each uniquely contributes to theory-of-mind acquisition. If this were the case, we would expect to see each mechanism predicting unique
variance in children’s theory-of-mind scores. Second, effects across mechanisms may be multiplicative where their combined effects on theory-of-mind development are exponential.

To date, numerous studies have demonstrated the direct effects of child language (e.g., Astington & Jenkins, 1999) and conflict inhibition (e.g., Carlson & Moses, 2001) on theory-of-mind development, particularly that of false belief. However, despite examining the independent effects of child language and conflict inhibition, rarely have these studies also considered the interactive or contingent effects of these mechanisms.

One possibility is that conflict inhibition may be important for theory-of-mind development under certain linguistic conditions. Since child language is thought to provide children with a representational system to reason about abstract mental-state concepts, conflict inhibition may be required to help children show what they know about mental states during a theory-of-mind task (i.e., the expressive account of executive functions). Indeed, there is existing evidence to suggest that executive functions are required for children’s theory-of-mind acquisition (e.g., Hughes & Ensor, 2007) and that it is likely that these abilities help children express what they know about mental states (Slade & Ruffman, 2005). Thus, although both child language and conflict inhibition are required for theory of mind, conflict inhibition would have a greater effect on development when children also have the abstract understanding of mental states to reason through a theory-of-mind task. Particularly with more advanced theory-of-mind concepts like false belief, the unique combination of high language and high conflict inhibition may be required to provide the necessary cognitive skills that allow children to successfully pass these tasks. Therefore, the effects of language and conflict inhibition on theory of mind are contingent upon one another where there are differential effects of conflict inhibition across different levels of child language ability.
Thus, the goal of Model 3 is to examine the interactive effects of children’s language ability and their executive functioning skills, particularly that of conflict inhibition. Specifically, the primary interest was to examine whether effects of child language and conflict inhibition are additive or multiplicative during theory-of-mind acquisition. Given the exploratory nature of this study, no specific hypotheses were made. However, if child language and conflict inhibition are both important for theory-of-mind development, both mechanisms are expected to emerge as significant predictors of children’s theory-of-mind scores. This pattern of results would support the additive model of theory-of-mind development. Alternatively, if the product of children’s language and conflict inhibition scores significantly predicts theory-of-mind scores, these factors potentiate one another, supporting the multiplicative model of development. Lastly, both additive and multiplicative models of development may be accurate in describing theory-of-mind acquisition. Thus, in addition to significant effects of both child language and conflict inhibition, their interaction term will also predict significant variance in children’s theory-of-mind scores.

4.6 Model 4 - The Joint Effect of Environmental and Cognitive Factors: Testing the Compensatory Model of Theory-of-mind Development

To date, research has demonstrated enormous individual variability to when children acquire theory of mind. For instance, in a meta-analysis examining false-belief understanding, it was demonstrated that this ability emerges between 3 to 5 years of age in typically developing children (Wellman et al., 2001). To help explain individual variability, researchers have identified different environmental factors (e.g. family characteristics and socio-linguistic factors) and cognitive factors (e.g., general child language ability and executive functions) that

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2 Conflict inhibition was chosen since it has been found to be most robustly related to children’s false-belief scores. Moreover, in the current study, partial correlations controlling for the effects of age and gender show a significant association between theory of mind and conflict inhibition.
have been found to be causally related to theory-of-mind development in preschoolers. However, despite our understanding of the direct effects of these mechanisms, little is known about the relative role these factors play. Specifically, it is unclear as to how environmental and cognitive factors operate together during the course of theory-of-mind development. Given the important role of theory-of-mind understanding during social interactions, perhaps children are able to acquire theory of mind through different pathways. That is, the relative importance of each mechanism may be different across individuals where lower levels of one factor are compensated by higher levels of another so that typical development occurs. However, these multiple pathways result in the same outcome – an appreciation for how mental states relate to everyday, real-world behaviours.

To date, there is some evidence to suggest that environmental and cognitive factors may have a multiplicative effect on theory of mind. For instance, when compared with children with higher language ability with no siblings, children with lower language ability with two siblings displayed similar abilities in false-belief understanding (Jenkins & Astington, 1996). This suggests that both family-specific factors (i.e., presence of siblings) and individual cognitive ability (i.e., child language ability) are important during theory-of-mind acquisition where the lower level of one factor can be compensated by another. Thus, the relative importance of each mechanism may be different across children and multiple pathways may be involved during theory-of-mind development. More importantly, these patterns of results suggest that the absence of one mechanism can be compensated by the presence of another so that typical development occurs.

If compensatory mechanisms underlie theory-of-mind development perhaps similar compensatory patterns will also be seen for other environmental factors in addition to siblings
such as parental mental-state talk. Particularly during instances of low language ability and/or conflict inhibition, explicit discussions about mental states with parents can scaffold children’s theory-of-mind reasoning. Through parent-child conversations, children are given the opportunity to talk about mental-state concepts. Perhaps when parents explicitly highlight multiple perspectives during mental-state discourse, children learn about the subjective nature of mental states. Moreover, by talking about multiple perspectives, children may also be given the opportunity to hold two distinct perspectives in mind. This scaffolding from more knowledgeable experts may help children develop and internalize cognitive structures required to think about and manage mental states that may be important for reasoning through a theory-of-mind task. Similarly, more sophisticated language and/or executive functioning skills may have the same compensatory effect during instances of low linguistic mental-state input since cognitive resources to reason about theory of mind are more securely in place, requiring less linguistic support from the environment.

4.6.1 Hypothesis 3: Relations between Child Language Ability and Theory of Mind are moderated by Parental Cognitive Talk

In summary, although direct effects of environmental and cognitive factors on theory of mind have been demonstrated, there is also evidence to suggest that there may be possible compensatory relations between these mechanisms (e.g., Jenkins & Astington, 1996). The goal of Model 4 is to test whether the effects of child language on theory of mind is moderated by parent-child conversations about mental states. Given that relative to other mental-state terms, parental use of cognitive terms has been found to be a more consistent predictor of children’s theory-of-mind scores (e.g., Adrian et al., 2007) a quantitative measure of parental epistemic terms will be used in the current analysis. Similarly, a measure of children’s conflict inhibition
is used to account for the specificity in executive function-theory of mind relations demonstrated by current research (e.g., Carlson & Moses, 2001). Finally, children’s score on the Test of Early Language Development-3 (TELD-3), a general child language measure, will be used to account for children’s overall linguistic ability. Building upon research by Jenkins and Astington (1996), it was hypothesized that high levels of parental cognitive talk will compensate for the effects of low language ability and/or low conflict inhibition skills during theory-of-mind development. Similarly, higher language ability and more sophisticated conflict inhibition skills are expected to compensate for low levels of parental cognitive talk.

4.7 Summary

In sum, the current thesis aimed at understanding how different environmental and cognitive processes operate together during theory-of-mind development. Utilizing a socially diverse sample and extending beyond false-belief understanding, the following models of theory-of-mind development are proposed:


   *Hypothesis:* The effects of family risk on theory of mind are mediated by children’s language ability. That is, family risk affects theory of mind by influencing the rate at which children acquire language. With slower rates of language acquisition, children exposed to higher levels of family risk are also more likely to experience delays in theory-of-mind development.

**Hypothesis:** The effects of parental cognitive talk on theory of mind will be mediated by parent-child reciprocity. Parental cognitive talk affects theory of mind by influencing the extent to which parents and children engage in reciprocal conversations. Specifically, when parents use more cognitive terms during conversations with preschoolers, they are also more likely to engage in reciprocal conversations that then facilitate more advanced theory-of-mind understanding in children.

3. **Model 3: Testing possible contingency effects between conflict inhibition and child language ability on theory of mind**

   Given that there is evidence to support both the additive and multiplicative models of theory-of-mind development, no specific hypotheses were made.

4. **Model 4: Testing the compensatory model of theory-of-mind development**

   **Hypothesis:** Parental cognitive talk will moderate the relation between general child language ability and/or conflict inhibition and theory of mind. Specifically, high levels of parental cognitive talk will compensate for the effects of low language ability and/or low conflict inhibition skills whereas higher language ability and more sophisticated conflict inhibition skills are expected to compensate for low levels of parental cognitive talk.
Chapter 5: Methods

5.1 Participants

This study involved 77 monolingual English-speaking preschoolers between the ages of 3 to 5 years along with their parents. Two participants were subsequently excluded from analyses since one participant did not verbally communicate during testing and another participant had a parent who experienced developmental delay. In total, data from 75 families were included. Preschoolers ranged from 3 years and 0 months to 5 years and 11 months of age ($M_{age} = 4$ years 6 months, $SD = 11$ months). There were approximately equal numbers of boys ($n = 32$, $M_{age} = 4$ years 5 months, $SD = 10$ months) and girls ($n = 43$, $M_{age} = 4$ years 7 months, $SD = 11$ months).

Families were recruited from a range of socioeconomic backgrounds in communities within the Greater Toronto and surrounding areas (e.g., Newmarket and Oshawa). Considering that bilingual children have been found to perform better on false-belief tasks (Goetz, 2003), families were eligible to participate insofar as their preschooler was monolingual English speaking. Families were recruited from local non-profit, charitable agencies in low-, mid- and high-income neighbourhoods. These included community centres and community-based organizations (e.g., Early Years Learning Centres). A portion of families from Oshawa were recruited through the Durham District School Board. Schools within the Oshawa area from low-, mid- and high-income neighbourhoods were contacted and consent forms were distributed to junior and senior kindergarten classes. Interested families were contacted and invited to participate in the study. For all participants, testing occurred in an unfamiliar, quiet room in local community or Early Years Centres.
5.2 Materials and Procedure

The purpose of the present study is to examine how environmental and cognitive factors operate together during theory-of-mind development. To this end, children’s general language ability, theory-of-mind understanding and executive functioning abilities were assessed. A sample of parent-child talk was also collected and coded for parental mental-state talk and quality of parent-child relationship. The order in which these tasks were presented was not counterbalanced across participants since individual differences are most accurately assessed when participants are exposed to the same stimuli context. In addition to presenting participants with the same stimuli, the order in which stimuli are presented is also important. Unlike instances where means are compared in a repeated-measures design, counterbalancing does not resolve the limitation of an order effect when examining correlations (Carlson & Moses, 2001). For this reason, I presented all tasks to children in the same order to maintain consistency across participants.

5.2.1 Assessing Children’s Language Ability

First, children’s general language ability was assessed with the TELD-3, (Hresko, Reid, & Hammill, 1999). This test involves presenting children with pictures and stories while prompting them to respond through pointing, gesturing and short answers. The language dimensions of content (semantics) and form (phonology, morphology and syntax) are both assessed in the receptive and expressive language domains. The TELD-3 was chosen because of the highly robust relationship seen between this test and children’s false-belief understanding (Milligan et al., 2007).

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3 Correlations within each order do not fully constrain the overall correlations that emerge when the data are collapsed across orders. This is because the nature of the correlation within each order will depend on the shapes of the within-order scatter plots and their locations with respect to one another.
Children’s raw scores on the expressive and receptive language subtest of the TELD-3 were summed to create a general language composite score. Higher scores indicated better language ability. The distribution of children’s general language scores was normal.

5.2.2 Assessing Children’s Theory-of-mind Understanding

After the TELD-3, children’s theory-of-mind understanding was assessed with a modified version of the Wellman and Liu (2004) Theory-of-Mind scale. The Theory-of-Mind scale presents various tasks in a sequential format that map closely onto the development of children’s theory-of-mind understanding. As children move through the scale, tasks become conceptually more difficult. Thus, progression further along the scale reflects more sophisticated theory-of-mind understanding. The first three tasks of the theory-of-mind scale assessed children’s understanding of diverse desires and beliefs, and knowledge and ignorance. This is followed by tasks that assessed more sophisticated theory-of-mind understanding such as false-belief, belief-based emotion, and real-apparent emotion understanding. Particularly since false-belief understanding develops primarily between the ages of 3-5 years, an additional change-in-location false-belief task was included. In summary, children were presented with the following tasks: 1) diverse desire task, 2) diverse belief task, 3) knowledge access task, 4) explicit false-belief task, 5) unexpected contents false-belief task 6) change-in-location false-belief task, 7) belief-based emotion task and 8) real-apparent emotion task. Refer to Table 1 for a summary of these tasks. Refer to Appendix A for task protocol.

Considering that theory-of-mind development follows a predictable pattern (Wellman & Liu, 2004), the order in which these tasks were presented was not changed. If children failed two consecutive tasks on the theory-of-mind scale, testing was stopped. For all theory-of-mind tasks, stories were enacted for children with the use of pictures, puppets and/or props.
Table 1.

*Description of Theory-of-mind Tasks Used* (Wellman & Liu, 2004)

<table>
<thead>
<tr>
<th>Theory-of-Mind task</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diverse Desire</td>
<td>Child judges that two individuals (the child vs. another individual) can have different desires about the same object.</td>
</tr>
<tr>
<td>Diverse Belief</td>
<td>Child judges that two individuals (the child vs. another individual) can have different beliefs about the same object, when the child does not know which belief is true.</td>
</tr>
<tr>
<td>Knowledge Access</td>
<td>Child sees what is inside a box and judges (Yes or No) the knowledge of another individual who has not seen inside the box.</td>
</tr>
<tr>
<td>Explicit False Belief</td>
<td>Child judges where someone will search, given the person's mistaken belief. In this task, children are told of the other person’s mistaken belief.</td>
</tr>
<tr>
<td>Contents False Belief</td>
<td>Child judges another person's false belief about the contents of a distinct container when child knows it does not contain its typical contents.</td>
</tr>
<tr>
<td>Change-in-location False Belief</td>
<td>Child judges where someone will search, given the person’s mistaken belief. Child has to infer someone’s false belief when object is moved.</td>
</tr>
<tr>
<td>Belief-based Emotion</td>
<td>Child judges how a person will feel, given a belief that is false.</td>
</tr>
<tr>
<td>Real-Apparent Emotion</td>
<td>Child judges that a person can feel one thing but display a different emotion.</td>
</tr>
</tbody>
</table>

Children’s performance across theory-of-mind tasks was scored individually. Children were given a score of 1 if they were able to successfully answer the control and target questions associated with each task for a maximum score of eight. Prompts were also provided to help children answer control and target questions if they appeared to have difficulty understanding
what the experimenter was asking. These prompts simply re-stated the response options available for each particular question. Children were given a score of 0 if they provided an incorrect response for the control questions and/or target questions.

5.2.3 Assessing Children’s Understanding of Sentential Complements

Following theory-of-mind assessment, children’s understanding of sentential complements was examined. Sentential complements are specific linguistic constructions that allow for the expression of a contradiction between mental states and reality. These linguistic structures have been demonstrated to be related to children’s theory-of-mind development (e.g., Hale & Tager-Flusberg, 2003). To examine children’s understanding of sentential complements, children completed the Comprehension of Sentential Complements task (deVilliers & Pyers, 2002). This task involved six different pictured scenarios in which children were told of a character who made a mistake, lied or had a false belief. The children’s task was to report the content of the character’s belief/lie/mistake. For example:

1. She told the girl there was a bug in her hair, but (second picture) it was only a leaf. What did she tell the girl?

2. She said there was a spider in her cereal, but (second picture) it was really a berry. What did she say?

In all instances, children completed all six tasks. Children received a score of 1 if they were able to accurately identify what each character said or told. An aggregate sentential complement score was created based on the total number of successful trials. The distribution was found to be slightly skewed and a square root transformation was applied to normalize the data. Refer to Appendix B for task protocol.
5.2.4 Assessing Parent-child Mental-state Talk

Following the Comprehension of Sentential Complement tasks, parents and their children were invited to look through a wordless storybook. This task was used to assess how parents talked about mental state concepts with their children. Parents and their children talked about the story “The Midnight Circus” (Collington, 1993) which documents the adventures of a little boy whose mechanical horse comes alive and takes him on a magical journey to a midnight circus. This particular storybook was chosen because of the wide range of emotions and false-belief scenarios illustrated throughout the story. Parents and their children were asked to complete this task alone in a quiet, secluded room. More importantly, parents were told to go through and talk about the wordless storybook similarly to how they would when reading storybooks with their children. A video camera was set up non-intrusively in a corner of the room so that parent-child conversations could be videotaped for later transcribing and coding of interactions. Due to four instances of technical difficulties and one refusal from the child to complete the task, five parent-child storybook reading sessions were excluded from analyses. A sample of mental-state talk was collected for 70 parent-child dyads. Coding of parent-child conversations will be discussed in Chapter 6.

5.2.5 Assessing Children’s Executive Functioning Ability

Lastly, children’s executive functioning ability was assessed. Children completed an executive function battery that consisted of tasks that assessed inhibitory control (i.e., red-dog/blue-dog stroop task) (for a similar task, see Gerstadt, Hong, & Diamond, 1994), conflict inhibition (i.e., bear/dragon task) (Kochanska, Murray, Jacques, Koenig, & Vandegeest, 1996), working memory (i.e., backward word span task) (Slade & Ruffman, 2005) and delay inhibition (i.e., gift delay task) (Kochanska et al., 1996). Moreover, to distinguish children’s
working memory from their short-term memory, the forward word span task was also administered before the backward word span task. Pictures, puppets and/or props were used to administer all executive functioning tasks. Refer to Table 2 for a description of each executive function task. Refer to Appendix C for executive functioning task protocols.

Table 2.

Tasks Included in Executive Functioning Battery

<table>
<thead>
<tr>
<th>Executive Function Task</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red Dog/Blue Dog Task</td>
<td>Children are required to say “red” when they see a picture of a blue dog and say “blue” when they see a picture of a red dog</td>
</tr>
<tr>
<td>Bear-Dragon Task</td>
<td>Children are required to alternately perform and suppress actions requested by a bear and a dragon puppet</td>
</tr>
<tr>
<td>Forward Word Span Task</td>
<td>Children are required to repeat as many words as they can in the initial order that is presented to them by the experimenter</td>
</tr>
<tr>
<td>Backward Word Span Task</td>
<td>Children are required to repeat as many words as they can in backwards order from the initial order that is presented to them by the experimenter</td>
</tr>
<tr>
<td>Gift Delay Task</td>
<td>Children are required to face away from the experimenter and asked not to peek while the experimenter wraps a present for them</td>
</tr>
</tbody>
</table>

Children received a score of 1 for each successful trial on the red dog/blue dog. When a child responded with the correct answer, it was coded as a successful trial. However, during
instances where children changed their minds, their last response was coded as their final response for that particular trial. Number of successful trials was summed and children received a maximum score of 28 on this task.

For the bear/dragon task, bear and dragon puppets were replaced with frog and monkey puppets because children were more familiar with them. When children were able to successfully inhibit or perform an appropriate action, it was coded as a successful trial. When children failed to or partially inhibited or performed an inappropriate action, it was coded as an unsuccessful trial. Number of successful trials was summed. Higher scores reflected better conflict inhibition. Children received a maximum of score of 10 on the task.

Successful trials on the forward- and backward word-span task represented instances where children were able to repeat as many words in forward or backward order (depending on the task) from the initial order that was presented to them by the experimenter. Children received a maximum score of 12 on both tasks with higher scores reflecting better memory.

Lastly, the gift delay task score was based on the amount of time children were able to inhibit their impulse to turn around while the experimenter wrapped their present. Longer time spent before turning around reflected better delay inhibition.

5.2.6 Family Demographic Questionnaire

During the assessment of children’s conflict inhibition ability, parents completed a questionnaire aimed at assessing the family’s home environment. Questions about the family (e.g., how many siblings does the target child have?) as well as specific parental factors (e.g., what is the highest level of education you’ve completed?) were asked. Refer to Appendix D for family demographic questionnaire.
Chapter 6: Coding Scheme for Parental Mental-state talk and Parent-child Interactions

All parent-child storybook reading sessions were transcribed verbatim from the original videotaped session. All parent-child turns were transcribed but only parental turns were coded. Transcribers were native English-speaking undergraduate students with a background in psychology. In this study, two aspects of parent-child interactions were of interest. First, parental mental-state talk was examined. This included 1) the quantity of parental mental-state talk and 2) how parents talked about mental states during conversations. Second, the quality of the parent-child interaction was examined. This included 1) displays of positivity and negativity by both parents and children and 2) the extent to which parents and children were ‘in tune’ with each other during the storybook reading process. In the sections below, coding protocol for each type of parent-child interaction will be discussed.

6.1 Parental Mental-state Talk Coding

6.1.1 Inter-coder Reliability

To ensure an acceptable level of agreement between coders, 20% of transcripts were randomly selected to establish inter-coder reliability. Reliability transcripts were first independently coded and compared with determine the level of agreement and disagreement. Agreements represented instances where both coders assigned the same mental-state code to the same event. Disagreements consisted primarily of instances in which coders assigned different codes for the same event or failure to code an event. Agreement between coders was found to be acceptable across all parental mental-state talk codes. Specific measures of inter-rater reliability are reported in the following sections. Disagreements were resolved through
discussion and in some cases, with reference to the original videotaped session. Remaining transcripts were randomly divided between coders and coded independently.

6.1.2 Parental Mental-state Talk Coding

The primary objective was to examine the different types of mental-state term references parents made when speaking with their preschoolers (for a similar coding scheme see Sabbagh & Callanan, 1998). There were five different types of mental-state terms: pretend, knowledge, desire, preference and emotion. Inter-coder reliability revealed a high level of agreement between coders on mental-state term codes ($\kappa = .98$). A description of each mental-state term category is provided in Table 3. The total number of parental mental-state term references was summed together according to mental-state term category.

Whose perspective parents highlighted was also coded. Mental-state term focus coding included four different types: 1) self-self (mental-state term is used to describe the parent’s own mental state), 2) self-protagonist (parent takes the role of the story protagonist and expresses the story protagonist’s perspective), 3) other-other (parent uses mental-state term to describe the perspective of the child) and 4) other-protagonist (parents use mental-state term to describe the perspective of the story protagonist in the story). Inter-coder reliability revealed a high level of agreement between coders for focus codes ($\kappa = .97$). Examples of each focus code are provided in Table 4. Parental focus talk references were summed together according to focus-talk category.

Aside from the quantity of parental mental-state term references, how parents talked about different perspectives was also examined. Specifically, the extent to which parents highlighted multiple perspectives and provided causal explanations were examined. There were
Table 3.

*Mental State Term Categories*

<table>
<thead>
<tr>
<th>Mental State Term Category</th>
<th>Description</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pretend Term</td>
<td>Refers to mental-state terms that illustrate an element of imagination or fantasy.</td>
<td>Pretend, imagine</td>
</tr>
<tr>
<td>Cognitive Term</td>
<td>Refers to mental-state terms that are intended to reflect a thought or belief. Thoughts refer to any cognitive activity or process.</td>
<td>Think, know, believe</td>
</tr>
<tr>
<td>Desire Term</td>
<td>Refers to mental-state terms that involve an internal experience characterized by longing, wishing or craving for an object, action or state of affairs that may or may not be possible.</td>
<td>Want, wish</td>
</tr>
<tr>
<td>Preference Term</td>
<td>Refers to mental-state terms that reflect the preference of an individual.</td>
<td>Like, prefer, favourite</td>
</tr>
<tr>
<td>Emotion Term</td>
<td>Refers to mental-state terms that describe an emotional or affective experience. Examples include <em>happy, sad, scared</em>, etc.</td>
<td>Happy, sad, scared</td>
</tr>
</tbody>
</table>

two different codes used to capture parents’ talk about multiple perspectives: 1) *direct reference* (instances where parents used a mental state term to reflect a mentalistic process) and 2) *implicit contrastive* (when two mental state concepts or mental-state terms are implicitly discussed). Specifically for implicit contrastives, there were two different types: 1) *contradiction* (instances where parents and their child expressed different perspectives on the same event) and 2) *self-correction* (instances where the parent highlighted a shift or change in
Table 4.

**Focus Coding Categories**

<table>
<thead>
<tr>
<th>Focus Coding Category</th>
<th>Description</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self-self</td>
<td>Mental-state terms are coded as self-self when terms are used to describe the speaker’s own mental states.</td>
<td>M: What is this? A monkey or a gorilla? <em>I think</em> this one’s a gorilla</td>
</tr>
<tr>
<td>Self-protagonist</td>
<td>Mental-state terms are coded as self-protagonist during instances where the speaker takes on the role of the story protagonist and expresses the mental state of the story protagonist.</td>
<td>M: And Chris said “<em>I am very sad</em>”</td>
</tr>
<tr>
<td>Other-other</td>
<td>Mental-state terms are coded as other-other reference when the speaker uses them to describe the mental states of the other participant who is part of the parent-child dyad.</td>
<td>M: What is going on here? <em>You know</em> what this is</td>
</tr>
<tr>
<td>Other-protagonist</td>
<td>Mental states are coded as other-protagonist when a speaker refers to the mental states of the characters in the story.</td>
<td>M: And <em>he wondered</em> if it was just a dream.</td>
</tr>
</tbody>
</table>

M: Mother

their perspective). Unlike direct references, both contradictions and self-corrections highlighted the existence of multiple perspectives. Examples provided in Table 5. Parental references to direct references and implicit contrastives were summed together. Subcategories were collapsed together.
Lastly, the extent to which parents provided a causal explanation for their perspective was examined. There are two different causality codes for direct references: 1) *explicit causality* (instances where parents explicitly highlighted causality with a causal term) and *implicit causality* (instances were causality is implicitly highlighted by parents). For both contradictions and self-corrections, only explicit causality was coded. Inter-coder reliability revealed an acceptable level of agreement between coders on direct reference ($\kappa = .91$) and implicit constrastive codes ($\kappa = .76$). Examples are provided in Table 5. A measure of parental causal talk was created by summing across different types of causal-talk categories. Categories were then collapsed according to how causality was discussed (i.e., explicit and implicit causality).

Table 5.

*Mental-state Conversational Code*

<table>
<thead>
<tr>
<th>Conversational Code</th>
<th>Description</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct Reference</td>
<td>Utterances where the mental-state term is used to refer to thoughts or mental processes in a non-contrastive manner.</td>
<td>M: Look! He <em>wants</em> (desire term-direct reference) to follow the other children!</td>
</tr>
<tr>
<td>Direct Reference-Explicit Causality</td>
<td>Utterances where the mental state term is used to refer to thoughts or mental processes in a non-contrastive manner that <em>explicitly</em> highlights causality with a causal term.</td>
<td>M: He’s <em>scared</em> (emotion term-direct reference) <em>because</em> (causal term) he’s moving backwards and so is the horse (causal explanation).</td>
</tr>
<tr>
<td>Direct Reference-Implicit Causality</td>
<td>Utterances where a mental state term is used to refer to thoughts or mental processes in a non-</td>
<td>M: He was still <em>sad</em> (emotion term-direct reference). Do you see the tears on his face (causal explanation)?</td>
</tr>
</tbody>
</table>
contrastive manner that *implicitly* highlights causality (without a causal term).

<table>
<thead>
<tr>
<th>Implicit Contrastive – Self Correction</th>
<th>Instances where 2 different mental states are implicitly contrasted when parent changes his/her mind/belief</th>
<th>M: He got up on his pony and rode all the way home (perspective #1). . . .actually he didn’t go home, he went to a circus (perspective #2).</th>
</tr>
</thead>
<tbody>
<tr>
<td>Implicit Contrastive – Self Correction Causal</td>
<td>Similar to an implicit contrastive-self correction but parent provides an explanation for why they changed their mind</td>
<td>M: He was so excited that he started running home. He started running home (Perspective #1). But of no...he’s actually running after the truck (Perspective #2). He’s really upset. He’s running after the truck. Because why (causal term)? He wants to ride on the pony (causal explanation). And Chris is so upset.</td>
</tr>
<tr>
<td>Implicit Contrastive – Contradiction</td>
<td>Implicit contrastive that is marked by different mental states of two individuals during a disagreement</td>
<td>F: what are these? C: Men F: No, these are working men C: No.</td>
</tr>
<tr>
<td>Implicit Contrastive – Contradiction Causal</td>
<td>Similar to a implicit contrastive-contradiction but speaker provides reason for why they disagree</td>
<td>M: Who’s this? C: A man. M: No, it’s a nurse because (causal term) she has all these medical supplies (causal explanation)</td>
</tr>
</tbody>
</table>

F: Father, M: Mother, C: Child

### 6.2 Quality of Parent-child Interaction Coding

#### 6.2.1 Inter-coder reliability

Videotaped sessions of the wordless storybook reading task were used to code for the quality of the parent-child interaction. Like parental mental-state talk coding, 20% of all
wordless storybook-reading sessions was selected to establish inter-coder reliability. Randomly selected sessions were independently coded by two coders. Agreements and disagreements were compared. Agreements represented instances where coders’ independent scores were exactly the same or fell 1 point above or below each other (for each coding category). Disagreements were instances where scores fell more than 1 point above or below each other. Reliability between coders was found to be acceptable across all quality codes. Specific measures of inter-rater reliability are reported in the following sections. Disagreements were resolved through discussion and with reference to the original videotaped session. The remaining wordless storybook reading sessions were randomly divided between coders and coded independently.

6.2.2 The Parent Child Interaction System (PARCHISY)

Quality coding of parent-child interactions was based on the Parent Child Interaction System (PARCHISY), a global rating system of parent-child interactions developed by Deater-Deckard et al., (1997). This coding system allows observers to rate different parent and child behaviours on a 7-point Likert scale (1 = no occurrence of the behavior to 7 = continual occurrence of the behavior). Most importantly, the PARCHISY has been used to examine naturalistic behaviors in a variety of populations (e.g., Hughes & Ensor, 2005) and has been demonstrated to be a reliable and valid global rating system of parent-child interactions.

All storybook reading sessions were divided into two segments at the halfway point and each section was coded separately. Considering that across all parent and child quality codes, the first segment was significantly correlated with the second segment, all parent and child scores were averaged across segments to create a mean score for each coding category. Sessions were coded in this fashion to account for variability in emotional tone throughout the
story since the emotional content of the story can affect parent-child interactions (e.g., children may be more responsive during suspenseful parts of the story). Parent-child codes across segments were significantly correlated (parental negativity, \( r = .44 \); parental positivity, \( r = .75 \); child responsiveness, \( r = .91 \); child positivity, \( r = .70 \); reciprocity, \( r = .88 \)) and a mean score was created to account for story-specific characteristics that can influence how parents and their children interacted with each other.

6.2.2.1 Parent-specific Codes. Parent-specific codes examined two different domains: the extent to which parents displayed 1) positive affect and 2) negative content. Positive affect captured instances where parents displayed warmth through nonverbal behaviours such as smiling and laughing. Possible scores ranged from 1 (no positive affect displayed) to 7 (constant positive affect – smiling and laughing throughout task). Higher scores reflected more parental displays of positive affect. Inter-coder reliability revealed a high level of agreement between coders (\( \kappa = .96 \)).

In contrast, negative content referred to parental displays of negative control as expressed through behaviours such as criticism and physical control of child’s hand/arms/body. Possible scores ranged from 1 (no negative control shown) to 7 (exclusive use of criticism, may include shaming and physical control of child’s hands/arms/body; may include instances of corporal punishment). Higher scores reflected more negative affect displayed by parents. Inter-coder reliability revealed perfect agreement between coders (\( \kappa = 1.00 \)).

6.2.2.2 Child-specific Codes. Similar to parent-specific codes, child-specific codes also examined the extent to which children displayed positive affect (i.e., child positivity). Moreover, the extent to which children were responsive to their parents during the wordless storybook reading task was also examined (i.e., child responsiveness). Positive affect captured
the extent to which children displayed warmth (expressed through smiling and laughing) during
the wordless storybook reading task. Similar to parental codes, possible scores ranged from 1
(no positive affect displayed) to 7 (constant positive affect – smiling and laughing throughout
task). Higher scores reflected more displays of positive affect by the child. Inter-coder
reliability revealed a high level of agreement between coders ($\kappa = .96$).

The extent to which children were responsive to their parents’ comments, questions and
behaviours was also captured. Possible scores ranged from 1 (never responds – always ignores
parents’ comments, questions and behaviours) to 7 (always responds immediately to parent,
sometimes expanding on the comments made by parent). Higher scores reflect a higher degree
of responsiveness of the child to their parents’ comments, questions and behaviours. Inter-coder
reliability revealed an acceptable level of agreement between coders ($\kappa = .73$).

6.2.2.3 Reciprocity Code. Lastly, the extent to which parents and children displayed
shared positive affect was examined. The reciprocity code examined the extent to which
parents and children demonstrated shared, positive affect as expressed through eye contact and
“conversation-like” interactions. Possible scores ranged from 1 (no evidence of reciprocity) to
7 (highly integrated and reciprocal – constant shared positive affect and eye contact that never
loses “turn-taking” quality). Higher scores reflect a higher degree of reciprocity between
parents and children. Inter-coder reliability revealed an acceptable level of agreement between
coders ($\kappa = .88$).
Chapter 7: Descriptive Statistics

7.1 Family Demographic Questionnaire

To gain an understanding of the family context, various questions were asked to assess certain demographic characteristics with the Family Demographic Questionnaire (see Appendix D). Questionnaires were primarily completed by mothers with the exception of one father. Results are presented in subsequent sections.

7.1.1 Family Demographics

The majority of parents were born in Canada (83%) while others immigrated from areas such as the Caribbean (4%), the United States of America (3%), the United Kingdom (8%) and Asia (3%). The majority of children lived in two-parent households (84%) while 16% lived in single-parent families (i.e., parent was either widowed, separated, divorced or never married).

The educational background of parents and their partners was also assessed. Of all respondents, 16% had attended high school or graduated high school whereas 16% reported some college or university experience. Majority had college education (33%) while 20%, 9% and 5% had a university designation, a professional degree (e.g., teachers) or post-graduate education respectively. With respect to the respondent’s spouse, 18% had attended or graduated high school whereas 21% had some college or university experience. Majority had a college diploma (21%) or university degree (17%) while 5% and 8% had professional or post-graduate qualifications respectively. Spousal information from six families was missing (8%).

Family resources were also assessed. Total family income after taxes ranged between less than $15,000 to more than $90,000: 36% of families had a total income of less than
$50,000 (36%) while 29% of families had a total income of more than $50,000 but less than
$80,000. Finally, 32% of families had a total income of more than $80,000 after taxes. A small
percentage of families did not indicate their total income (3%).

7.1.2 Family Configuration

Including the parent and the child, family size ranged from two to eight individuals. The
majority of children lived in a family of four (55%) while 19% lived in a family of less than
four, 16% lived in a family of five and 9% lived in a family larger than five individuals. One
family did not report the number of individuals living in the same household (1%). Other than
immediate family members, nannies and extended family members (e.g., grandparents, uncles)
often lived with families. The majority of children (52%) had at least one sibling while 23%
had two siblings, 4% had three siblings and 2% had four siblings. There were 14 children who
were singletons (19%). Of the children who had siblings, 44% were the eldest, 13% were
middle-born, and 24% were the youngest.

7.2 Descriptive Statistics

7.2.1 Parental Mental-state Talk

7.2.1.1 Parental mental-state term talk. Parent-child discussions during the wordless
storybook-reading task were coded for different aspects of parental mentalistic talk with their
preschoolers (refer to Chapter 6). Mean scores and standard deviations for all parental measures
are presented below.

Descriptive statistics for parental mental-state term talk are presented on Table 6. Mean
scores suggest that the wordless storybook reading task was effective in eliciting mental-state
talk from parents, especially cognitive and emotion states. Since longer parent-child discourse
Table 6.

*Means and Standard Deviations for Parental Mental-state Term References*

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mental-state terms</td>
<td>32.20</td>
<td>18.50</td>
<td>5-94</td>
</tr>
<tr>
<td>Pretend Terms</td>
<td>1.03</td>
<td>1.74</td>
<td>1-12</td>
</tr>
<tr>
<td>Cognitive Terms</td>
<td>16.99</td>
<td>13.07</td>
<td>0-65</td>
</tr>
<tr>
<td>Desire Terms</td>
<td>2.96</td>
<td>3.09</td>
<td>0-17</td>
</tr>
<tr>
<td>Preference Terms</td>
<td>2.46</td>
<td>2.54</td>
<td>0-11</td>
</tr>
<tr>
<td>Emotion Terms</td>
<td>8.77</td>
<td>4.88</td>
<td>1-29</td>
</tr>
</tbody>
</table>

provided parents with more opportunity to reference a mental-state term, all raw scores were
converted to proportionate scores (based on total number of words used by parent
during the wordless storybook-reading task) to account for total parent talk.

**7.2.1.2 Parental focus talk.** Descriptive statistics for parental focus talk are presented on

Table 7.

Table 7.

*Means and Standard Deviations for Parental Focus Talk*

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Focus Category</td>
<td>31.94</td>
<td>18.42</td>
<td>5-94</td>
</tr>
<tr>
<td>Self-Self</td>
<td>6.71</td>
<td>6.56</td>
<td>0-28</td>
</tr>
<tr>
<td>Self-Protagonist</td>
<td>1.01</td>
<td>1.97</td>
<td>0-11</td>
</tr>
<tr>
<td>Other-Other</td>
<td>10.90</td>
<td>9.98</td>
<td>0-44</td>
</tr>
<tr>
<td>Other-Protagonist</td>
<td>13.31</td>
<td>7.27</td>
<td>0-42</td>
</tr>
</tbody>
</table>
Mean scores suggest that the wordless storybook-reading task was effective in eliciting parental talk about others’ perspectives. Particularly, parents were more inclined to talk about the mental states of the characters in the story and their child’s mental states. Discussion about the parents’ own perspectives also occurred during the task. Parents speaking from the perspective of the characters in the storybook occurred less frequently relative to other perspectives.

### 7.2.1.3 Parental talk about multiple perspectives.

Descriptive statistics for parental talk about multiple perspectives are presented on Table 8.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parental Multiple Perspective Talk</td>
<td>34.78</td>
<td>20.42</td>
<td>5-106</td>
</tr>
<tr>
<td>Direct Reference</td>
<td>32.20</td>
<td>18.58</td>
<td>5-95</td>
</tr>
<tr>
<td>Implicit Contrastive</td>
<td>2.57</td>
<td>2.69</td>
<td>0-12</td>
</tr>
</tbody>
</table>

Mean scores suggest that the wordless storybook-reading task was effective in eliciting direct references from parents. However, implicit contrastives (i.e., instances of self corrections or contradictions between parents and children) occurred less frequently between dyads.

### 7.2.1.4 Parental talk about causality.

Descriptive statistics for parental talk about causality are presented in Table 9. Mean scores suggest that in general, parents were providing causal explanations for their perspectives during the wordless storybook-reading task.
Table 9.

*Means and Standard Deviations for Parental Talk about Causality*

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parental Causal Talk</td>
<td>4.29</td>
<td>4.17</td>
<td>0-23</td>
</tr>
<tr>
<td>Explicit Causal Talk</td>
<td>1.66</td>
<td>1.70</td>
<td>0-6</td>
</tr>
<tr>
<td>Implicit Causal Talk</td>
<td>2.63</td>
<td>3.41</td>
<td>0-18</td>
</tr>
</tbody>
</table>

Interestingly, rather than explicitly talking about causality, parents were more likely to imply causality during instances of disagreements or self-corrections.

7.2.3 *Quality of Parent-child Relationship*

The quality of parent-child relationships was also coded from the wordless storybook-reading task. Since each session received two separate scores for each code, scores were averaged across the first and second half of each session. Means and standard deviations are presented in Table 10. Distributions of all quality measures were normal.

Table 10.

*Means and Standard Deviations for Quality of Parent-child Relationship Measures*

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quality Measure</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reciprocity</td>
<td>4.56</td>
<td>1.53</td>
<td>1-7</td>
</tr>
<tr>
<td>Parental Positivity</td>
<td>2.91</td>
<td>1.58</td>
<td>1-6</td>
</tr>
<tr>
<td>Parental Negativity</td>
<td>1.07</td>
<td>.26</td>
<td>1-2.5</td>
</tr>
<tr>
<td>Child Positivity</td>
<td>2.83</td>
<td>1.68</td>
<td>1-7</td>
</tr>
<tr>
<td>Child Responsiveness</td>
<td>5.17</td>
<td>1.68</td>
<td>1.5-7</td>
</tr>
</tbody>
</table>
7.2.4 Child Outcome Measures

7.2.4.1 TELD. Children’s total score on the TELD ranged between 32-70 with a mean of 53.97 ($SD = 9.36$). Scores were normally distributed.

7.2.4.2 Sentential Complement Understanding. Children’s total score on the sentential complement understanding task ranged between 0-6 with a mean of 1.79 ($SD = 2.25$). Sentential complement scores had a bimodal distribution.

7.2.4.3 Executive Functioning. Aggregate scores based on the number of successful trials were created for the red dog/blue dog, bear/dragon, and backward and forward word span tasks. Mean scores and standard deviations are presented in Table 11. With the exception of children’s bear/dragon scores, all distributions were normal.

Table 11.

Means and Standard Deviations for Executive Function Measures

<table>
<thead>
<tr>
<th>Executive Function Task</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red Dog/Blue Dog Task</td>
<td>17.24</td>
<td>10.38</td>
<td>0-28</td>
</tr>
<tr>
<td>Bear/Dragon Task</td>
<td>7.95</td>
<td>3.87</td>
<td>0-10</td>
</tr>
<tr>
<td>Forward Word Span Task</td>
<td>4.51</td>
<td>1.83</td>
<td>0-8</td>
</tr>
<tr>
<td>Backward Word Span Task</td>
<td>1.99</td>
<td>2.02</td>
<td>0-6</td>
</tr>
<tr>
<td>Gift Delay Task</td>
<td>44.17</td>
<td>23.61</td>
<td>1-60sec</td>
</tr>
</tbody>
</table>

7.2.4.4 Theory-of-mind scale. To assess children’s theory-of-mind understanding, a theory-of-mind composite score was created. Spearman correlations revealed significant associations amongst most tasks on the theory-of-mind scale (refer to Table 12 for a summary of results). Internal reliability among indicators was high ($\alpha = .78$) indicating that items were
Table 12.

*Intercorrelations between Different Theory-of-mind Tasks*

<table>
<thead>
<tr>
<th>Theory-of-mind Tasks</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Diverse Desires</td>
<td>----</td>
<td>.21</td>
<td>.10</td>
<td>-.06</td>
<td>.23*</td>
<td>-.12</td>
<td>.07</td>
<td>-.11</td>
</tr>
<tr>
<td>2. Diverse Belief</td>
<td>----</td>
<td>.23*</td>
<td>.30*</td>
<td>.34*</td>
<td>.22*</td>
<td>.27*</td>
<td>.21</td>
<td></td>
</tr>
<tr>
<td>3. Knowledge Access</td>
<td>----</td>
<td>.26*</td>
<td>.56*</td>
<td>.42*</td>
<td>.52*</td>
<td>.32*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Explicit False Belief</td>
<td>----</td>
<td>.25*</td>
<td>.42*</td>
<td>.20*</td>
<td>.24*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Contents False Belief</td>
<td>----</td>
<td>.56*</td>
<td>.68*</td>
<td>.50*</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Change-in-location</td>
<td>----</td>
<td>.47*</td>
<td>.50*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>False Belief</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Belief-based Emotion</td>
<td>----</td>
<td>.38*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Real-apparent Emotion</td>
<td>----</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note * p < .05.

measuring the same common construct. The theory-of-mind composite score was then created by summing across all correct trials (M score = 4.21, SD = 2.24). Moreover, since the theory-of-mind scale was constructed based on Guttman scale analysis, higher scores reflected more sophisticated understanding (Wellman & Liu, 2004). The distribution of children’s theory-of-mind scores was found to be normal.

7.2.4.1 Effect of child gender. To examine the effects of child gender on child outcome measures, a series of bivariate correlations were conducted. Boys were the reference category (coded as 0) and girls coded as 1. Despite non-significant correlations with general language ability, sentential complement understanding and various executive functioning tasks, child gender was significantly correlated with theory-of-mind scores, (r = .24, p < .05). This suggests
that on average, girls scored higher on the theory-of-mind scale. However, this significant association may reflect the slightly larger number of older girls in the sample. Thus, to control for this effect, gender was included as a covariate in all analyses that examined theory of mind.

The purpose of the study was to examine environmental and cognitive factors important for theory-of-mind development and their additive and interactive effects. The broad scope of the data set provides opportunities to investigate other research questions beyond those proposed in the present thesis. Thus, only exploratory analyses that are directly relevant to each model will be presented. Additional correlations that are not directly related to the thesis is presented in Appendix E as a reference.
To examine the effect of environmental factors on theory-of-mind development, two mediation analyses (as described in Chapter 4, pg 28-35) testing for the mediating effects of child language and parental cognitive talk were conducted. Results for each model are presented below.

8.1 Model 1: The Mediating Role of Child Language on the Relation between Family Risk and Theory of Mind

8.1.1 Exploratory Analysis

The extent to which families experienced risk was assessed with six binary indicators: parental education qualification, parental paid employment, access to a car, receiving non-contributory benefits, living in government subsidized housing, and family income under $30,000 CND. The majority of families had at least one spouse in the household with post-secondary education (72%), paid employment (88%) and access to a car (89%). Data from three families were missing (4%). Lastly, the majority of families (79%) was not receiving non-contributory benefits from the government (e.g., welfare), did not live in subsidized government housing (89%), and had a total family income of over $30,000 (87%). Data from six (8%), three (8%) and three (4%) families were missing respectively.\(^4\)

Spearman correlations amongst different indicators of family risk revealed significant correlations amongst most indicators (refer to Table 13 for a summary of results).

\(^4\) Respondents may not have necessarily responded to all questions resulting in unequal sample sizes across different risk questions.
### Table 13.

*Intercorrelations between Different Indicators of Family Risk*

<table>
<thead>
<tr>
<th>Family Risk Indicators</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. No education qualification</td>
<td>----</td>
<td>.29*</td>
<td>.22</td>
<td>.05</td>
<td>.35*</td>
<td>.46*</td>
</tr>
<tr>
<td>2. No paid employment</td>
<td>----</td>
<td>.51*</td>
<td>.46*</td>
<td>.41*</td>
<td>.65*</td>
<td></td>
</tr>
<tr>
<td>3. No access to a car</td>
<td>----</td>
<td>.25*</td>
<td>.46*</td>
<td>.39*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Receiving non-contributory government assistance</td>
<td>----</td>
<td>.41*</td>
<td>.33*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Living in government subsidized housing</td>
<td>----</td>
<td>.59*</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Low income</td>
<td>----</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note * p < .05.

Six families had missing risk information and thus were removed from analyses.

Of the remaining families (n = 69), internal reliability among risk indicators was high ($\alpha = .78$) indicating that items were measuring the same common variance in family risk. Family risk cumulative scores was created by summing up the total number of risks families were exposed to ($M\ score = 0.77, SD = 1.37$).

To examine the association between family risk, child language and theory of mind, partial correlations controlling for age and gender were conducted (refer to Table 14 for a summary of results). Significant associations between these variables provide the necessary conditions to examine possible mediation processes between variables. To reduce multicollinearity (Aiken & West, 1991), predictor and covariate variables were centred (subtracting raw scores from the mean score so that the mean becomes zero) and used in the current analyses.
Table 14.

*Intercorrelations between Family Risk, Child Language, and Theory of Mind Controlling for the Effects of Age and Gender*

<table>
<thead>
<tr>
<th>Variables</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Family Risk</td>
<td>----</td>
<td>-.48</td>
<td>-.32*</td>
</tr>
<tr>
<td>2. Child Language (TELD score)</td>
<td>----</td>
<td>----</td>
<td>.39*</td>
</tr>
<tr>
<td>3. Theory-of-mind Score</td>
<td>----</td>
<td>----</td>
<td>----</td>
</tr>
</tbody>
</table>

Note *p < .05.

8.1.2 Mediation Analysis

To test for mediation, steps outlined by Baron and Kenny (1986) were followed (refer to Chapter 4, pg 26-27). First children’s theory-of-mind scores were regressed on family-risk scores to show a significant negative association between the dependent and independent variable. Second, child-language scores were regressed on family-risk scores to show a significant negative association between the mediator and independent variable. Lastly, children’s theory-of-mind scores were regressed on child-language scores to show a significant association between the dependent and mediator variable.

8.1.2.1 Relation between family risk and theory of mind. Hierarchical regression analysis was used to estimate the variance in children’s theory-of-mind scores that was attributable to family risk after accounting for the effects of age and gender. Age and gender variables were entered into the model at Step 1. Results revealed a significant overall model, F(2, 68) = 25.09, p < .05, with both age and gender emerging as significant covariates (refer to Table 15 for a summary of results). Child age and gender together accounted for 41% of the variance in children’s theory-of-mind scores.
Table 15.

Effects of Family Risk on Children’s Theory-of-Mind Scores when Controlling for Child Age and Gender

<table>
<thead>
<tr>
<th>Variable</th>
<th>B</th>
<th>SE b</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>0.13</td>
<td>0.02</td>
<td>0.61*</td>
</tr>
<tr>
<td>Gender</td>
<td>0.86</td>
<td>0.42</td>
<td>0.19*</td>
</tr>
<tr>
<td><strong>R² for Step 1 = .41</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>0.14</td>
<td>0.02</td>
<td>0.63*</td>
</tr>
<tr>
<td>Gender</td>
<td>0.93</td>
<td>0.41</td>
<td>0.20*</td>
</tr>
<tr>
<td>Family Risk</td>
<td>-0.40</td>
<td>0.15</td>
<td>-0.24*</td>
</tr>
<tr>
<td><strong>ΔR² for Step 2 = .06</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* p < .05, one-tailed.

Family risk mean scores were then entered into the model to assess the effect of family risk on children’s theory-of-mind scores. Again, the overall model was significant, $F(3,68) = 20.75, p < .05$. Results indicated that family risk significantly accounted for additional variance in the second model, $F_{change}(1, 65) = 7.29, p < .05$. Indeed, there was a main effect of family risk. Over and above the effect of age and gender, family risk accounted for an additional 6% of the variance. Part correlations$^5$ indicated that after accounting for the effects of age, family risk accounted for 24% of the total variance explained in the current model. Taken together, results suggest that exposure to higher amounts of family risk predicted lower theory-of-mind scores in children.

$^5$ Part correlations refer to the correlation between independent and dependent variables, after controlling for the effects of other predictor and/or covariate variables on the independent variable. Thus, part correlations estimate the unique variance in which the independent variable accounts for in the dependent variable after controlling for the effects of other predictors in the model. Partial correlations however, measure the association between the independent and dependent variables while accounting for the effects of covariates in both variables.
8.1.2.2 Relation between family risk and child language. The second hierarchical regression analysis examined the relation between family risk and child language. Child age and gender were entered at Step 1 as covariates. The overall model was significant, $F(2, 68) = 31.35, p < .05$, with age emerging as a significant covariate (refer to Table 16 for a summary of results).

Table 16.

Effects of Family Risk on Children’s TELD Scores when Controlling for Age and Gender

<table>
<thead>
<tr>
<th>Variable</th>
<th>$B$</th>
<th>SE $b$</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>0.62</td>
<td>0.08</td>
<td>0.68*</td>
</tr>
<tr>
<td>Gender</td>
<td>1.67</td>
<td>1.68</td>
<td>0.09</td>
</tr>
<tr>
<td>$R^2$ for Step 1 = .47*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>0.64</td>
<td>0.07</td>
<td>0.71*</td>
</tr>
<tr>
<td>Gender</td>
<td>2.07</td>
<td>1.49</td>
<td>0.11</td>
</tr>
<tr>
<td>Family Risk</td>
<td>-2.37</td>
<td>.54</td>
<td>-0.34*</td>
</tr>
<tr>
<td>$\Delta R^2$ for Step 2 = .12*</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* $p < .05$, one-tailed.

Age accounted for 47% of the variance seen in children’s TELD score. Family risk mean scores were then entered at Step 2. Again, the overall model was significant, $F(3, 68) = 33.12, p < .05$.

A significant change statistic, $F_{change}(1,65) = 19.30, p < .05$, suggested that family risk accounted for additional significant variance in the model. Indeed, there was a significant main effect of family risk. Over and above the effects of age, family risk significantly predicted 12% of the variance in children’s TELD scores. Part correlations indicated that after accounting for the effects of age, family risk accounted for 34% of the total variance explained by the current
model. These results suggest that children exposed to higher levels of family risk were more likely to show lower general language abilities.

8.1.2.3 Relation between child language and theory of mind. Again, hierarchical regression analysis was used to examine relations between child language and theory of mind. Moreover, family risk was entered at Step 3 to examine whether the relation between family risk and theory of mind is fully or partially mediated.

Again, the effects of age and gender were entered into the model to control for these effects. The overall model was significant, $F(2,68) = 25.09, p < .05$, with a main effect of both age and gender (refer to Table 17 for a summary of results). Combined, age and gender accounted for 43% of the variance seen in children’s theory-of-mind scores.

To examine the effects of child language on their theory-of-mind scores, child TELD scores were entered into the model at Step 2. Again, the overall model was significant, $F(3,68) = 22.83, p < .05$. Results showed that children’s TELD scores significantly predicted additional variance in children’s theory-of-mind scores, $F_{\text{change}}(1,65) = 10.84, p < .05$. Indeed, child TELD scores emerged as a significant predictor of their theory-of-mind scores, accounting for an additional 8% of the variance once the effects of age and gender were controlled. Part correlations indicated that child TELD scores uniquely explained 28% of the total variance predicted by the current model. Thus, children with higher language abilities were also more likely to score higher on the theory-of-mind scale.

Next, the relation between family risk and theory of mind was examined after accounting for child language. Since results suggest that the effect of family risk on theory of mind may be mediated by children’s language ability (as indicated by a significant relationship between family risk and theory of mind, a significant relationship between family risk and
Table 17.

**Effects of Family Risk on Children’s Theory-of-Mind Scores after Controlling for Child Age, Gender and General Language Abilities**

<table>
<thead>
<tr>
<th>Variable</th>
<th>B</th>
<th>SE b</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>0.13</td>
<td>0.02</td>
<td>0.61*</td>
</tr>
<tr>
<td>Gender</td>
<td>0.86</td>
<td>0.42</td>
<td>0.19*</td>
</tr>
<tr>
<td>$R^2$ for Step 1 = .43*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>0.07</td>
<td>0.03</td>
<td>0.34*</td>
</tr>
<tr>
<td>Gender</td>
<td>0.70</td>
<td>0.40</td>
<td>0.15</td>
</tr>
<tr>
<td>TELD</td>
<td>0.10</td>
<td>0.03</td>
<td>0.40*</td>
</tr>
<tr>
<td>$\Delta R^2$ for Step 2 = .08*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Step 3</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>0.09</td>
<td>0.03</td>
<td>0.41*</td>
</tr>
<tr>
<td>Gender</td>
<td>0.77</td>
<td>0.40</td>
<td>0.17*</td>
</tr>
<tr>
<td>TELD</td>
<td>0.07</td>
<td>0.03</td>
<td>0.31*</td>
</tr>
<tr>
<td>Family Risk</td>
<td>-0.22</td>
<td>0.16</td>
<td>-0.13</td>
</tr>
<tr>
<td>$\Delta R^2$ for Step 3 = .01</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* $p < .05$, one-tailed.

children’s TELD scores, and a significant relationship between children’s TELD scores and their theory-of-mind scores), the nature of this mediation pathway was explored. To determine whether child language was a partial or full mediator, family risk mean scores were entered into the model at Step 3. The overall model was significant, $F(4,68) = 17.82, p < .05$. When controlling for the effects of age, gender and child language, results indicated that family risk did not predict additional significant variance in children’s theory-of-mind scores, $F_{change}(1,64) = 1.82, p = n.s$. Child language remained a significant predictor of children’s theory-of-
mind scores whereas the effect of family risk loses significance. The standardized regression coefficient of family risk drops from -0.24 to -0.13 when child language is controlled (refer to Figure 1 for an illustration of Model 1).

![Diagram](image)

Figure 1: The mediating effect of child language on the relation between family risk and theory of mind

To test whether the indirect effect of family risk on theory of mind is significantly different from zero, Sobel’s test was used (Baron & Kenny, 1986). Sobel’s test for mediation revealed a Z score of -2.64 ($p < .05$), indicating that the mediating effect is significantly different from zero and that child language accounted for a significant amount of common variance shared between family risk and theory of mind.

Last, to estimate the effect size of the mediated pathway, R-squared measures were used. R-squared measures identify the variance in theory-of-mind scores that is explained by both family risk and child language scores but not by family risk or general child language ability alone. This gives us an estimate of the amount of variance in children’s theory-of-mind
scores that is explained specifically by the mediated effect (MacKinnon, 2008). Results suggested that approximately 19% of the variance in children’s theory-of-mind scores was explained by the combined effects of family risk and children’s language ability. These results suggest that the predictive association between family risk and theory of mind was attenuated when child language was also included as a predictor\(^6\).

8.2 Model 2: The Mediating Role of Parent-child Reciprocity on the Relation between Parental Cognitive Talk and Theory of Mind

8.2.1 Exploratory Analysis

Model 2 examined the mediating effects of parent-child reciprocity on the relation between parental cognitive talk and theory of mind. Partial correlations controlling for the effects of age and gender were conducted to examine the association between parental cognitive talk, parent-child reciprocity and theory of mind (refer to Table 18 for a summary of results).

Table 18.

Intercorrelations between Parental Cognitive Talk, Parent-child Reciprocity, and Theory of Mind

<table>
<thead>
<tr>
<th>Variables</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Parental Cognitive Talk</td>
<td>----</td>
<td>.51*</td>
<td>.28*</td>
</tr>
<tr>
<td>2. Parent-child Reciprocity</td>
<td>----</td>
<td></td>
<td>.34*</td>
</tr>
<tr>
<td>3. Theory-of-mind Score</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note * \(p < .05\).

---

\(^6\) Given that family risk had a bimodal distribution, there was concern that family risk should be treated as a grouping variable. Analyses were re-run with families placed in either high- or low-risk groups. Similar results were found when family risk was treated as a dichotomous variable.
Significant associations between these variables provide the necessary conditions to proceed with the proposed mediation analysis.

8.2.2 Mediation Analysis

To test for mediation, the steps outlined by Baron and Kenny (1986) were followed. First children’s theory-of-mind scores were regressed on parental cognitive-talk scores to show a significant association between the dependent and independent variable. Second, reciprocity scores were regressed on parental cognitive-talk scores to show a significant association between the mediator and independent variable. Last, children’s theory-of-mind scores were regressed on parent-child reciprocity scores to show a significant association between the dependent and mediator variable. Proportionate cognitive-talk scores were used to account for total parent talk. Since cognitive-talk scores were slightly skewed, a square root transformation was used to normalize the data. A total of 70 families were included in the current analyses.

8.2.2.1 Relation between parental cognitive talk and theory of mind. Hierarchical regression analysis was used to examine the relationship between parental cognitive talk and children’s theory-of-mind understanding. Age and gender were entered in Step 1 as covariates. The overall model was significant, $F(2, 69) = 25.50, p < .05$, with main effects of both age and gender (See Table 19 for a summary of results). Combined, age and gender accounted for 43% of the variance seen in children’s theory-of-mind scores. These results suggest that both age and gender are significant covariates.

Next, parental cognitive talk was entered into the model. Again, the overall model was significant, $F(3, 69) = 20.72, p < .05$. Parental cognitive talk was found to predict additional significant variance in the model, $F_{\text{change}} (1, 66) = 6.78, p < .05$. Indeed, there was a significant
Table 19.

**Effects of Parental Cognitive Talk on Children’s Theory-of-Mind Scores**

<table>
<thead>
<tr>
<th>Variable</th>
<th>$B$</th>
<th>SE $b$</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>0.13</td>
<td>0.02</td>
<td>0.61*</td>
</tr>
<tr>
<td>Gender</td>
<td>0.82</td>
<td>0.41</td>
<td>0.18*</td>
</tr>
<tr>
<td>$R^2$ for Step 1 = .43*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>0.12</td>
<td>0.02</td>
<td>0.57*</td>
</tr>
<tr>
<td>Gender</td>
<td>0.99</td>
<td>0.40</td>
<td>0.22*</td>
</tr>
<tr>
<td>Parent Cognitive Talk</td>
<td>12.84</td>
<td>4.93</td>
<td>0.23*</td>
</tr>
<tr>
<td>$\Delta R^2$ for Step 2 = .05*</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* $p < .05$, one-tailed.

effect of parental cognitive talk, accounting for an additional 5% of the variance in children’s theory-of-mind scores. Part correlations also indicate that after accounting for the effects of age and gender, parental cognitive talk uniquely predicted 21% of the total variance explained by the regression model. Results suggest that parents who referenced more cognitive terms during conversations with their preschoolers had children who scored higher on the theory-of-mind scale.

**8.2.2.2 Relations between parental cognitive talk and parent-child reciprocity.**

Hierarchical regression analysis was used to examine the relation between parental cognitive talk and parent-child reciprocity. Age and gender were entered into the model at Step 1 as covariates. The overall model was not significant, $F(2, 69) = 1.61, p = n.s.$, with no main effects of age or gender. These results suggest that neither age nor gender significantly predicted parent-child reciprocity.
Next, parental cognitive talk was entered at Step 2. The overall model was significant, $F(3, 69) = 13.27, p < .05$ (refer to Table 20 for a summary of results). A significant change statistic, $F_{\text{change}}(1, 66) = 34.94, p < .05$, suggested that parental cognitive talk predicted significant variance in parent-child reciprocity scores. There was a main effect of parental cognitive talk that accounted for 33% of the variance in parent-child reciprocity scores. Part correlations suggested that parental cognitive talk uniquely predicted 50% of the variance accounted for by the current model. These results suggest that parents who referenced more cognitive terms were also more likely to engage in more positive and reciprocal interactions with their children during these interactions.

### 8.2.2.3 Relations between parent-child reciprocity and theory of mind

To examine the relation between parent-child reciprocity and theory of mind, hierarchical regression analysis was used. Age and gender were entered into the model as covariates. The overall model was significant, $F(2, 69) = 25.50, p < .05$, with main effects of both age and gender (refer to Table 20).
21 for a summary of results). Together, age and gender accounted for 43% of the variance in children’s theory-of-mind scores.

Next, parent-child reciprocity scores were entered at Step 2. The overall model was significant, $F(3, 69) = 21.73, p < .05$. Results indicated that parent-child reciprocity predicted Table 21.

**Effects of Parental Cognitive Talk on Theory-of-mind Scores after Controlling for Child Age, Gender and Parent-child Reciprocity Scores**

<table>
<thead>
<tr>
<th>Variable</th>
<th>$B$</th>
<th>SE $b$</th>
<th>$\beta$</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>0.13</td>
<td>0.02</td>
<td>0.61*</td>
</tr>
<tr>
<td>Gender</td>
<td>0.82</td>
<td>0.41</td>
<td>0.18*</td>
</tr>
<tr>
<td>$R^2$ for Step 1 = .43*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>0.12</td>
<td>0.02</td>
<td>0.56*</td>
</tr>
<tr>
<td>Gender</td>
<td>0.72</td>
<td>0.39</td>
<td>0.16</td>
</tr>
<tr>
<td>Parent-child Reciprocity score</td>
<td>0.37</td>
<td>0.13</td>
<td>0.26*</td>
</tr>
<tr>
<td>$\Delta R^2$ for Step 2 = .07*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Step 3</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>0.11</td>
<td>0.02</td>
<td>0.55*</td>
</tr>
<tr>
<td>Gender</td>
<td>0.84</td>
<td>0.40</td>
<td>0.19*</td>
</tr>
<tr>
<td>Parent-child Reciprocity score</td>
<td>0.27</td>
<td>0.16</td>
<td>0.19</td>
</tr>
<tr>
<td>Knowledge Terms</td>
<td>6.86</td>
<td>6.02</td>
<td>0.13</td>
</tr>
<tr>
<td>$\Delta R^2$ for Step 3 = .01</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* $p < .05$, one-tailed.

additional significant variance in children’s theory-of-mind scores, $F_{\text{change}} (1, 66) = 8.48, p < .05$. Parent-child reciprocity scores emerged as a significant predictor of theory of mind, accounting for an additional 7% of the variance in children’s scores, over and above the effects of age and gender. Part correlations indicated that parent-child reciprocity uniquely predicted
25% of the total variance accounted for by the current model. These results suggest that children who shared more reciprocal, positive conversations with their parents were also more likely to score higher on the theory-of-mind scale.

These results suggest that the effect of parental cognitive talk on children’s theory-of-mind understanding may be mediated by parent-child reciprocity (as indicated by a significant association between parental cognitive terms and children’s theory-of-mind scores, a significant association between parental cognitive terms and parent-child reciprocity scores, and a significant association between parent-child reciprocity scores and theory of mind). To examine whether the relationship between parental knowledge talk and theory of mind was partially or completely attenuated by parent-child reciprocity, parent cognitive term references were entered into the model at Step 3. Although the overall model was significant, $F(4, 69) = 16.69, p < .05$, results indicated that no additional significant variance was predicted by the model, $F_{change}(1, 65) = 1.30, p \text{ = n.s.}$ Indeed, there was no main effect of parental cognitive terms, suggesting that it was no longer a significant predictor of children’s theory-of-mind scores once parent-child reciprocity was controlled. More importantly, the beta value of parental cognitive term drops from 0.23 to 0.13 (refer to Figure 2 for an illustration of Model 2). However, the parent-child reciprocity score also loses significance once the parental cognitive score is entered into the model. It is likely that there is a high degree of shared variance between parental knowledge and parent-child reciprocity scores.

To test whether the mediated path is significantly different from zero, Sobel’s test was used (Baron & Kenny, 1986). Sobel’s test for mediation revealed a $Z$ score of 2.61 ($p < .05$), indicating that the mediating effect is significantly different from zero. Last, to estimate the
effect size of the mediated pathway, R-squared measures were used. Results suggested that approximately 13% of the variance in children’s theory-of-mind scores is explained by the combined effect of parental use of cognitive terms and parent-child reciprocity. Taken together, these results suggest that the predictive association between parental cognitive talk and theory of mind is completely attenuated when parent-child reciprocity is also included as a predictor.
Chapter 9: Effects of Cognitive Factors on Theory-of-mind Development

9.1 Exploratory Analysis

To investigate the influence of cognitive factors, moderation analysis was used to examine how these mechanisms operated together during theory-of-mind development. Specifically, Model 3 tested whether the effects of child language and conflict inhibition were contingent on each other during theory-of-mind development. Partial correlations controlling for the effects of age and gender were conducted to examine the associations between child language, conflict inhibition and theory of mind (refer to Table 22 for a summary of results).

Table 22.

Intercorrelations between Child Language, Conflict Inhibition, and Theory of Mind Controlling for the Effects of Age and Gender

<table>
<thead>
<tr>
<th>Variables</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Child Language (TELD Score)</td>
<td>----</td>
<td>.54*</td>
<td>.38*</td>
</tr>
<tr>
<td>2. Conflict Inhibition (Bear/Dragon Score)</td>
<td></td>
<td>----</td>
<td>.31*</td>
</tr>
<tr>
<td>3. Theory-of-mind Score</td>
<td></td>
<td></td>
<td>----</td>
</tr>
</tbody>
</table>

Note * *p < .05.

Results indicated that child language, conflict inhibition and theory of mind were significantly correlated. More importantly, after controlling for the effect of age, both TELD and conflict inhibition scores was found to be moderately correlated. These conditions suggested that it is acceptable to proceed with the proposed moderation analysis. To reduce the amount of
multicollinearity between variables, independent (i.e., child language) and moderating variables (i.e., conflict inhibition scores) were centred so that their means were equal to zero.

9.2 Moderation Analysis

To test for moderation, the criteria recommended by Baron and Kenny (1986) were followed. After controlling for the effects of age and gender (covariates), both independent (TELD scores) and moderator (bear/dragon scores) variables were entered into a hierarchical regression model predicting children’s theory-of-mind scores. Once the independent effects of these variables were controlled, the interaction term (TELDxBear/Dragon) was entered into the model. Variables were entered in this order since inspecting the product term without controlling for the variables in which they are based confounds the moderator effect with the effects of the predictor and moderator variable (Frazier, et. al., 2004).

The complete dataset was used for this analysis ($n = 75$). To control for the effects of child age and gender, they were entered at Step 1. The overall model was significant, $F(2,74) = 28.25, p < .05$, with main effects of age and gender (refer to Table 23 for a summary of results). Age and gender accounted for 44% of the variance seen in children’s theory-of-mind scores.

To examine the effects of child language on theory of mind, TELD scores were entered at Step 2. The overall model was significant, $F(3, 74) = 25.69, p < .05$. Results indicated that TELD scores accounted for additional significant variance in the model, $F_{change}(1,71) = 11.97, p < .05$. Indeed, there was a significant main effect of TELD score. After controlling for the effects of age and gender, general child language accounted for an additional 8% of
Table 23.

Summary of Hierarchical Regression Analysis for the Moderating Role of Conflict Inhibition on the Relation between Language and Theory of Mind

<table>
<thead>
<tr>
<th>Variable</th>
<th>B</th>
<th>SE b</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>0.13</td>
<td>0.02</td>
<td>0.62*</td>
</tr>
<tr>
<td>Gender</td>
<td>0.82</td>
<td>0.40</td>
<td>0.18*</td>
</tr>
<tr>
<td><strong>R² for Step 1</strong></td>
<td>.44*</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>0.07</td>
<td>0.02</td>
<td>0.34*</td>
</tr>
<tr>
<td>Gender</td>
<td>0.67</td>
<td>0.38</td>
<td>0.15</td>
</tr>
<tr>
<td>TELD</td>
<td>0.10</td>
<td>0.03</td>
<td>0.41*</td>
</tr>
<tr>
<td><strong>ΔR² for Step 2</strong></td>
<td>.08*</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Step 3</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>0.07</td>
<td>0.02</td>
<td>0.32*</td>
</tr>
<tr>
<td>Gender</td>
<td>0.61</td>
<td>0.38</td>
<td>0.14</td>
</tr>
<tr>
<td>TELD</td>
<td>0.08</td>
<td>0.03</td>
<td>0.32*</td>
</tr>
<tr>
<td>Bear/Dragon</td>
<td>0.08</td>
<td>0.07</td>
<td>0.13</td>
</tr>
<tr>
<td><strong>ΔR² for Step 3</strong></td>
<td>.01</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Step 4</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>0.06</td>
<td>0.02</td>
<td>0.27*</td>
</tr>
<tr>
<td>Gender</td>
<td>0.49</td>
<td>0.37</td>
<td>0.11</td>
</tr>
<tr>
<td>TELD</td>
<td>0.08</td>
<td>0.03</td>
<td>0.33*</td>
</tr>
<tr>
<td>Bear/Dragon</td>
<td>0.25</td>
<td>0.11</td>
<td>0.43*</td>
</tr>
<tr>
<td>TELDxBear/Dragon</td>
<td>0.02</td>
<td>0.01</td>
<td>0.32*</td>
</tr>
<tr>
<td><strong>ΔR² for Step 4</strong></td>
<td>.03*</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* p < .05, one-tailed.

the variance seen in children’s theory-of-mind scores. Part correlations suggest that children’s language ability uniquely explained 28% of the total variance accounted for by the current model.

At Step 3, children’s bear/dragon scores were entered into the model. Despite a significant overall model, $F(3, 74) = 19.62, p < .05$, children’s bear/dragon scores did not predict additional variance in children’s theory-of-mind scores, $F_{change}(1, 70) = 0.28, p = n.s.$
Indeed, bear/dragon scores did not emerge as a significant predictor of children’s theory-of-mind scores.

In Step 4, the interaction term, TELDxBear/dragon, was entered into the model to determine whether the effects of child language and conflict inhibition were multiplicative. The overall model was significant, $F(1,71) = 17.31, p < .05$. Results suggested that the interaction term predicted additional significant variance in children’s theory-of-mind scores, $F_{change}(1,69) = 4.34, p < .05$. In fact, there was a significant effect of the interaction term that accounted for an additional 3% of the variance seen in children’s theory-of-mind scores. After accounting for the effects of child age, gender and language ability, the product between child language and conflict inhibition ability uniquely predicted 17% of the total variance explained by the current model. Moreover, although qualified by a significant interaction, significant main effects of language and conflict inhibition emerged\(^7\). This interaction was plotted at 1 SD above and below the mean for the TELDxBear/dragon term (refer to Figure 3)\(^8\). Results suggested that when high language is coupled with high conflict inhibition, children scored higher on the theory-of-mind scale. Conversely, when language and/or conflict inhibition abilities were low, children scored lower on the theory-of-mind scale.

Lastly, to ensure that the effects of age and gender are consistent across different levels of child language, conflict inhibition and TELDxBear/dragon, interaction terms between covariates (age and gender) and all other variables (TELD, bear/dragon, and

\(^7\) According to Frazier, et al., (2004), when first-order effects are interpreted before the interaction term is entered into the model, all of the variance shared among the predictor, the moderator, and their interaction is attributed to these first-order effects. Thus, the main effects of child language and conflict inhibition are interpreted at Step 4 of the regression model.

\(^8\) Given the bi-modal distribution of children’s conflict inhibition scores, there were concerns that the moderating variable should be treated as a dichotomous variable. Moderation analysis was re-run with children assigned to two groups: 1) those with conflict inhibition and 2) those without conflict inhibition. Similar results were found.
Figure 3: Children’s theory-of-mind score as a function of language and bear/dragon scores

TELD_xBear/dragon were entered into the model (Frazier, et. al., 2004). Six interaction terms were constructed and entered into the final step. Although the overall model was significant, $F(1,71) = 17.31, p < .05$, no additional variance was predicted by interaction terms, $F_{\text{change}}(6, 63) = 0.17, p = \text{n.s.}$ Similarly, none of the interaction terms emerged as significant predictors. Thus, the effect of age and gender are consistent across child TELD and bear/dragon scores. More importantly, consistency is also seen across different levels of the interaction term.

9.3 Testing the Significance of the Moderating Effect

To test for the significance of the moderating effect, two analyses were conducted: 1) simple effects analyses and 2) test of simple slopes. Unlike plotting the moderating effect, these
tests provides additional information regarding the significance of the relations between the independent and dependent variable at different levels of the moderator. Simple effects analyses were used to examine the effects of conflict inhibition across high- and low-language groups and test of simple slopes examines the effects of language across high- and low-conflict inhibition groups.

Simple effects analyses were conducted to examine whether the effect of conflict inhibition was significant at high and low levels of language. Results demonstrated that at high levels of language, the effect of conflict inhibition was significantly different ($b = -2.42, p < .05$). This suggests that the difference between high- and low-conflict inhibition groups at high language is significant. However, at low levels of language, the effect of conflict inhibition was not significantly different ($b = .38, p = ns$). This suggests that the difference between high- and low-conflict inhibition groups at low language was not significant.

Since regression coefficients in a moderation analysis are interpreted in relation to the value of 0 for other variables in the model, it is important to also evaluate whether the slope of each condition is significantly different from 0. Results from the simple slopes analysis indicated that the slope of the line representing children with high conflict inhibition was significantly different from zero ($b = 1.14, p < .05$). This suggests that the effect of language in children with high conflict inhibition is significantly different across low and high language groups. However, the slope of the line representing children with low conflict inhibition was not significantly different from zero ($b = 0.36, p = n.s.$). This suggests that the effect of language in children with low conflict inhibition is not significantly different across low and high language groups.
Taken together, these results suggest that although child language and conflict inhibition may have limited effects on early theory-of-mind understanding, they are both important for false-belief understanding. This is suggested by a non-significant effect of conflict inhibition in children with low language ability and a non-significant effect of language across children with low conflict inhibition ability. However, more advanced theory-of-mind development such as false belief, is influenced by child language and conflict inhibition where optimal development occurs when children have high levels of both.
Chapter 10: The Joint Effect of Environmental and Cognitive Factors on Theory-of-mind Development

10.1 Exploratory Analysis

Model 4 tested the compensatory model of theory-of-mind development. To this end, moderation analysis was used to examine whether the effects of child language and/or conflict inhibition on theory of mind is augmented by parental cognitive talk. Partial correlations controlling for the effects of age were conducted to look at the associations between child language, conflict inhibition, parental cognitive talk, and theory of mind (refer to Table 24 for a summary of results).

Table 24.

*Intercorrelations between Child Language, Conflict Inhibition, Parental Cognitive Talk and Theory of mind Controlling for the Effects of Child Age and Gender*

<table>
<thead>
<tr>
<th>Variables</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Child Language (TELD score)</td>
<td>----</td>
<td>.48*</td>
<td>.18</td>
<td>.42*</td>
</tr>
<tr>
<td>2. Conflict Inhibition (Bear/dragon score)</td>
<td>----</td>
<td>.17</td>
<td></td>
<td>.34*</td>
</tr>
<tr>
<td>3. Parental Cognitive Talk</td>
<td>----</td>
<td></td>
<td>.28*</td>
<td></td>
</tr>
<tr>
<td>4. Theory of Mind (Theory-of-mind Scale)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note * p < .05.

Results suggested that all variables were significantly correlated with children’s theory-of-mind scores. Moreover, parental cognitive talk was not significantly correlated with either child language or conflict inhibition scores, satisfying conditions for testing for moderation effects.
10.2 Moderation Analysis

To test for moderation, criteria recommended by Baron and Kenny (1986) were followed. Since five families did not participate in the wordless storybook-reading task, data from 70 families were analyzed.

In the current analysis, hierarchical linear regression analysis was used. After controlling for the effects of age and gender (covariates), child TELD and bear/dragon scores were entered into the model to examine whether cognitive factors predicted significant variance in children’s theory-of-mind scores. Next to examine the independent effects of the socio-linguistic environment parental use of cognitive terms was entered into the model at Step 3. Lastly, the compensatory model of theory-of-mind development was tested by examining whether parental use of cognitive terms moderated the effects of child language and /or conflict inhibition on theory of mind. To this end, the interaction term TELDxCognitive and Bear/DragonxCognitive was entered into the last step of the model. Variables were entered in this order since inspecting the product term without controlling for the variables from which they are based confounds the moderator effect with the effects of the predictor and moderator variable (Frazier, et. al., 2004).

After controlling for child age and gender (Step 1), children’s bear/dragon and TELD scores where entered into the model to examine the effects of conflict inhibition and general language on theory of mind (Step 2). The overall model was significant, $F(4, 69) = 19.49, p < .05$. Results indicated that Model 2 predicted additional significant variance in children’s theory-of-mind scores, $F_{change}(2,65) = 8.09, p < .05$ (refer to Table 25). Although bear/dragon score was non-significant, children’s TELD scores emerged as a significant predictor of theory
Table 25.

Effects of Child Language, Conflict Inhibition and Parental Cognitive Talk on Theory-of-mind Scores

<table>
<thead>
<tr>
<th>Variable</th>
<th>B</th>
<th>SE b</th>
<th>β</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>0.13</td>
<td>0.02</td>
<td>0.61*</td>
</tr>
<tr>
<td>Gender</td>
<td>0.82</td>
<td>0.41</td>
<td>0.18*</td>
</tr>
<tr>
<td>$R^2$ for Step 1 = .43*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>0.05</td>
<td>0.02</td>
<td>0.26*</td>
</tr>
<tr>
<td>Gender</td>
<td>0.74</td>
<td>0.38</td>
<td>0.17*</td>
</tr>
<tr>
<td>Bear/Dragon score</td>
<td>0.09</td>
<td>0.07</td>
<td>0.16</td>
</tr>
<tr>
<td>TELD score</td>
<td>0.09</td>
<td>0.03</td>
<td>0.36*</td>
</tr>
<tr>
<td>$\Delta R^2$ for Step 2 = .11*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Step 3</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>0.05</td>
<td>0.02</td>
<td>0.27*</td>
</tr>
<tr>
<td>Gender</td>
<td>0.87</td>
<td>0.37</td>
<td>0.20*</td>
</tr>
<tr>
<td>Bear/Dragon score</td>
<td>0.09</td>
<td>0.07</td>
<td>0.15</td>
</tr>
<tr>
<td>TELD score</td>
<td>0.08</td>
<td>0.03</td>
<td>0.32*</td>
</tr>
<tr>
<td>Parental Cognitive Terms</td>
<td>9.56</td>
<td>4.65</td>
<td>0.17*</td>
</tr>
<tr>
<td>$\Delta R^2$ for Step 3 = .03*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Step 4</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>0.05</td>
<td>0.02</td>
<td>0.27*</td>
</tr>
<tr>
<td>Gender</td>
<td>0.89</td>
<td>0.38</td>
<td>0.20*</td>
</tr>
<tr>
<td>Bear/Dragon score</td>
<td>0.09</td>
<td>0.07</td>
<td>0.15</td>
</tr>
<tr>
<td>TELD score</td>
<td>0.09</td>
<td>0.06</td>
<td>0.38</td>
</tr>
<tr>
<td>Parental Cognitive Terms</td>
<td>18.61</td>
<td>29.69</td>
<td>0.34</td>
</tr>
<tr>
<td>Bear/Dragon x Cognitive Terms</td>
<td>1.51</td>
<td>2.11</td>
<td>0.38</td>
</tr>
<tr>
<td>TELD x Cognitive</td>
<td>-0.44</td>
<td>0.66</td>
<td>-0.52</td>
</tr>
<tr>
<td>$\Delta R^2$ for Step 4 = .004</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* $p < .05$, one-tailed.

of mind, accounting for an additional 11% of variance over and above the effects of age and gender. Part correlations indicated that after accounting for the effects of age and gender,
children’s TELD scores accounted for 22% of the total variance explained by the current model.

To examine the effects of parent-child discussions about cognitive states on theory of mind, parental references to cognitive states were entered into the model at Step 3. The overall model was significant, $F(5,69) = 17.21, p < .05$, and results suggested that Model 3 predicted additional significant variance in children’s theory-of-mind scores, $F_{change}(1,64) = 4.23, p < .05$. Parental references to cognitive terms emerged as a significant predictor of children’s theory-of-mind scores and accounted for an additional 3% of variance, over and above the effects of child age, gender and general language ability. Part correlations indicated that parental cognitive references uniquely predicted 17% of the total variance in children’s theory-of-mind scores explained by the current model.

Lastly, to examine whether parental references to cognitive terms moderated the effects of general language and/or conflict inhibition on theory of mind, the interaction term between these factors were entered in the last step. Although the overall model was significant, $F(6,69) = 14.16, p < .05$, Model 4 did not appear to explain additional significant variance in children’s theory-of-mind scores, $F_{change}(1,63) = 0.10, p = n.s$. Indeed, neither interaction term emerged as a significant predictor of children’s theory-of-mind scores.

Taken together, these findings suggest that child language abilities and parental cognitive talk are both unique predictors of children’s theory-of-mind scores. More importantly, results suggest that there are no contingencies operating between these variables as predictors of theory of mind.
Chapter 11: Summary of Results

In sum, the following results were obtained:

1. **Model 1**: Testing the mediating role of child language on the relation between family risk and theory of mind

   *Results:* In support of the original hypothesis, results suggest that the effects of family risk on theory of mind are completely mediated by children’s language ability. That is, family risk may affect theory of mind by influencing the rate at which children acquire language. With slower rates of language acquisition, children exposed to higher levels of family risk are also more likely to experience delays in theory-of-mind development.

2. **Model 2**: Testing the mediating role of parent-child reciprocity on the relation between parental cognitive talk and theory of mind

   *Results:* In support of the original hypothesis, results suggest that the effects of parental cognitive talk on theory of mind may be completely mediated by parent-child reciprocity. Parental cognitive talk may affect theory of mind by influencing the extent to which parents and children engage in reciprocal conversations. Specifically, when parents use more cognitive terms during conversations with preschoolers, they are also more likely to engage in reciprocal conversations which then facilitates more advanced theory-of-mind understanding in children.

3. **Model 3**: Testing possible contingency effects between conflict inhibition and general child language ability on theory of mind
Results: Results suggest that although general child language and conflict inhibition may have limited effects of early theory-of-mind development, they are both important for false belief. That is, although general child language and conflict inhibition ability both independently predict children’s false-belief understanding, when there are high levels of both, optimal theory-of-mind development occurs. Results suggest that the effects of language and conflict inhibition on false-belief development are contingent upon each other.

4. Model 4: Testing the compensatory model of theory-of-mind development

Results: Contrary to original hypothesis, there is no evidence to suggest that parental cognitive talk moderated the relation between theory of mind and general child language ability or conflict inhibition. However, both general child language ability and parental talk about cognitive states were found to uniquely predict variance in children’s theory-of-mind scores. These results support the additive model of theory-of-mind development. Specifically each mechanism may play distinct roles during theory-of-mind acquisition.
Chapter 12: Discussion

The goal of the present thesis was to examine the influence of environmental and cognitive factors on theory-of-mind development. To this end, possible mediation and moderation processes that can help explain “why” and “under what circumstances” environmental and cognitive factors are important for theory-of-mind development were examined. Several important themes emerged from the findings. First, findings from Model 1 and 2 suggest that more distal environmental factors such as family-specific and socio-linguistic factors may influence theory-of-mind development indirectly by affecting mechanisms that are more proximal to the child. This is demonstrated by the possible mediating effects of child language on the relation between theory of mind and family risk (Model 1) and the possible mediating effects of parent-child reciprocity on the relation between theory of mind and parental cognitive talk (Model 2). The first section of this chapter will discuss these results.

Second, it appears that although cognitive mechanisms have a direct influence on theory-of-mind development, they may also operate in conjunction with each other to promote optimal development. This is illustrated by results from Model 3. Specifically, although child language and conflict inhibition were found to be important for false-belief development, they are more important when children also have high levels of both abilities. This suggests that certain combinations of factors may be related to more advanced theory-of-mind understanding in children. This pattern of results will be further discussed in the second section of the current chapter.
Lastly, environmental and cognitive factors appear to play distinct roles during theory-of-mind development. This finding suggests that both are necessary, but individually not sufficient for optimal theory-of-mind acquisition and support the additive model of development. These findings will be examined in the last section of the current chapter.

12.1 Effects of Environmental Factors on Theory-of-mind Development

12.1.1 Mediating Role of Child Language on the Relation between Family Risk and Theory of Mind

Model 1 examined the possible mediating effects of child language on the relation between family risk and theory of mind. In support of original hypothesis, results suggest that effects of family risk on theory-of-mind development may be mediated by children’s language ability. More importantly, the effects of family risk may be completely accounted for by child language. These findings converge with multiple studies that have found a relationship between socioeconomic status and theory of mind. Specifically, a disproportionate number of children living in low socioeconomic status families have been found to display a developmental lag in theory-of-mind development (e.g., Holmes et al., 1996). Despite these consistent findings, the process that explains how family risk operates on theory of mind is relatively unclear. Results from the current study offer some new insight. That is, family risk may delay theory-of-mind development by impeding the rate at which children acquire language.

Results from this study also reconcile some inconsistencies seen in the research literature. On the one hand, some studies have found a direct relationship between socioeconomic status and theory of mind (e.g., Cole & Mitchell, 1998; Cutting & Dunn, 1999) while others have not. Rather, socioeconomic status was found to relate to child abilities such as language and executive functions (e.g., Noble et al., 2005) that are responsible for facilitating theory of mind. Given that current results suggest that the effects of socioeconomic
status on theory of mind may be mediated by children’s language ability, perhaps inconsistencies across studies reflect differences in variables that are measured across studies. This is especially true of studies that did not consider the effects of children’s own cognitive ability (e.g., language) while examining the effects of socioeconomic status on theory of mind (e.g., Holmes et al., 1996). In the following section, the mediating effect of child language on the relation between family risk and theory of mind will be discussed.

12.1.1.1 Mediating effect of child language. The current findings suggest that a possible mechanism by which family risk affects children’s theory-of-mind development is through child language. That is, family risk may impede language development that subsequent affects the rate at which children acquire a theory of mind. These patterns are consistent even after controlling for the effects of age and gender.

These findings align with multiple studies. First, it has been consistently shown that children from high-risk families are more likely to experience a delay in language development (e.g., Raviv et al., 2004). It has been postulated that differences in linguistic experiences account for why children from lower socioeconomic status background families generally display delays in language development. For instance, naturalistic and empirical studies suggest that children from lower socioeconomic background families are exposed to different patterns of maternal speech (see Hart & Risley, 1995 for a review) that result in linguistic differences. Indeed, there is evidence to demonstrate that the mean length of utterance of mothers explains why family risk is related to children’s language development (Hoff, 2003).

In addition to possible parental characteristics, the home environment associated with lower socioeconomic status families may also directly impact on children’s language development. Particularly since low socioeconomic status families are more likely to
experience risk and vulnerabilities (McLoyd, 1998), children may receive less cognitive stimulation that is required for optimal language development. Indeed, Raviv and colleagues (2004) demonstrated that children from low socioeconomic status families received less cognitive stimulation in their homes, which increased their likelihood of experiencing delays in language development. Moreover, the socio-emotional climate of the home may also contribute to language development. Since stress may affect how children learn (McLoyd, 1998), it is possible that highly stressed homes create an environment that impedes children’s language development.

Delays in language acquisition subsequently affect the rate at which children acquire theory of mind. This is demonstrated in the current study where even after controlling for the effects of child age and gender, child language significantly predicted theory-of-mind ability. This contributes to the substantial amount of evidence that has demonstrated a causal association between child language and theory of mind (e.g., Astington & Jenkins, 1999). As suggested by some, perhaps language provides children with a representational system that allows them to reason about, discuss and reflect upon mental state concepts (Astington & Baird, 2005). Perhaps children living in high-risk conditions are less likely to reach age-appropriate milestones for language development. Without a certain level of mastery of language, children may not have the cognitive ability that allows them to engage in meta-representation, a necessary condition for reasoning through a false-belief task. Indeed, existing research does suggest that children require a certain threshold of language understanding before being able to pass the false-belief task (Jenkins & Astington, 1996).

Taken together, the present data suggest that family risk may operate on theory of mind by affecting the rate at which children acquire language. However, several caveats should be
considered when interpreting the data. First, given the cross-sectional design of the study, it is
difficult to establish the causal relationship between variables. Although current results suggest
that a possible mechanism whereby family risk affects theory of mind is through child
language, it is difficult to establish causality without longitudinal data. Particularly since certain
individuals with a specific genetic predisposition may be more likely to self-select into risky
environments (e.g., Costello, Compton, Keeler, & Angold, 2003), it remains relatively unclear
whether the current effect of family risk on theory of mind is due to a social causal effect or a
social selection effect. Without a longitudinal design, it is difficult to address this issue.
Nevertheless, the current study represents an initial attempt at examining the distal effects of
family risk on theory-of-mind development.

Second, it was unusual that a parent factor was not found to mediate the relationship
between family risk and theory of mind since distal factors often influence developmental
outcomes by affecting how parents interact with their children. One possibility that can explain
these results is how family risk was operationalized. Since the current family-risk composite
includes indicators assessing family resources (e.g., access to a car) and parental competency
(e.g., no education qualification), effects of both constructs may have been incorporated in the
same variable. Therefore, in addition to measuring distal effects (e.g., family income), the
current family risk variable also includes a measure of more proximal effects (e.g., parental
competency). This limits how results are interpreted since it remains relatively unclear as to
whether child language mediates the effects of family resources, parental competency or both.
A direction for future research is to examine whether the unique effects of family
characteristics (e.g., low family income) and parental competency (e.g., no educational
designation) on theory-of-mind development are mediated by child language.
Lastly, it was surprising to find full mediation since conceivably, child language
development may be affected by different factors. However, given that family-risk scores
measure both family resources and parental competency, it can be viewed as a general index of
overall family functioning. Thus this variable may account for the majority of family
characteristic and socio-linguistic factors that might collectively affect child language.
Nevertheless, the fact that the current model explains approximately 19% of the variance in
children’s theory-of-mind scores suggests that other possible mechanisms more proximal to the
child may mediate the relationship between family risk and theory of mind. Perhaps other
mechanisms such as sibling and peer relationships may also explain why family risk is
associated with theory-of-mind development. Future research is required to address this
possibility.

12.1.2 The Mediating Effects of Parent-child Reciprocity on the Relation between Theory of
Mind and Parental Cognitive Talk

Results from Model 2 suggest that a possible mechanism whereby parental cognitive
talk affects theory-of-mind development is through parent-child reciprocity. That is, the extent
to which parents and children engage in reciprocal interactions may explain why children’s
exposure to parental cognitive talk is related to their theory-of-mind development. More
importantly, this pattern of results emerged while controlling for the effects of age and gender.

Current results align with those of Ensor and Hughes (2008). Although these authors
did not explicitly test the mediating effects of parent-child connectedness, their results suggest
that connected conversation, relative to parental cognitive talk, is a stronger predictor of
children’s social understanding. Although the current measure of parent-child reciprocity did
not examine the specific semantic relatedness between each parent-child turn, it does capture
the general, conversation-like reciprocal quality of the parent-child dyad. Arguably some extent of semantic connectedness is required if parents and children are to engage in reciprocal conversations. Thus, given the likely overlap between these two measures, current results lend support for the effects of parent-child connectedness during theory-of-mind development.\(^9\) Moreover, these results also converge with other studies that have shown a causal association between connected conversations and theory-of-mind development (e.g., Dunn & Brophy, 2005).

Current results also extend those of Ensor and Hughes (2008). First, in addition to assessing parent-child connectedness, the current parent-child reciprocity measure also considers the extent to which dyads express shared, positive affect. Unlike Ensor and Hughes (2008) where only semantic exchanges between parent and child were measured, the joint effect of reciprocal conversations and shared positive affect was examined in the current study. Particularly since there is some evidence to suggest parental affect such as warmth and positivity is beneficial to theory-of-mind development (e.g., Hughes et al., 1999), by also considering the socio-emotional climate in which reciprocal conversation takes place, the current results extend our understanding of how these parent-child discussions influence theory-of-mind acquisition. Arguably, conversations are intrinsically social. Thus, the affective climate that conversations take place in may be just as important as “what” or “how” things are being discussed. Indeed, current results suggest that it is the unique combination of reciprocal conversations occurring within exchanges that are mutually positive for both speakers that predicts theory-of-mind development.

\(^9\) Since there is high theoretical overlap between parent-child connectedness and parent-child reciprocity, parent-child connectedness and parent-child reciprocity will be used interchangeably.
Second, in addition to amplifying effects of connected parental cognitive talk on theory of mind (Ensor and Hughes, 2008), preliminary results from the current study also suggest possible mediation effects of parent-child reciprocity. These observations provide some preliminary insight into the role of parental cognitive talk during theory-of-mind acquisition. Although highly speculative, in addition to helping children acquire a linguistic label for mental state concepts, perhaps parental use of cognitive-state terms is more helpful in assisting children to appreciate different perspectives. By 3 years of age, children generally have acquired a mental-state lexicon (e.g., Bartsch & Wellman, 1995). Thus, it seems reasonable to suggest that within the preschool years parental cognitive talk may be used primarily to help children appreciate the existence of multiple perspectives (as suggested by Harris, 2005). Particularly since there is some evidence to suggest that the effects of parental desire and cognitive talk on children’s own mental-state talk may be different across ages (Taumoepeau & Ruffman, 2008), perhaps similar effects of age are seen between parental cognitive talk and theory-of-mind acquisition. That is, depending on children’s age, how parental cognitive talk affects theory-of-mind acquisition may be different. Specifically, for younger children who have yet to acquire a mental-state lexicon, perhaps exposure to parental cognitive talk may be more helpful in introducing cognitive terms into children’s vocabulary. However, once children have acquired cognitive terms, parental talk about cognitive states may play a more important role in helping children appreciate the subjective nature of mental states. Nevertheless, these results suggest that parents’ use of cognitive terms plays an important role during theory-of-mind acquisition. Why parental cognitive talk may be important for theory of mind is discussed below.
12.1.2.1 Mediating effects of parent-child reciprocity. Results from this study offer some new insight into why parental talk about cognitive states may relate to children’s theory-of-mind development. Specifically, parent-child reciprocity may be a possible mechanism that can help explain how parental cognitive talk operates on theory-of-mind acquisition; parents’ use of cognitive terms may encourage more parent-child reciprocity within a shared, positive context which in turn facilitates theory-of-mind acquisition in children. How this mechanism may operate on theory-of-mind development is discussed in the following sections.

Current results suggest that more parental use of cognitive terms during conversations predicted more positive, reciprocal parent-child interactions. These findings converge with those reported by Ensor and Hughes (2008), where the authors found that mother’s use of desire and cognitive terms occurred more often within connected conversations. The authors suggest that particularly with cognitive terms, they are primarily used during parent-child conversations to talk about multiple knowledge states. This then allows dyads to actively co-construct a shared perspective since cognitive terms are used primarily to explicitly highlight the subjective nature of knowledge states. Moreover, as parents use more cognitive terms during conversations, the dyad is encouraged to develop more sensitivity towards the other speakers’ perspective. For instance, as parents actively engage their child in the co-construction of a shared perspective, children, in response to their parents, may also become more in tune with their parents’ knowledge state. This mutual sensitivity may increase positivity that is shared between each member of the dyad as both parent and child are encouraged to share their perspective. Indeed, preliminary results from the current study demonstrate that there is a significant association between parental and child positivity with parental cognitive talk where more parental talk about knowledge states was found to be related to both parental and child
positivity (refer to Appendix E). Thus, as parents use more cognitive terms during conversations, not only are they encouraging more connected conversations, but they create an environment that facilitates mutual reciprocity in which a shared perspective is co-constructed.

When cognitive states are discussed within a context of shared, reciprocal, positive affect, optimal theory-of-mind development may subsequently occur. These results also align with those reported by Ensor and Hughes (2008) where the authors also found that earlier parent-child connected conversations predicted later social understanding in children. Ensor and Hughes (2008) suggest that children’s mental-state understanding may be enhanced by parent-child conversations that are semantically related since a shared conversational focus explicitly highlights similarities and differences between the parent and child. Perhaps within this context, children find it easier to connect a mental-state term utterance with a mental-state concept. By making these connections explicit, parents may scaffold theory-of-mind acquisition by reducing the cognitive load required to internalize these mental-state concepts. Moreover, this process may be further facilitated by positivity between parents and children. Since parental positivity has been shown to be beneficial to theory-of-mind development (e.g., Hughes et al., 1999), perhaps positive parent-child reciprocity creates an optimal socio-emotional environment for theory-of-mind acquisition.

Insofar as the effects of parental cognitive talk on theory of mind are mediated by parent-child reciprocity, it is also important to acknowledge several caveats when interpreting the results. First, it may be possible that the effects of parent-child reciprocity on theory of mind are mediated by parental cognitive talk. Given the cross-sectional nature of the current study, it is very difficult to address this issue. However, despite these constraints, there is some preliminary evidence to suggest that the effect of parent-child relationships on children’s
social-cognitive outcomes may not necessarily be mediated by how parents talk about mental states. In a study by Raikes and Thompson (2006), the authors tested the mediating effect of parent-child references to emotion states on the relation between parent-child attachment security and children’s understanding of emotions while accounting for the effects of child language and maternal depression. However, despite meeting all criteria for mediation, the proposed mediated pathway was not significantly different from zero. This suggests that the mediated pathway (i.e., the combined effect of parent-child emotion talk and parent-child attachment security) was not significantly different from that of the direct pathway (i.e., parent-child attachment security). Thus, it may be possible that relative to parental talk about mental states, the quality of the parent-child relationship may be a more proximal predictor of children’s social cognitive outcome. Nevertheless, to help address this issue a possible avenue for future research includes a longitudinal investigation of parental cognitive talk and parent-child reciprocity and their influence on theory-of-mind development.

Second, effects of parental cognitive talk and parent-child reciprocity on theory of mind may be bi-directional where the effect of one scaffolds the other. That is, as parent-child reciprocity is encouraged by parents’ use of cognitive terms, subsequent parental references to cognitive states may occur because of higher levels of parent-child reciprocity. This suggests that in addition to the reported mediated pathway, the relationship between parental cognitive talk, parent-child reciprocity and theory of mind can be more accurately described by accounting for possible bi-directional influences of factors. Given that more sophisticated statistical analyses that can model these relations often require larger sample sizes, a direction for future research includes examining more intricate relations between multiple mechanisms with advanced statistic techniques.
12.1.3 Limitations of Mediation Models

In sum, results from Model 1 and Model 2 suggest that the influence of more distal factors such as family risk and parental cognitive talk may operate through more proximal mechanisms such as child language and parent-child reciprocity during theory-of-mind development. However, there are several important caveats that should be considered while interpreting results. First, at best, current results only imply causality and illustrate possible processes that underlie theory-of-mind development. Considering that longitudinal data were not used in the current study, it is difficult to speak to the causal relationships between variables. Second, without a longitudinal design, the possible effect of a third variable is not controlled for. For instance, parental cognitive talk and parent-child reciprocity may both be a function of family risk and is only present in families who are exposed to low family risk. Moreover, possible genetic effects are not addressed since it is difficult to attribute family risk to social selection or social causation with a cross-sectional design. Thus, future research employing a longitudinal design is required to address some of these limitations and to substantiate current results. Nevertheless, reported findings provide us with a stepping-stone towards understanding the mediating effects that facilitate theory-of-mind development.

12.1.4 Implication of Results: Reconceptualizing the Development of Theory of Mind with the Bioecological Model

Taken together, results from Model 1 and 2 suggest that environmental factors such as family risk and parental cognitive talk may have an indirect influence on theory-of-mind development. First, family risk may operate on theory of mind by impeding children’s language development which, subsequently delays their theory-of-mind acquisition. Second, parental cognitive talk may operate on theory of mind by influencing the extent to which parents and
their children engage in reciprocal, connected conversations. These results challenge us to re-conceptualize theory-of-mind development within a framework that considers both direct and indirect influences of environmental factors and child cognitive abilities. One such model is the bioecological model. Bronfenbrenner and Ceci (1994) argue that development occurs within a multi-level structure where children are influenced directly and indirectly by different factors embedded within multiple layers of their social context. Children are also actively involved in their own developmental outcomes, in that development is partially defined by children’s own response to their environment. Components of the bioecological model include distal and proximal processes. Distal processes indirectly influence development by exerting their effects on more proximal processes that are found in the child’s immediate environment. Indeed, preliminary results from the current study suggest that similar relations between distal and proximal factors govern theory-of-mind development. Specifically, more distal factors (e.g., family risk) have been shown to influence theory of mind by operating through a mechanism more proximal to the child. Thus, a fruitful avenue of research can examine mediating processes that can help us understand how more distal mechanisms affect theory-of-mind development.

How children respond to environmental influences (i.e., through the expression of phenotype or psychological functioning) also depends on their own unique attributes or abilities (Bronfenbrenner & Ceci, 1994). Thus, the interaction between environmental influences (particularly those that are more proximal to the child) and genetic predispositions of children determine developmental outcomes in children and explain why there are individual differences across children. Considering that genetic information was not included in the current study, it is difficult to determine the extent to which genetic influences affect theory-of-mind acquisition.
Although there is some evidence to suggest that genetic factors explain approximately 15% of the variance in children’s theory-of-mind scores (Hughes et al, 2005), future research should consider the effects of biological factors in relation to other mechanisms such as child language, conflict inhibition and parental cognitive talk.

Current results also suggest that environmental processes have varying degrees of influence on theory-of-mind development. That is, some processes may have a larger affect on theory-of-mind development relative to others. For instance, relative to Model 2, Model 1 accounted for more variance in children’s theory-of-mind scores. This suggests that when family risk operates through child language, its effects on theory of mind is greater than that of parental cognitive talk when it operates through parent-child reciprocity. These observations have important implications for interventions aimed at preventing delays in theory-of-mind acquisition. For instance, insofar as family risk influences the rate of theory-of-mind acquisition by impeding children’s language ability, perhaps to help children meet age-appropriate milestones in false-belief understanding, intervention programs can focus on improving children’s linguistic abilities. Moreover, by identifying processes that have a larger impact on theory-of-mind development, interventions that can play a larger preventative role can be developed. This possibility represents an exciting avenue of research that can bridge theory with practice.

In sum, current findings demonstrate that more distal environmental factors such as family-specific and socio-linguistic mechanisms operate through more proximal processes during theory-of-mind development. More importantly, these results challenge us to reconceptualize theory-of-mind development within a bioecological model that considers the influences of multiple mechanisms during development.
12.2 Effects of Cognitive Factors on Theory-of-mind Development

To examine under what circumstances cognitive factors such as child language and conflict inhibition are important for theory-of-mind development, moderation analysis was conducted. Results suggest that although child language and conflict inhibition may have limited effects on early theory-of-mind understanding, more advanced theory-of-mind understanding (e.g., false belief) involves both child language and conflict inhibition. Specifically, effects of child language on optimal theory-of-mind development are contingent on children’s conflict inhibition ability. That is, when both language and conflict inhibition are high, theory-of-mind scores were also high. However, when language and/or conflict inhibition were low, children scored lower on the theory-of-mind scale. These patterns of results support multiplicative model of theory-of-mind development. In the following sections, these results will be discussed.

12.2.1 Effects of Child Language and Conflict Inhibition on Advanced Theory-of-mind Understanding

Results suggest that although child language and conflict inhibition are both important for more advanced theory-of-mind development, there appears to be limited effects of these mechanisms during early theory-of-mind development. This is demonstrated by a non-significant effect of conflict inhibition in children with low language (simple effects analysis) and the non-significant effect of language in children with low conflict inhibition (simple slopes analysis). This suggests that performance on the theory-of-mind scale was similar across children with high conflict inhibition or high language. Thus, despite having high language or conflict inhibition ability, these children were still unable to pass the threshold for false-belief understanding (a score of at least 4 on the theory-of-mind scale).
These results are particularly puzzling since there is a substantial amount of evidence to suggest that both language (e.g., Astington & Jenkins, 1999) and conflict inhibition (e.g., Hughes, 1998) are causally related to children’s theory-of-mind development. However, it is important to be mindful that these studies have typically examined child language and conflict inhibition in relation to children’s false-belief understanding. Particularly since items on the theory-of-mind scale represent different conceptual changes in children’s understanding, it may be possible that different mechanisms are responsible for facilitating change across theory-of-mind tasks. In this sense, it seems reasonable to suggest that for children to respond correctly on the diverse desires tasks, a certain mastery of language and/or conflict inhibition may not be required. However, as the cognitive requirements to respond appropriately on more advanced theory-of-mind tasks increase, a certain threshold of child language and/or conflict inhibition may be required. Indeed, there is some evidence to date to suggest a certain threshold of linguistic ability is required for false-belief understanding (Jenkins & Astington, 1996).

Main effects of language and conflict inhibition suggest that independently, these mechanisms are important for false-belief understanding. These observations converge with multiple studies that have documented the independent effects of child language (e.g., Astington & Jenkins, 1999) and conflict inhibition (e.g., Carlson & Moses, 2001) on children’s false-belief understanding.

The effect of language on false belief has been documented extensively in the theory-of-mind literature. For instance, the causal effect of child language on children’s false-belief understanding has been demonstrated across multiple studies (e.g., Astington & Jenkins, 1999). Although there is some debate as to which aspects of language are stronger predictors of children’s false-belief understanding, Slade and Ruffman (2005) argue that both semantic and
syntactical understanding of language is required for reasoning about false beliefs. Not only are children required to distinguish between different types of mental-state terms (e.g., wanting X and thinking X), they are also required to disentangle non-mental semantic differences between terms (e.g., being scared of X and being scared of Y). To track these differences involves both semantic and syntactic understanding. Indeed similar effects of general language ability on theory of mind have been reported by other studies that have examined the specific role of language (Cheung et al., 2004; Tardif et al., 2007).

While language may provide children with the representational system necessary to conceptualize mental states, conflict inhibition may provide the cognitive resources required to reason through a theory-of-mind task (particularly that of false belief). Perhaps mastery of conflict inhibition enables children to simultaneously reason about two conflicting mental states. As suggested by Carlson and Moses (2001), the cognitive resources required to reason through a false-belief task closely mimics that of a conflict inhibition task. Thus, as children master the ability to manage two conflicting rules and respond appropriately with the less salient rule their ability to express their knowledge about mental states on a false-belief task also improves.

12.2.3 Multiplicative Effects of Child Language and Conflict Inhibition on False-belief Development

Interestingly, in addition to the independent contributions of child language and conflict inhibition, the effects of these mechanisms appear to operate together during false-belief acquisition. That is, the effect of child language on false belief appears to be contingent on children’s conflict inhibition ability.
Results demonstrated that children with high language and high conflict inhibition ability performed better on the theory-of-mind scale than those with just high language or high conflict inhibition. This suggests that although both language and conflict inhibition contribute independently to false belief, when high levels of both are combined, optimal theory-of-mind development occurs. This pattern of results raises the possibility that although language and conflict inhibition may play distinct roles during false-belief acquisition, their effects also potentiate one another. Considering that optimal development is seen in children who have both high language and high conflict inhibition, perhaps it is the unique combination of these skills that help children reason about more sophisticated theory-of-mind tasks. For instance, since a score of 4 on the theory-of-mind scale suggests that children have some appreciation for false belief, results show that children with high language or high conflict inhibition generally score less than the minimum threshold that indicates false-belief understanding. Perhaps a certain threshold of linguistic ability, coupled with conflict inhibition ability enables children to consistently respond appropriately on more advanced theory-of-mind tasks such as the false-belief and belief-based emotion task. Indeed, there is evidence to suggest that a certain threshold of linguistic understanding is required before children are able to pass false-belief tasks (Jenkins & Astington, 1996) and that children’s executive functioning ability is associated with more advanced theory-of-mind understanding (e.g., Carlson & Moses, 2001). This suggests that although child language and conflict inhibition are necessary for theory-of-mind acquisition, they are individually not sufficient for more advanced theory-of-mind development. Current results suggest that it is the unique combination of high language and high conflict inhibition that allows children to reason about more advanced theory-of-mind concepts such as false beliefs and belief-based emotions.
12.2.2 Implications of Results: Unique Patterns of Development

These observations underscore the importance of considering how different mechanisms operate together during theory-of-mind acquisition. Particularly since it is conceivable that mechanisms rarely influence development in isolation, examining potentially moderating effects can help us identify certain conditions that can potentiate the effects of specific mechanisms important for optimal theory-of-mind development. More importantly, these findings support the notion that certain patterns or combinations of mechanisms are important for optimal theory-of-mind development. This emphasizes the importance of considering the effect of individual patterns or behaviours during development and perhaps taking a person-focused approach in understanding developmental processes. Rather than focusing exclusively on the effects of one variable, the person-focused approach focuses on individual patterns of behaviours that are important for development. This holistic framework can complement the more traditional variable-focused approach so that individual patterns important for theory-of-mind development can be understood. Not only will this give us a deeper understanding of how mechanisms facilitate theory-of-mind development, but can also be applied in developing ways to encourage optimal development in children.

12.3 The Joint Effect of Environmental and Cognitive Factors During Theory-of-mind Development

Model 4 tested the compensatory model of theory-of-mind development by examining the interactive influence of environmental and cognitive factors. Contrary to hypothesis, there is no evidence to support the compensatory model of theory-of-mind development. Specifically, contingent effects between parental cognitive talk and child language and/or conflict inhibition were not found. However, both child language and parental cognitive talk
predicted unique variance in children’s theory-of-mind scores. This suggests that both these factors play distinct roles during theory-of-mind development.

12.3.1 The Additive Model of Theory-of-mind Development

Results from Model 4 suggest that general child language ability and parental cognitive talk both contribute independently to theory-of-mind development, lending support for the additive model of development. These observations converge with the growing number of studies that have demonstrated an independent effect of child language (e.g., Astington & Jenkins) and parental mental-state talk (e.g. Ruffman et al., 2002) on children’s theory-of-mind development. Moreover, when examining the influence of multiple cognitive and environmental factors on theory of mind, McAlister and Peterson (2006) found that general child language ability, presence of a child sibling and executive function ability all uniquely predicted children’s performance on various theory-of-mind tasks. Although the joint effect of these factors was not explicitly tested, these results demonstrated that the effects of children’s own cognitive abilities and environmental factors are unique during theory-of-mind development.

Taken together, these findings, along with the current results, provide strong evidence for the independent effects of child language and parental mental-state talk on theory-of-mind development. In contrast, however, the current findings do not converge with those reported by Jenkins and Astington, (1996). Recall that the authors found that despite low language ability, children with siblings had theory-of-mind scores that were similar to children who displayed high language ability. Perhaps similar compensatory effects were not found in the current study because sibling- and parent-child relationships influence theory-of-mind development in different ways. Bronfenbrenner (1979) argues that the crux of development lies within primary
dyads that continue to motivate and steer the course of development even when members are not physically within proximity to each other. Children are more likely to acquire skills, knowledge and values from a person with whom a primary dyad is established. The parent-child dyad is the most common primary dyad studied during the infancy and preschool years.

Perhaps when compared with parent-child dyads, sibling-child dyads do not provide the same learning experience that is required to scaffold theory-of-mind development. Specifically, parent-child discussions primarily teach children about the fundamental nature of mental states whereas sibling-child interactions further reinforce these concepts by giving children opportunities to apply these concepts to real-world interactions with others. For instance, the sibling-child relationship is classified as one that is primarily reciprocal where children are provided with opportunities to co-construct shared meaning during these interactions. Parent-child relationships, on the other hand, are more complementary where exchanges are hierarchical and assume that the parent is invested with greater knowledge or authority. Perhaps these fundamental differences between sibling- and parent-dyads play different roles during theory-of-mind acquisition. Conceivably, parent-child discussions about mental states may help children appreciate the subjective nature of mental states whereas sibling interactions offer a context in which these new concepts can be applied to real-life situations.

Related to the findings of Jenkins and Astington (1996), it is possible that similar compensatory effects were not found simply because parent and sibling interactions affect theory of mind differently. Since sibling-interactions may scaffold learning by providing opportunities for children to practice newly acquired mental-state concepts or help them acquire more sophisticated linguistic ability, for children with low language, play and interactions with siblings may provide the additional support required for typical theory-of-
mind development to occur. Conversely, parental knowledge-state talk may be a necessary condition for theory-of-mind development. Since parent-child interactions are complementary, parents may be more effective in helping children acquire an understanding of fundamental mental-state concepts. Although interactions with siblings may also have similar advantages, it is likely that sibling-child dyads may not scaffold learning to the same extent as parent-child dyads. Thus, despite more exposure to mental-state talk with siblings (e.g., Brown, Donelan-McCall, & Dunn, 1996) it is how cognitive states are discussed during parent-child conversations that is important for facilitating theory-of-mind development. This suggests that regardless of children’s linguistic and conflict inhibition abilities, children with less exposure to parental knowledge-state talk will do relatively worse than those with more exposure. In the following section, how child language and parental knowledge-state talk operates on theory of mind will be examined.

12.3.2 The Role of Child Language and Parent-child Cognitive Talk during Theory-of-mind Acquisition

Child language and parental talk about cognitive states independently predict theory of mind because these constructs may play distinct roles during theory-of-mind acquisition. Perhaps language provides children with a representational system that allows them to represent, talk about and reflect upon mental states. Parental mental-state talk, on the other hand, may be more effective in highlighting the existence of multiple perspectives. Harris (2005) argues that conversations with others help preschoolers appreciate the subjective nature of mental states. Through the experience of information exchange, children learn to appreciate others as epistemic subjects who may hold a perspective different from theirs. Particularly with cognitive terms, parents-child dyads are given more opportunity to exchange perspectives since
these terms are used primarily to talk about different belief and knowledge states. Moreover, how cognitive terms are used by parents also seems to influence the rate of theory-of-mind development. For instance, when cognitive terms are used within a context in which parents and their children experience high levels of semantic connectedness (speaker utterances that are semantically related to previous speaker utterances), children are more likely to display more advanced social understanding (Ensor & Hughes, 2008).

Lastly, there is some evidence to suggest that parental cognitive talk operates on theory of mind through a mediating variable. For instance, despite finding a significant association between parental cognitive talk and theory of mind, parental cognitive talk becomes a non-significant predictor once the effects of parent-child connectedness are controlled (Ensor & Hughes, 2008). This suggests that parent-child connectedness, rather than parental cognitive talk is a stronger predictor of theory of mind. More importantly, it may be possible that parental cognitive talk operates through parent-child connectedness to affect the rate at which children acquire theory of mind. Results from Chapter 8 provide some preliminary evidence to support this process. Although it remains unclear as to how connected conversations facilitate theory of mind, Ensor and Hughes (2008) suggest that shared conversational focus highlights similarities and differences in perspectives across speakers. Moreover, when conversational partners are able to co-construct a shared perspective, reciprocal, shared positive affect is likely encouraged. Nevertheless, existing research and findings presented in Chapter 8 suggest that the effects of parental knowledge-state talk on theory of mind may be indirect and operate through parent-child connected talk.
12.3.3 The Role of Conflict Inhibition during Theory-of-mind Acquisition

Surprisingly, children’s conflict inhibition ability was not found to predict children’s theory-of-mind scores once children’s own language abilities were accounted for. This finding is in contrast with multiple studies that have found a relationship between children’s conflict inhibition and theory of mind (e.g., Carlson & Moses, 2001; Carlson et al., 2002). Although it may be possible that the effect was not detected because of limited variability (e.g., the bimodal distribution of scores) there are two possible reasons for why the current study failed to find similar results. First, it is possible that conflict inhibition may be important to theory-of-mind development under certain linguistic conditions. Second, conflict inhibition may have very specific relations to advanced theory-of-mind concepts (e.g., false belief).

Conflict inhibition may be important to theory-of-mind acquisition when children also have a certain level of linguistic understanding. That is, when children reach a certain threshold of linguistic competency and presumably a certain level of mental-state understanding, conflict inhibition is more important since it helps children apply this understanding more consistently on theory-of-mind tasks. This would suggest that conflict inhibition is more important to theory-of-mind development when children also have a certain level of language ability. Results discussed in Chapter 9 provide preliminary evidence to suggest that when high levels of language are coupled with high conflict inhibition, optimal theory-of-mind development occurs.

Moreover, the relation between conflict inhibition and theory of mind may be specific to that of false belief. Considering that research has primarily found significant associations between conflict inhibition and false belief (e.g., Carlson & Moses, 2001), it is possible that conflict inhibition does not share the same relations with less advanced theory-of-mind
concepts like simple desires and beliefs. Thus, significant associations may have been obscured since the theory-of-mind scale consists of multiple tasks measuring different aspects of mental-state understanding. More important, insofar as the effects of conflict inhibition are specific to that of false belief, the sample used in the current study may have also further masked any associations that may have been present. Considering that the current study involved families from a range of socioeconomic status backgrounds (with the exception of Hughes & Ensor, 2005; 2007), unlike existing studies that have used primarily upper- and middle-class families, in the current study children are less likely to experience optimal development across both language and conflict inhibition. Particularly since the effects of conflict inhibition are contingent on language, children who display high conflict inhibition but low language are likely to score lower on the theory-of-mind scale. However, once this interaction effect was accounted for, a significant association between conflict inhibition and theory-of-mind emerges (refer to results in Chapter 9).

It is acknowledged that it is difficult to determine whether the effects of conflict inhibition on theory of mind are dependent on a certain threshold of language or whether it relates specifically to the false-belief task. Despite the difficulty in teasing these conditions apart, conflict inhibition may provide the necessary cognitive resources that allow children to express what they already know about mental states on a theory-of-mind task.

Taken together, results from Model 4 suggest that environmental and cognitive factors each play distinct roles during theory-of-mind development. Related to the current study, the effects of general child language ability, conflict inhibition and parental cognitive talk on theory-of-mind development were examined. Although only general child language ability and parental cognitive talk emerged as significant predictors, results suggest that these mechanisms
each uniquely contribute to theory of mind. Thus, it is not likely that the effect of one mechanism can compensate for the other. Both these factors are important for theory-of-mind development.

The fact that previous research has found evidence for the compensatory model of theory-of-mind development (e.g., Jenkins & Astington, 1996), raises the possibility that the degree of influence may vary across mechanisms. Although highly speculative, perhaps some mechanisms play a more fundamental role in helping children acquire theory-of-mind understanding while others support, or further scaffold the rate of acquisition. Although speculative, insofar as fundamental mental-state concepts, necessary cognitive abilities, and an understanding of the subjectivity of mental states are internalized, presence of supportive mechanisms (e.g., siblings or peers) can help accelerate the rate at which theory-of-mind is acquired. This may be achieved by providing children with the opportunity to practice newly learned concepts in everyday situations. However, if fundamental elements are missing, regardless of the opportunities children are given, without the necessary conditions in place, it may be difficult for children to benefit from supportive mechanisms.

12.3.4 The Distinct Role of Environmental and Cognitive Factors During Theory-of-mind Development

In sum, results from Model 3 and Model 4 demonstrate the independent effects of child language, conflict inhibition and parental cognitive talk on theory of mind, particularly that of false belief. These findings support the additive model of theory-of-mind development. Perhaps language provides children with a representational system that allows them to represent, discuss and reflect upon mental-state concepts (Astington & Baird, 2005) while conflict inhibition ability provide children with the cognitive ability to manage mental states so that
they are able to respond appropriately on false-belief tasks. It is likely that conflict inhibition is important for helping children express what they know about mental states (e.g., Carlson & Moses, 2001) and to date, there is some evidence to suggest that children require a certain level of conflict inhibition before being able to successfully pass a false-belief task (e.g., Carlson et al., 2004). Lastly, through parent-child conversations about cognitive states, children learn about the subjective nature of mental states and the existence of multiple perspectives.

These patterns of results indicate to us that environmental and cognitive factors may play distinct roles during theory-of-mind acquisition and facilitate development in different ways. For instance, cognitive factors such as general child language ability and conflict inhibition are child abilities that are unique to each child and provide the cognitive foundation that allows children to reason about mental states. Environmental factors like parental cognitive talk however, help children learn how to apply theory of mind to real-world experiences. Through social interactions with others, children learn how theory of mind is used to guide behaviours according to prescribed social norms within cultural expectations. Given that theory of mind plays such a fundamental role in interpreting human behaviour, there is no surprise that there are universal similarities in the sequence of theory-of-mind acquisition across cultures (e.g., Wellman et al., 2006). However, what might differ across cultures is the relative importance placed upon different aspects of human behaviours. For instance, when compared with Euro-American mothers and children, Chinese dyads are less likely to reference the child’s preference, opinions and emotions during memory conversations and are more likely to focus on shared activities and the important roles of others (e.g., Wang, 2001; Wang & Fivush, 2005). Moreover, it is Chinese children’s own references to others’ mental states rather than references to their own mental states that relate to false-belief understanding (Lu, Su, & Wang,
2008). Therefore, the relative importance of whose mental states are being discussed and its impact on theory-of-mind development may be different across cultures. Thus, although the way in which theory-of-mind concepts are used to interpret human behaviour may be similar across cultures, the specific aspects of human behaviours that are interpreted with theory of mind may vary across cultures.
Chapter 13: Limitations

Although preliminary, the current results provide a stepping-stone into the direction of examining how environmental and cognitive factors operate together during theory-of-mind acquisition. Not only does the present study extend theory-of-mind research by incorporating theory-of-mind concepts beyond that of false belief, it also includes a sample of families from socioeconomically diverse backgrounds. However there are several limitations that must be considered when interpreting these results. In the following sections, limitations associated with the current study as well as using multilevel modelling in theory-of-mind research will be discussed.

When interpreting the findings presented in the study, it is important to consider several limitations. First, compared with other larger-scaled studies, the current sample is limited in sample size. Although results from Model 1, 2, and 3 provide some evidence for mediation and moderation effects, many mediation and moderation processes are small in effect size. Thus, larger sample sizes may be required to detect additional causal processes similar to those presented in the current study. Also, with a larger sample size, more sophisticated data analyses can be conducted. For instance, given the current sample size, possible bi-directional effects of different mechanism were not considered. As noted in Chapter 8, it is highly probable that parental cognitive talk and parent-child reciprocity have bi-directional influences on one another. However, give the limitations imposed by a small sample size, more sophisticated analyses (e.g., structural equation modelling) that can account for the bi-directional effects of these mechanisms were not considered since analyses would result in unstable models.
Relatedly, given the cross-sectional nature of the current study, it is difficult to discuss causality despite using mediation analyses. Thus, future research should consider employing a longitudinal design that involves extensive sampling so that it is possible to apply more advanced data analysis techniques to examine more intricate relations among mechanisms.

Some variables used in the current study were also limited in their measurement. First, children’s conflict inhibition measure lacked variance. Many children either failed or passed the bear/dragon task entirely with little variation in between. Although similar results were found when bear/dragon scores were re-coded into groups (i.e., those with conflict inhibition vs. those without), future studies should consider incorporating additional conflict inhibition measures that will increase the variability in children’s scores. Second, current measures of family risk incorporate indicators of both family resources and parental competency. Thus, current findings speak generally to family risk and fail to distinguish between these issues. Although there are advantages for using global measures, inevitably, specificity between family resource and parental competency in relation to theory of mind are potentially lost. Thus, future research may consider examining these factors as separate variables to examine whether these mechanisms have different effects on theory of mind. Lastly, all parent-child measures were drawn from the same task. Thus, mental-state talk and parent-child quality measures are not mutually exclusive although different aspects of these interactions were measured. Moreover, parent-child measures were drawn from one context. Arguably, how parent’s talk about mental-state concepts and how parents and children interact with each other may change as a function of context.

There is also some concern with defining distal and proximal mechanisms. Not only are these distinctions arbitrary, but can differ across disciplines. Jenkins (2008) points out that what
is defined as distal and proximal is largely influenced by our scientific discipline. Although current findings suggest that parent-child reciprocity is a proximal mechanism to theory of mind, according to the neuroscientist, it may be distal since the experience of parent-child reciprocity may affect processes more proximal to development (e.g., at the cellular level). Thus, when interpreting results, it is also important to be mindful of differences in how mechanisms are interpreted across disciplines.

In sum, current findings from the present study provide additional insight into three important aspects of theory-of-mind development. First, results suggest that environmental factors such as family risk and parental cognitive talk may indirectly influence theory-of-mind development by operating through a mediator that is more proximal to the child. Second, aside from directly influencing theory of mind, effects of child language and conflict inhibition on false-belief understanding are also multiplicative. This suggests that cognitive mechanisms also have the potential to augment one another during false-belief development. Lastly, both environmental and cognitive factors independently contribute to theory-of-mind development, suggesting that these mechanisms play distinct roles during acquisition. Taken together, these findings suggest that theory-of-mind development occurs within a multilevel framework where children are simultaneously directly and indirectly influenced by mechanisms found within children and within multiple layers of their social context. Although child language, conflict inhibition and parental cognitive talk each make unique contributions to theory of mind, some mechanisms also operate together during theory-of-mind development. These observations challenge us to re-conceptualize theory-of-mind development within a bioecological framework and open up exciting avenues of research for the field of theory of mind.
References


Appendix A: Theory-of-mind Task Protocols

**Diverse-Desire Task**

Here’s Mr. Jones. It’s snack time, so Mr. Jones wants a snack to eat. Here are two different snacks; a carrot and a cookie.

Which snack would you like best? Would you like a carrot or a cookie best?

*If child chooses the carrot:*

Well, that’s a good choice, but Mr. Jones really likes cookies. He doesn’t like carrots. What he likes best are cookies.

*If child chooses the cookie:*

Well, that’s a good choice, but Mr. Jones really likes carrots. He doesn’t like cookies. What he likes best are carrots.

So, now it’s time to eat. Mr. Jones can only choose one snack, just one. Which snack will Mr. Jones choose? A carrot or a cookie?

**Diverse-Belief Task**

*Child is introduced to a toy figure of a girl and a picture of a bush and a house.*

Here is Linda. Linda wants to find her cat. Her cat might be hiding in the bushes or it might be hiding in the house.

Where do you think the cat is? In the bushes or in the house?

*If child chooses the bushes:*

Well, that’s a good idea, but Linda thinks her cat is in the house. She thinks her cat is in the house.

*If child chooses the house:*

Well, that’s a good idea, but Linda thinks her cat is in the bushes. She thinks her cat is in the bushes.

So, where will Linda look for her cat? In the bushes or in the house?

**Knowledge-Access Task**

*Child is shown a nondescript plastic box that a toy dog.*
Here’s a box. What do you think is inside the box? (child can give any answer he/she likes or indicates that he/she does not know) Let’s see what’s inside!

*The box is opened and the child is shown that there is a toy dog inside the box.*

It’s really a dog inside! (The box is closed). Okay, what is inside the box? (dog or other) *child is corrected if their response is “other”

*Child is then introduced to a toy figure of a girl.*

Polly has never ever seen inside this box. Now here comes Polly. Does Polly know what is in the box? (YES/NO)

Did Polly see inside this box? (YES/NO)

**Explicit False-belief Task**

*Shows the child a toy figure of a boy*

Here’s Scott. Scott wants to find his mittens. His mittens might be in his backpack or they might be in the closet. Really, Scott’s mittens are in his backpack. But Scott thinks his mittens are in his backpack.

So, where will Scott look for his mittens? In his backpack or in the closet?

Where are Scott’s mittens really? In his backpack or in the closet?

**Contents False-belief Task**

*Child is introduced to a crayon box.*

Here’s a crayons box. What do you think is inside the crayons box? (Next, the crayons box is opened) Let’s see…..it’s really balloons inside! (The crayons box is closed)

Okay, what is in the crayons box? (Balloons/other) *the child is corrected if their response is “other”

*Then a toy figure is produced.*

Peter has never ever seen inside this Band-aid box. Now here comes Peter. So, what does Peter think is in the box? Band-aids or balloons?

Did Peter see inside this box? (YES/NO)
**Change-in-location False-belief Task**

I’m going to tell you a story. You listen carefully, and then I’ll ask you some questions, okay?

The boy has a ball. He puts it away in his box. He goes upstairs. While he’s gone his sister takes the ball out of the box. She plays with it, and then she puts the ball away. She puts it away in the basket. Then the girl goes outside. The boy comes back. He wants to play with his ball.

Where will the boy look for the ball? PROMPT ONLY IF NEEDED: Will he look in the box, or in the basket? (Box/Basket)

Where did he put the ball before he went upstairs? (Box/Basket)

Where is the ball really? (Box/Basket)

**Belief-based Emotion Task**

*Child is introduced to a cookie bag and a toy figure of a boy*

Here is a cookie bag and here is Sally. What do you think is inside the bag? (cookies/other) *if child says “other”, they are prompted with “you think it might be cookies in here?”*

Now I’m going to tell you a story. You listen carefully, and then I’ll ask you some questions, okay?

Sally says: “Oh good, because I love cookies. Cookies are my favourite snack. Now I will go outside to play.

(Sally is put away and out of sight)

Let’s see what’s inside the cookie bag (cookie bag is opened). There are really rocks inside and no cookies! There’s nothing but rocks. (The cookie bag is closed)

Ok, what is Sally’s favourite snack? (Cookies)

Sally has never ever seen inside the bag. Now here comes Sally. Sally’s back and its snack time and she’s hungry! Let’s give Sally this bag.

How does Sally feel when she gets this bag? Happy or sad?

(Researcher opens the bag and lets Sally look inside)

How does Sally feel after she looks inside the bag? Happy or sad?

**Real-apparent Emotion Task**
Here are some pictures of faces. Can you tell me how this person feels? (said as researcher points to each face in turn)

*children are corrected if they give the wrong label to each expression. They are shown each face again until they are able to correctly label each emotion.

This is a story about a boy. I’m going to ask you about how the boy really feels inside and how he looks on his face. He might really feel one way inside but look a different way on his face. Or, he might really feel the same way inside as he looks on his face. I want you to tell me how he really feels inside and how he looks on his face.

This story is about Matt. Matt’s friends were playing together and telling jokes. One of the older children, Rosie, told a mean joke about Matt and everyone laughed. Everyone thought it was very funny, but not Matt. But Matt didn’t want the other children to see how he felt about the joke, because they would call him a baby. So, Matt tried to hide how he felt.

What did the other children do when Rosie told a mean joke about Matt?  (Laughed)
*child is told the correct answer if they give the wrong answer

In the story, what would the other children do if they knew how Matt felt? (Call him a baby)
*child is told the correct answer if they give the wrong answer

(Pointing to the three emotion pictures) So, how did Matt really feel when everyone laughed? Did he feel happy, sad or okay?

(Pointing to the three emotion pictures) How did Matt try to look on his face when everyone laughed? Did he look happy, sad or okay?
Appendix B: Comprehension of Sentential Complements Task Protocol

1. She said the girl was reading a book, but she was really playing cards. What did she say?

2. She told the girl there was a bug in her hair, but it was only a leaf. What did she tell the girl?

3. She said her friend was eating an egg, but it was really a ball. What did she say?

4. She told her dad he had a cut, but it was really ketchup. What did she tell her dad?

5. She said there was a spider in her cereal, but it was really a berry. What did she say?

6. She told the teacher she drew a face, but it was really a scribble. What did she tell the teacher?
Appendix C: Executive Functioning Task Protocols

**Red Dog / Blue Dog Inhibitory Control Task**

In this game I am going to show you pictures of some dogs. Your job is to tell me the name of the dog on the card I show you. This dog here is called “RED” so when you see this card you will say “RED”. This dog here is called “BLUE” so when you see this dog you will say “BLUE”. So when you see this dog (show blue dog) you will say ______ (RED) and when you see this dog (show red dog) you will say ____ (BLUE).

(Correct any mistakes. Child must get both trials correct in order to pass training trial. Go through entire training protocol once more if child fails either initial training trials)

Okay, now you’ve got it.

(Proceed with trial once child successful passes training session. Children are presented with 28 consecutive randomized pictures of red and blue dogs)

**Bear/Dragon Task**

**Frog and monkey puppets substituted for bear and dragon puppets**

Child is introduced to a frog and a monkey puppet.

Experimenter: Here we have a frog and a monkey. If the frog tells you to do something, you should do it, okay? (Activation trial)

If the monkey tells you to do something you shouldn’t do it, okay? (Inhibition trial)

Practice:

Experimenter holds up the monkey and says “Touch your nose” (demonstrating how to ‘touch your nose’ with the animal).

If the child does not touch their nose the experimenter says “Good Work”

Experimenter then holds up the frog and says “Touch your nose” (demonstrating how to do this action). If the child does touch their nose the experimenter says “Good work, I can see that you know who to listen to and who to ignore”

**If child responds incorrectly, the experimenter paraphrases the directions again and asks the same question from the same animal until the child responds correctly. For the child to pass the practice condition, he/she is required to correctly respond to two consecutive frog and monkey trials. If the child is unable to reach the requirements for the practice condition after 4 consecutive frog-monkey trials, they will be excluded from this task.**
Actual Test:

Note: Animal just says action. The animal doesn’t demonstrate action.

Note: After every five trials the child is reminded which animal to listen to and which to ignore regardless of if they are correct or incorrect.

Note: No praise given throughout test

Two blocks of 10 trials are asked of the children (5 inhibition and 5 activation)

1. Stick out tongue (F)
2. Touch your toes (M)
3. Clap your hands (M)
4. Jump up and down (F)
5. Touch your eye (M)

Remind child who to listen to and who to ignore

6. Spin around in a circle (F)
7. Touch your ear (F)
8. Stand on one foot (M)
9. Stand up (M)
10. Touch your mouth (F)

F: Frog
M: Monkey

Forward Word Span Task

General Directions
- Read each trial verbatim at the rate of one word per second, dropping your voice slightly on the last word
- Do not repeat any trial of items. If the child asks you to repeat a trial say. Just take your best guess

Training: (with pictures)
This is a flower and this is a cup
Look, I put this flower down first and then this cup
I’m just going to say what I just said, so I say *flower* (point) then *cup* (point)
Now you say what I just said (pointing to each picture to help). Well done!

Look, I say *cookie* first then *tree*
Now you say what I just said. So you say *tree* (point) *cookie* (point). Well done!

Look, I say *truck, boy, ice cream*
So you say (child is prompted to respond) *truck* (point), *boy* (point) and *ice cream* (point)

Now try one, I say *shoe, chair*
Can you say what I just said? Well done!
Now I’m not going to put the pictures down now, I’m just going to say the words. I want you to say what I say.

**training trials repeated for three times before task is abandoned**

Test Trials (with no pictures):

1 a) I say cat sun. You say what I said.  
   b) I say apple glasses. You say what I said.

2 a) I say house scissors pencil. You say what I said.  
    b) I say telephone fish penny. You say what I said.

3 a) I say bread foot table hat. You say what I said.  
    b) I say plane knife house scarf. You say what I said.

4 a) I say dog boat dress tree bike. You say what I said.  
    b) I say toe pants ring baby cup. You say what I said.

5 a) I say fork moon grass bag train horse. You say what I said.  
    b) I say spoon cloud star mouse pot book. You say what I said.

6 a) I say snow hill pig banana watch circle jacket. You say what I said.  
    b) I say cake window glasses penny mouse pencil hill. You say what I said.

* Testing will stop when child fails both items of a trial

**Backward word-span task**

General Directions
- Read each trial verbatim at the rate of one word per second, dropping your voice slightly on the last word
- Do not repeat any trial of items. If the child asks you to repeat a trial say: Just take your best guess
Training: (with pictures)  
This is a *horse* and this is a *sheep*  
Look, I put this *horse* down first and then this *sheep*  
But I’m going to say the names of these 2 things in backwards order, so I say *sheep* (point) then *horse* (point)  
Now you say them in backwards order (pointing to each picture to help). Well done!  

Look, I say *fork* first then *bed*  
But I want you to say the backwards order, so you say *bed* (point) *fork* (point). Well done!  

Look, I say *television*, *leaf*, *baby*  
But I want you to say the backwards order, so you say (child is prompted to respond) *baby* (point), *leaf* (point) and *television* (point)  

Now try one, I say *teddy*, *ball*  
You say those backwards. Well done!  
Now I’m not going to put the pictures down now, I’m just going to say the words. I want you to say what I say in a backwards order.  

**training trials repeated for three times before task is abandoned**  

Test Trials: (with no pictures)  

1. a) I say glasses house. You say those backwards  
   b) I say scissors telephone. You say those backwards  

2. a) I say sandwich foot. You say those backwards  
   b) I say apple pencil. You say those backwards  

3. a) I say plane dog pear. You say those backward  
   b) I say knife boat sun. You say those backwards  

4. a) I say table hat toe penny. You say those backwards  
   b) I say shirt fish hand pants. You say those backwards  

5. a) I say shoe nose car house ring. You say those backwards  
   b) I say scarf orange circle dress rope. You say those backwards  

6. a) I say truck cow stairs window grass water. You say those backwards  
   b) I say book snow hill pig smile moon. You say those backwards.  

7. a) I say cloud rat window clock branch bug rope. You say those backwards.  
   b) I say pot bowl spoon chair mouse chair book. You say those backwards  

* Testing will stop when child fails both items of a trial
Gift Delay Task

Researcher: I have a present for you, but it’s a big surprise. I forgot to wrap it before you got here and I want to wrap it before giving it to you. Can you sit in that chair facing the wall (back is turned away from experimenter) while I wrap your present?

Researcher starts to nosily wrap the present while child sits with their back to the researcher. Researcher continues to wrap the present for 60 s. or until the child peeks, whichever event occurs first.

Researcher: I’m done! You can turn around now so that I can give you your present. (Child is given the chance to open their present)
Appendix D: Family Demographic Questionnaire

SECTION A
Completed by: Mother Father

1. My place of birth is: _______________________

2. Number of years I have spent in Canada: ______________

3a) I am:
□ Married
□ Living common-law
□ Widowed
□ Separated
□ Divorced
□ Single/never married

3b) If separated/divorced/widowed, how long have you’ve been separated/divorced/widowed?
____________________________________

4. Highest level of education you have (please select one):

□ Under 7 yrs of school
□ 7-9 yrs of school
□ 10-11 yrs of school
□ High school
□ Some College
□ Some University
□ College
□ University
□ Post-graduate Studies
□ Professional School (e.g., teacher’s college)

5. I work as a(n) ________________________ for a living

6. Is there or has there been a spouse or partner living with you and your child in the same house?

□ YES
□ NO

If yes, please answer questions 7 & 8. If no, please proceed to question 9.

7. Highest level of education your spouse or partner has (please select ONE):

□ Under 7 yrs of school
□ 7-9 yrs of school
□ 10-11 yrs of school
□ High school
□ Some College
□ Some University
□ College
□ University
□ Post-graduate Studies
□ Professional School (e.g., teacher’s college)
8. My spouse/partner works as a(n) __________________________ for a living.

9. The annual total income (after taxes), from all working adults of my family over the past year falls between (please select ONE):

- □ Less then $15,000
- □ More then $15,000 but less then $20,000
- □ More then $20,000 but less then $30,000
- □ More then $30,000 but less then $40,000
- □ More then $40,000 but less then $50,000
- □ More then $50,000 but less then $60,000
- □ More then $60,000 but less then $70,000
- □ More then $70,000 but less then $80,000
- □ More then $80,000 but less then $90,000
- □ More then $90,000

10. On average, I would say that our income level has not changed since the birth of my child:

- □ True
- □ False

If true, please proceed to the Question 12. If false, please proceed to Question 11:

11. Since the birth of my child, the annual total income of my family has:

- □ Increased a little (e.g., I do not notice a change in our lifestyle)
- □ Increased somewhat (e.g., I can afford more luxury items for me and my family)
- □ Increased dramatically (e.g., our family moved into a new neighbourhood or we could if we wanted to)
- □ Decreased a little (e.g., I do not notice a change in our lifestyle)
- □ Decreased somewhat (e.g., I cannot afford to buy the luxury items that I used to buy)
- □ Decreased dramatically (e.g., my family has moved into a smaller house because of financial problems)

12. Please read the following statements carefully and try to answer as honestly as possible. If the statement accurately describes your family, please mark TRUE. If the statement does not accurately describe your family, please mark FALSE.

a. My spouse and/or I have educational qualifications (e.g., university degree or college diploma) □ TRUE □ FALSE
b. My spouse and/or I have paid employment □ TRUE □ FALSE
c. Our family has access to a car □ TRUE □ FALSE
d. Our family is receiving non-contributory benefits □ TRUE □ FALSE
e. My family is living in government subsidized housing □ TRUE □ FALSE
f. In my family we speak only English □ TRUE □ FALSE

13. My postal code is: ___________________________
SECTION B

The following questions are about _______________ (Child’s name inserted here). Please answer the following questions.

1. My child’s date of birth: _____________  
2. My child’s place of birth: _____________

3. Number of Older Siblings: _____________  
4. Number of Younger Siblings: _____________

Age(s): ___________________  
Age(s): ___________________

5. How many people live in the same house with you and your child? ________

What is their relationship to your child?  
1) _________________________
   2) _________________________
   3) _________________________

6. How old was your child when he/she started speaking? _____________

7. What language did your child first learn to speak? _____________
Appendix E: Additional Exploratory Analyses

In the following section, exploratory analyses examining associations between environmental factors and cognitive factors are presented. Given the size of the current dataset, the following exploratory analyses are not exhaustive of all possible associations between factors.

Environmental Factors

Intercorrelations between Type of Parental Mental-state Talk

To examine the intercorrelations between different types of parental mental-state term references, bivariate correlations were conducted. Only parents’ use of cognitive terms was found to be significantly related to their use of desire terms, $r = .36, p < .05$. There were no relations between other types of mental-state terms. This suggests that when talking about mental states, parents were more likely to talk about one mental state concept, with the exception of cognitive and desire states.

Intercorrelations between Parent-Child Quality Measures

To examine the associations between different parent-child quality measures, bivariate correlations were conducted. Results are presented in Table 1. With the exception of parental negativity, most quality measures were significantly correlated.

Intercorrelations between Parental Mental-state Talk and Parent-child Quality Measures

Associations between parental mental-state talk and parent-child quality measures were examined. Results indicated that in general, measures of parental mental-state talk were not significantly associated with parent-child relationship quality measures. Only parental cognitive talk was found to be significantly related to parent-child reciprocity, $r = .57, p < .05$, parent
Table 1.

**Intercorrelations between Different Parent-child Quality Measures**

<table>
<thead>
<tr>
<th>Parent-child Quality Measures</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Parent-child reciprocity</td>
<td>----</td>
<td>.69*</td>
<td>-.16</td>
<td>.67*</td>
<td>.84*</td>
</tr>
<tr>
<td>2. Parental positivity</td>
<td>----</td>
<td>-.22</td>
<td>.74*</td>
<td>.58*</td>
<td></td>
</tr>
<tr>
<td>3. Parental negativity</td>
<td>----</td>
<td>-.17</td>
<td>-.15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Child positivity</td>
<td>----</td>
<td></td>
<td>.60*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Child responsiveness</td>
<td>----</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note * p < .05.

positivity, $r = .42, p < .05$, child positivity, $r = .66, p < .05$, and child responsiveness, $r = .57, p < .05$.

**Intercorrelations between Family Risk and the Socio-linguistic Environment**

To examine the effects of family risk on the socio-linguistic environmental, bivariate correlations were performed. Results indicated that with respect to parental mental-state talk, family risk was not significantly related to any measures. Similarly, family risk was not significantly related to any parent-child quality measures. These results suggest that parent’s use of mental-state terms as well as the quality of observed parent-child interactions did not differ as a function of family risk.

**Intercorrelations between Environmental Factors and Family Configuration**

To examine relations between various family configuration patterns and environmental factors, bivariate correlations were conducted. Results suggested that although number of younger or older siblings did not correlate with family risk, parental mental-state talk or most
parent-child quality measures, total number of siblings did relate to parental negativity, \((r = .28, p < .05)\). This suggests that in bigger families, parents were more likely to display negativity during the storybook reading session.

*Intercorrelations between Environmental Factors and Child Age and Gender*

Bivariate correlations were done to see whether various family-specific and socio-linguistic factors significantly related to child age and gender. No significant associations emerged. This suggests that family risk, parental mental-state talk nor quality of parent-child interactions varied as a function of child age or gender.

*Intercorrelations between Environmental Factors and Theory-of-mind Scores*

Partial correlations, controlling for the effects of age and gender, examined the relation between environmental factors (i.e., family risk, parental mental-state talk and parent-child quality measures) and theory of mind. Results demonstrated that theory-of-mind scores were negatively associated with family risk, \(r = -.32, p < .05\), and significantly correlated with parental cognitive talk only, \(r = .26, p < .05\). No other significant associations were seen for other types of parental mental-state talk. However, theory of mind was found to be significantly related to parent-child reciprocity, \(r = .31, p < .05\), child positivity, \(r = .29, p < .05\), child responsivity, \(r = .43, p < .05\), and negatively associated with parental negativity, \(r = -.29, p < .05\). Similar patterns of associations were seen with children’s false-belief scores.

**Cognitive Factors**

*Intercorrelations between Cognitive Factors*

To examine the relationship between child language abilities, sentential complement understanding and executive functions, bivariate correlations were conducted. Results are presented in Table 2.
Table 2.

*Intercorrelations between Executive Functioning, Child Language, and Sentential Complement Understanding Tasks*

<table>
<thead>
<tr>
<th>Tasks</th>
<th>1</th>
<th>2</th>
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<th>4</th>
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<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Red Dog/Blue Dog</td>
<td>----</td>
<td>.26*</td>
<td>.32*</td>
<td>.24*</td>
<td>.23*</td>
<td>.33*</td>
<td>.13</td>
</tr>
<tr>
<td>2. Forward Word Span</td>
<td>----</td>
<td>.54*</td>
<td>.53*</td>
<td>.36*</td>
<td>.66*</td>
<td>.35*</td>
<td></td>
</tr>
<tr>
<td>3. Backward Word Span</td>
<td>----</td>
<td>.40*</td>
<td>.31*</td>
<td>.65*</td>
<td>.36*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Bear/Dragon</td>
<td>----</td>
<td>.48*</td>
<td>.72*</td>
<td>.30*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Gift Delay</td>
<td>----</td>
<td>.39*</td>
<td>.31*</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. TELD</td>
<td>----</td>
<td>.41*</td>
<td></td>
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<tr>
<td>7. Sentential Complement</td>
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</tr>
</tbody>
</table>

Note *p < .05.

Partial correlations controlling for the effects of age and gender were then conducted. Results are presented in Table 3. Generally, children’s language scores significantly correlated with their memory (both forward and backward) and conflict inhibition ability.

*Intercorrelations between Cognitive and Environmental Factors*

*Associations between family risk and cognitive factors.* Next, associations between cognitive and various environmental factors were examined with partial correlations. With respect to family risk, significant negative associations between family risk and TELD scores, \( r = -.42, p < .05 \) and the bear/dragon task, \( r = -.40, p < .05 \), were found once the effects of age and gender were controlled.
Table 3.

*Intercorrelations between Executive Functioning, Child Language, and Sentential Complement Understanding Tasks when Controlling for the Effects of Child Age and Gender*

<table>
<thead>
<tr>
<th>Tasks</th>
<th>1</th>
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<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Red Dog/Blue Dog</td>
<td>----</td>
<td>.09</td>
<td>.11</td>
<td>.07</td>
<td>.10</td>
<td>.08</td>
<td>-.02</td>
</tr>
<tr>
<td>2. Forward Word Span</td>
<td>----</td>
<td></td>
<td>.31*</td>
<td>.25</td>
<td>.17</td>
<td>.41*</td>
<td>.23</td>
</tr>
<tr>
<td>3. Backward Word Span</td>
<td>----</td>
<td></td>
<td></td>
<td>.05</td>
<td>.05</td>
<td>.44*</td>
<td>.20</td>
</tr>
<tr>
<td>4. Bear/Dragon</td>
<td>----</td>
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<td>.33*</td>
<td>.54*</td>
<td>.02</td>
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<td>5. Gift Delay</td>
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<td>.28</td>
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<td>6. TELD</td>
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<td>7. Sentential Complement</td>
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</tbody>
</table>

Note: *p < .05.

**Associations between parental mental-state talk and cognitive factors.** Results also suggested that parents’ use of cognitive terms was significantly correlated with children’s score on the backward word span task, $r = .30, p < .05$. However, once the effects of age and gender were accounted for, this relationship became non-significant. In general, none of the parental mental-state talk measures significantly correlated with general child language ability, sentential complement or executive function measures.

**Associations between parent-child quality measures and cognitive factors.** With respect to parent-child quality measures, children’s performance on the red dog/blue dog task was found to significantly relate to parent-child reciprocity, $r = .37, p < .05$, parental positivity, $r =$
.34, \( p < .05 \), and child responsivity, \( r = .40, p < .05 \). These associations remained after accounting for the effects of age and gender.

Children’s score on the forward word-span task was also found to negatively relate to parental negativity, \( r = -.33, p < .05 \). These associations remained after accounting for the effects of age and gender. Children’s score on the backward word-span was also found to significantly correlate with parent-child reciprocity, \( r = .30, p < .05 \), parental positivity, \( r = .25, p < .05 \), child positivity, \( r = .24, p < .05 \), and child responsiveness, \( r = .23, p < .05 \). However, once the effects of age and gender were accounted for, these associations become non-significant.

Taken together, these results suggested that family risk was negatively associated with children’s cognitive abilities. Moreover, rather than parental mental-state talk, cognitive factors, particularly that of executive functioning, may be more consistently related to the quality of parent-child interactions.

**Intercorrelations between Family Configuration and Child Measures**

To examine relations between various family configuration patterns and child measures, partial correlations controlling for the effects of child age and gender were conducted. Although total number of siblings did not correlate with any child measure, number of younger siblings was significantly related to language scores, \( (r = .28, p < .05) \), whereas number of older siblings negatively correlated with language scores \( (r = -.35, p < .05) \). No other associations were noted. This suggests that the presence of siblings influenced the rate at which children acquired language. More importantly, none of the family configuration variables significantly related to theory-of-mind or false-belief scores, suggesting that family size did not affect theory-of-mind development.
Interrelations between Cognitive Factors and Theory-of-mind Scores

Next, relations between theory of mind and child language, sentential complements and executive functioning were examined with bivariate correlations. Results are presented in Table 4. Results suggested that children’s theory-of-mind scores were significantly related to their executive functioning and language abilities. Similar associations were also found for children’s false-belief scores.

Table 4.

Intercorrelations between Theory of Mind and Executive Functioning, Child Language, and Sentential Complement Understanding Tasks

<table>
<thead>
<tr>
<th>Tasks</th>
<th>1</th>
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</thead>
<tbody>
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<td>.56*</td>
<td>.61*</td>
<td>.57*</td>
<td>.30*</td>
<td>.67*</td>
<td>.51*</td>
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<tr>
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<td>.25</td>
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</tr>
<tr>
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<td>.53*</td>
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</table>

Note *p < .05.

Partial correlations were then conducted to examine relations between theory of mind and cognitive factors while accounting for the effects of age and gender. Results are presented
in Table 5. Results suggested that children’s theory-of-mind understanding was significantly related to their working memory and conflict inhibition skills as well as their language abilities. Similar patterns of results were seen for children’s false-belief scores. Specifically, children’s false-belief scores significantly correlated with the bear/dragon task, $r = .43, p < .05$, understanding of sentential-complement scores, $r = .31, p < .05$, and TELD scores, $r = .30, p < .05$.

Table 5.

*Intercorrelations between Theory of Mind and Executive Functioning, Child Language, and Sentential Complement Understanding Tasks when Controlling for the Effects of Child Age and Gender*

<table>
<thead>
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<th>Tasks</th>
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<td>.06</td>
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<td>.35*</td>
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<td>.01</td>
<td>-.06</td>
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Note: * $p < .05.$