Parenting, language, and perspective taking: advantages of constructivist approaches

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Abstract

Theory of mind (ToM) is a type of cognitive perspective taking which involves the ability to attribute mental states in order to explain and predict behaviour (Premack & Woodruff, 1978). The causal factors involved in the development of ToM have been the subject of vast amounts of theorizing and research. However, a focus on the development of children's belief and desire reasoning over the last 30 years has meant that the development of children's visual perspective taking (VPT) and emotional perspective taking skills received less attention over this period. Similarly, little attention has been paid to the relationships among the development of ToM, VPT, and emotional perspective taking skills, with resultant constraints on theorizing and research into the factors involved in the development of these skills.

Although an increasing amount of empirical evidence has highlighted the importance of language and social interaction in the development of children's perspective taking skills, few theories or research projects have adequately attempted to delineate the complex and dynamic nature of the developmental relationships among these variables. Thus, the aim of the current longitudinal research project was to investigate the relationships among parenting, socio-emotional engagement, shared practices, language (sentential complements, conversation skill), cognitive flexibility, and perspective taking (cognitive, visual, emotional) in typically developing children and children with specific language impairment (SLI). This was achieved by testing hypotheses drawn from various "constructivist" theories (e.g., Racine & Carpendale, 2007; Vygotsky, 1930/1981) and, where possible, by contrasting these with predictions drawn from the dominant modular (e.g., Baron-Cohen, 1995), theory-theory (e.g., Gopnik, 1996), and simulation (e.g., Harris, 1996) theories.

The first empirical chapter reports the validation of a measure of children's conversation skill suitable for use in research investigating the relationship between conversation skill and perspective taking skill. A 7-item parent report measure of children's conversation skill was piloted with a sample of 95 typically developing English speaking children (*M* age = 64.2 months) and found to have good reliability. The validity of this measure was then demonstrated with the data from the first year of the main longitudinal research project using a different sample of 92 typically developing children (*M* age = 61.3 months) and 30 children with SLI (*M* age = 63.0 months).

The second empirical chapter reports subsequent analyses with the data from these same samples that investigated the factors involved in the development of

children's conversation skills. Drawing on Racine and Carpendale's (2007) constructivist theory it was predicted that joint attention and imitation would mediate the relationship between socio-emotional engagement and conversation skill. Results for all three groups of children converge in supporting this hypothesis.

The results of analyses regarding the relationships among maternal language input and child sentential complements skill, cognitive flexibility, and false belief understanding using the concurrent and longitudinal (one year later) data from the main longitudinal research project are reported in the third empirical chapter. The findings for the typically developing children and the children with SLI converge in supporting a model in which maternal language input predicts the child's memory for false complements, which in turn predicts cognitive flexibility and explicit false belief understanding, with cognitive flexibility partially mediating the effect of memory for false complements on explicit false belief understanding.

The fourth and final empirical chapter expands considerably on the findings of the first three by reporting the results of analyses investigating the relationships among parenting, socio-emotional engagement, shared practices, language (sentential complements, conversation skill), and perspective taking (cognitive, visual, emotional). The results of concurrent, longitudinal, and pass-fail contingency analyses of the data from the main longitudinal research project were most consistent with constructivist theories (e.g., Racine & Carpendale, 2007; Vygotsky, 1930/1981) and least consistent with the more nativistic theories (e.g., Baron-Cohen, 1995).

Overall, the findings indicate that constructivist approaches provide a powerful way to investigate the development of children's social cognition and that maternal factors and mother-child shared practices facilitate children's mastery of sentential complements, cognitive flexibility, conversation skill, and explicit perspective taking skills. The results also support the argument that shared practices such as joint attention, imitation, and conversation skill are naturally embedded in socio-emotional engagement. Future research should further investigate the emotional factors that motivate the use of perspective taking skills for pro-social or Machiavellian ends.

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Preface

This thesis describes a longitudinal research program that aimed to broaden our understanding of the factors involved in the development of children's perspective taking skills, that is, the development of their ability to "put themselves in someone else's shoes". The thesis takes the form of a "thesis by publication" and as such each empirical chapter is presented in a format that is suitable for publication in a peer-reviewed journal. The thesis is my own composition and all sources have been acknowledged. The assistance received from various individuals and organisations in facilitating the conduct of the research program are duly acknowledged throughout the manuscript.

The thesis contains six chapters:

Chapter 1 provides a general introduction to the area of research along with an overview of the rest of the thesis.

Chapter 2 describes the validation of a parent-report measure of children's conversation skill suitable for use in research investigating the relationship between conversation skill and perspective taking skill.

Chapter 3 reports analyses that investigated the factors involved in the development of children's conversation skill. This manuscript is currently in press:

> Farrant, B. M., Maybery, M. T., & Fletcher, J. (in press). Socio-Emotional Engagement, Joint Attention, Imitation and Conversation Skill: Analysis in Typical Development and Specific Language Impairment. *First Language*

Chapter 4 reports the results of analyses regarding the relationships among maternal language input and child sentential complements skill, cognitive flexibility, and false belief understanding. This manuscript is currently undergoing the second stage of peer-review:

> Farrant, B. M., Maybery, M. T., & Fletcher, J. (under review). Language, Cognitive Flexibility, and Explicit False Belief: Longitudinal Analysis in Typical Development and Specific Language Impairment. *Child Development*

Chapter 5 reports the results of analyses investigating the relationships among parenting, socio-emotional engagement, shared practices, language (sentential complements, conversation skill), and perspective taking (cognitive, visual, emotional). This manuscript will be submitted for publication at the journal Monographs of the Society for Research in Child Development.

Chapter 6 provides a brief overview of the findings from each of the empirical chapters followed by an integration and general discussion of the theoretical and practical implications findings, methodological strengths and limitations, directions for future research, and overall conclusions.

Contribution of the candidate to publications:

In regard to Regulation 1.3.1.33 (point 2) from the *General Provisions for Higher Degrees by Research (by Thesis)* of the University of Western Australia, all study design, task development, participant recruitment and testing, data entry, analysis, interpretation, and preparation and revision of manuscripts was conducted by the candidate.

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Janet Fletcher (Co-supervisor)	Date

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Chapter 1

Introduction

Arguably, the most important socio-cognitive skills that separate humans from chimpanzees are the use of complex language and the ability to "read the minds" of other individuals. The ability to "read the minds" of other individuals is said to require a "theory of mind" (ToM) which is a type of cognitive perspective taking that involves the ability to attribute mental states in order to explain and predict behaviour (Premack & Woodruff, 1978). A key and much studied milestone in the development of ToM is the understanding of false belief (Wellman & Liu, 2004). False belief understanding is measured using tasks that assess whether children recognize that people can have mistaken beliefs about reality and whether they can predict what an individual who has a false belief will do, say, or think (Peterson, 2003). The causal factors involved in the development of children's ToM understanding have been the subject of vast amounts of theorizing and research over the last 30 years.

Much of the early research into the development of children's knowledge about the mind can be traced back to Piaget's (e.g., 1926/1959) theorizing regarding cognitive egocentrism in early childhood (Flavell, 1999) and his associated research into the development of visual perspective taking (VPT) skill (the ability to appreciate the visual experience associated with another viewpoint). However, the heavy focus on ToM development over the last 30 years has meant that the development of VPT skill has been the subject of relatively little theorizing and research over this period. Similarly, relatively little attention has been paid to the development of children's emotional perspective taking skills, which is surprising in light of the fact that a full appreciation of other people's inner worlds surely requires the ability to infer and understand their emotions. Furthermore, the relationships among the development of ToM, VPT, and emotional perspective taking skills have received relatively little attention. Arguably, in many cases this has resulted in narrow and constrained theorising and research into the factors involved in the development of children's perspective taking skills. The overarching aim of the current longitudinal research project was to address these issues in both typical development and in children with specific language impairment (SLI).

The importance of language acquisition for children's ToM development has been underscored by the convergent findings from a number of different lines of evidence including research with children with SLI (e.g., Farrant, Fletcher, & Maybery, 2006) and typically developing children (see Milligan, Astington, & Dack, 2007, for a recent meta-analysis). Although a number of social constructivist theories (e.g., Carpendale & Lewis, 2004; Nelson, et al., 2003; Symons, 2004) have been put forward since Astington (1996) lamented the dominance of internalist/nativistic theories over a

decade ago the field is still largely dominated by modular, simulation, and theory-theory theories that, to different degrees, downplay the roles of language acquisition and interaction in the social environment. Again, this is somewhat surprising given that biologists have long recognised that the development of every biological form, trait, and species-typical behaviour is dependent on the complex interaction between the environment and the individual's genetic information (Alcock, 1998). "The notion that there are genetically determined behaviors has long been emphatically rejected by biologists of all stripes" (Alcock, 1998, p. 324). Thus, the tendency in western developmental psychology to reach for the nature/nurture dichotomy is out of step with the thinking of today's biologists. Indeed, few developmental theories fully incorporate the kind of constructivist interactionism advocated by those committed to transcending the nature/nurture debate (e.g., Bateson, 2001; Oyama, 2001). Such accounts emphasise the importance of recognising that organisms and environments mutually define and influence each other; they are interpenetrating and interdependent, constituent parts of a whole from which complex forms and functions emerge, and it is ill conceived to treat some causes as more important than others (Oyama, 2001).

Thus, there are good grounds to get behind Astington's (1996) call for an integration of internalist and externalist views into a social constructivist account based on Vygotsky's work. However, such constructivist accounts are often criticized for failing to provide adequate theoretical arguments and testable predictions that differentiate them from competing theories (e.g., Moore, 2007). Perhaps these objections stem from the fact that it is difficult to eschew the relative simplicity of the nature/nurture dichotomy (Oyama, 1985) and because many well-meaning attempts at breaking out of the nature/nurture straightjacket are perceived as being vague and complex in much the same unfathomable way that led eighteenth century biologists to believe that development must depend on supernatural guidance (Bateson, 2001). Today, of course, scientists do not speak of supernatural guidance, but it has been fashionable in western developmental psychology to promote theories that postulate innate/genetically determined cognitive modules/mechanisms or behaviours to explain development. But genes do not code for cognitive modules/mechanisms or any part of the nervous system for that matter. They "store information coding for the amino acid sequences of proteins; that is all" (Bateson, 2001, p. 157), and as such their influence on behaviour is indirect and far removed.

The Present Thesis

Thus, among the challenges of the current research project was avoiding, as much as humanly possible, being drawn into the nature/nurture debate inherent in much of the contemporary theorising about the development of perspective taking. The aim was to engage with the constructivist ideas in each theory, draw predictions from them, and contrast these predictions with those based on non-constructivist (usually nativistic) ideas wherever possible. The data for the present thesis was collected in three phases. First, a pilot study involving primary care givers of typically developing children was conducted to validate a number of parent-report measures. The next phase, representing the first stage of the main longitudinal research project, included a different group of typically developing children, a group of children with specific language impairment (SLI), and their primary care givers, with data collection based on parent-report questionnaires and experimental tasks. The last phase, representing the second stage of the main longitudinal research project, involved returning to the typically developing children and the children with SLI a year later, again using parent-report questionnaires and experimental tasks.

As a number of constructivist and non-constructivist theories postulate contrasting predictions regarding the developmental relationship between conversation skill and ToM (Baron-Cohen, 1988, 1995; Gopnik & Meltzoff, 1997; Harris, 1992, 1996; Hutto, 2008, 2009; Racine & Carpendale, 2007a, 2007b; Vygotsky, 1987) one of the aims of the current research project was to test these contrasting predictions. However, as recently noted by Bigelow and Dugas (2009), a measure of children's pragmatic skill that focuses on conversation skill is required to further clarify the nature of the relationship between conversation skill and ToM. Accordingly, the first empirical chapter (chapter 2) reports the validation of a parent-report measure of children's conversation skill suitable for use in research investigating this relationship.

Expanding on the constructivist theme, drawing on Astington and Fillipova's (2005) argument that behaviours that have been considered precursors of ToM facilitate children's language development, the second empirical chapter (chapter 3) reports an investigation into the precursors of children's conversation skill. Consistent with Racine and Carpendale's (2007b) constructivist theory it was predicted that joint attention and imitation would mediate the relationship between early childhood socio-emotional engagement and children's subsequent conversation skill. Results for the pilot study and first-year data from the main longitudinal research project for the typically developing children and children with SLI converge in supporting this hypothesis.

The third empirical chapter (chapter 4) brings the constructivist perspective to the relationships among language, executive function (cognitive flexibility), and children's false belief understanding. Drawing on constructivist aspects of CCC-r theory (Zelazo, Muller, Frye, & Marcovitch, 2003), Racine and Carpendale's (2007a, 2007b) constructivist position and de Villiers and de Villiers' (2000; de Villiers, 2005) linguistic determinism theory, the relationships among maternal language input and child sentential complements skill, cognitive flexibility, and false belief understanding were analysed using the concurrent and longitudinal (one year later) data from the main longitudinal research project. The findings for the typically developing children and the children with SLI converge in supporting a constructivist model in which maternal language input predicts the child's memory for false complements, which in turn predicts cognitive flexibility and explicit false belief understanding, with cognitive flexibility partially mediating the effect of memory for false complements on explicit false belief understanding.

Expanding considerably on the findings of the first three empirical chapters, the fourth and final empirical chapter (chapter 5) brings a constructivist perspective to the relationships among parenting, socio-emotional engagement, shared practices, language (sentential complements, conversation skill), and perspective taking (cognitive, visual, emotional). A total of eight theories spanning the nativism-constructivism spectrum were reviewed and contrasting predictions were drawn wherever possible. The results of concurrent, longitudinal, and pass-fail contingency analyses of the data from the main longitudinal research project for the typically developing children and the children with SLI were most consistent with constructivist theories (e.g., Racine & Carpendale, 2007; Vygotsky, 1930/1981) and least consistent with the more nativistic theories (e.g., Baron-Cohen, 1995).

The final chapter of the thesis (chapter 6) begins by providing a brief overview of the findings from each of the empirical chapters followed by an integration and general discussion of the theoretical and practical implications of the results. Attention is then turned to the methodological strengths and limitations of the current research project along with directions for future research. Finally, overall conclusions following from the research are provided.

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Chapter 2

Validation of the Conversation Skill Scale

Abstract

The present study sought to validate a measure of children's conversation skill suitable for use in research investigating the relationship between conversation skill and theory of mind (ToM). A 7-item parent report measure of children's conversation skill was tested with a sample of 95 typically developing children (*M* age = 64.2 months) and found to have good reliability. The validity of this measure was then investigated in a different sample of 92 English speaking typically developing children (*M* age = 61.3 months), and by comparing 30 children with specific language impairment (*M* age = 63.0 months) with a sub-group of these typically developing children matched for non-verbal ability, gender, and age. Results of analyses with both groups of typically developing children and group comparisons involving the children with SLI converge in supporting the reliability and validity of the conversation skill scale. Thus, this measure is suitable for use in research investigating the relationship between conversation skill and ToM with typically developing children and children with specific language impairment.

Keywords: theory of mind, false-belief, conversation skill, language development, specific language impairment

Validation of the Conversation Skill Scale

Conversation skills are pragmatic communication skills that involve the contextually appropriate use and understanding of gestures and speech (Bates, 1976) whereas Theory of Mind (ToM) involves the ability to attribute mental states in order to explain and predict behaviour (Premack & Woodruff, 1978). An association between the development of conversation skill and ToM has long been recognized, especially in the case of autism (e.g., Baron-Cohen, 1988). A number of theories also postulate a developmental relationship between conversation skill and ToM (Baron-Cohen, 1988, 1995; Gopnik & Meltzoff, 1997; Harris, 1992, 1996; Hutto, 2008, 2009; Racine & Carpendale, 2007a, 2007b; Vygotsky, 1987).

A concurrent relationship has been found between children's pragmatic skill and their ToM development (Fernandez, 2007; James, 2002), and Hansen and Markman (2005) found that changing the pragmatic content (discourse structure) of the appearance-reality ToM task improved the performance of pre-school children on this task. Thus, there is evidence supporting a developmental relationship between conversation skill and ToM. However, as recently noted by Bigelow and Dugas (2009), longitudinal research using a measure of children's pragmatic skill that focuses on conversation skill is required to further clarify the nature of the relationship between conversation skill and ToM.

The Present Study

The aim of the present study was to validate a measure of children's conversation skill suitable for use in research investigating the relationship between conversation skill and ToM with typically developing children and children with specific language impairment (SLI). SLI involves intact nonverbal ability in the face of delayed or disordered language development (Bishop, 1997).

A parent report measure of children's conversation skill that focuses on the conversational ability aspects of pragmatic skill was tested with a typically developing sample in the first phase. The validity of this measure was then assessed with a different sample of typically developing children (phase two) and with a group of children with SLI (phase three). It was predicted that typically developing children's scores on the conversation skill scale would be significantly correlated with their ToM ability and that the children with SLI would have significantly lower scores on the conversation skill scale than a sub-group of the typically developing children matched for age, gender, and non-verbal ability.

Phase One: A Measure of Children's Conversation Skill

Method

Participants

Ninety five primary caregivers (89 mothers, 6 fathers) of children aged between 48 and 84 months (M = 64.2 months, SD = 10.0 months) participated. All of the children had English as their first language and 47 were female. Participants were recruited via three primary schools spread across working class to upper middle class areas. Questionnaires along with information sheets and consent forms were sent home with all Kindergarten, Pre-primary, and Year 1 children at each of the three schools. Primary caregivers who chose to participate mailed their completed questionnaires directly back to the researcher. A total of 348 sets of questionnaires were sent out and return rates varied between 23% in the working class area and 31% in the upper middle class area with an overall return rate of 27%.

Measures

Children's Conversation Skill

To produce a parent report measure of children's conversation skill that focused on the conversational ability aspects of pragmatic skill, a composite scale was constructed by combining six relevant items from the 25 item Conversation Skills Rating Scale (Girolametto, 1997) with an additional item devised specifically for the current research. Thus, the initial version of the composite scale was a 7-item instrument (see Table 1) in which primary caregivers rated how often their child displayed the described conversation skill on a 5-point scale ranging from almost never to almost always.

Results

Responses to individual items were scored from one to five such that higher scores reflected greater conversation skill.

Principal Components Analysis of the Conversation Skill Scale

The factor structure of all 7 items was examined using an unrotated Principal Components Analysis (PCA). A significant Bartlett's test of sphericity indicated that the factorability of these 7 items was acceptable. Examination of the scree plot and eigenvalues greater than one both supported the extraction of one component, which accounted for 57.49% of the variance. All 7 items had component loadings of greater than .51 on this first component. The reliability of the 7-item scale was good (α = .86). The 7 items along with their component loadings on the first component are shown in Table 1.

Table 1

Component Loadings Based on an Unrotated Principle Components Analysis for 7 Items from the Conversation Skill Measure (N = 95)

Item	Loading on the First Component
My child's answers are connected to what I asked. *	.86
My child's responses follow what I am talking about. *	.79
When I ask my child a question to check what s/he means, s/he answers me. *	.82
If I ask my child to repeat something I haven't understood, s/he does. *	.68
My child's sounds/gestures/words match my topic of conversation with him/her. *	.85
In a conversation, my child stays on the same topic for two or more turns. *	.52
My child's answers are appropriate (e.g. does not give too much or too little information).	.73

* Items from the Conversation Skills Rating Scale (Girolametto, 1997)

Phases Two and Three

Method

Participants

The data reported here represent part of a larger ongoing longitudinal research project. The children were recruited via three primary schools spread across working class to upper middle class areas. None of these children had participated in phase one of the present study. In total 105 typically developing Australian children were tested, and completed questionnaires were received from the primary caregiver for 92 of these children. All 92 typically developing children (46 male) spoke English as their first language and they were aged between 46 and 76 months (M = 61.3 months, SD = 8.3 months).

Thirty children with SLI (26 males) aged between 48 and 74 months (M = 63.0 months, SD = 9.0 months) were recruited from a metropolitan Language Development Centre (LDC). In order to receive a place in the LDC, children must have a significant primary language disability in the presence of normal non-verbal intelligence and sound adaptive behaviour skills. The placement committee (comprised of the LDC Principal, School Psychologist and Speech Pathologist) assess eligibility on the basis of standardized cognitive assessments, speech pathology referral, and information from

teachers and carers. In most cases, linguistic ability was assessed with the Clinical Evaluation of Language Fundamentals-Preschool (Semel, Wiig, & Secord, 1997) and non-verbal intelligence via the performance scale of the Wechsler Preschool and Primary Scale of Intelligence – Third Edition (Wechsler, 2002).

Measures

Children's Conversation Skill

The 7-item parent report measure developed in the first phase of the research was used as a measure of children's conversation skill. To increase the sensitivity of the measure, the reporting scale was changed to a 7-point scale ranging from never to always.

Theory of Mind

Children's ToM ability was measured using two batteries of tasks, each including one of the versions of Wellman and Liu's (2004) ToM scale used by Farrant et al. (2006), one of Woolfe, Want and Siegal's (2002) low verbal false belief tasks, and one of Sullivan and Tager-Flusberg's (1999) second order false belief tasks (see Appendix). These tasks range in difficulty from the diverse desires task that assesses whether the individual understands that other people can have desires that differ from his/her own through to the second order false belief task that assesses the ability to attribute second order or embedded mental states (e.g., he thinks that she thinks). Typically developing children, with few exceptions, pass the Wellman and Liu tasks in a fixed succession between the ages of 45 and 64 months (Peterson, Wellman, & Liu, 2005; Wellman & Liu, 2004). For the present study, the two versions of Wellman and Liu's (2004) ToM scale were modified to include control questions on the diverse desires and diverse beliefs tasks and an own false belief question in the contents false belief task.

Nonverbal Ability

The Fluid Reasoning composite score from the Leiter International Performance Scale-Revised (Roid & Miller, 1997) was used as a measure of nonverbal ability since it was not part of the psychometric testing performed by the LDC. The Fluid Reasoning composite score is calculated from age-adjusted scores on the Sequential Order and Repeated Patterns subtests and provides a measure of the child's nonverbal IQ.

Procedure

Consent forms and information sheets were sent to parents/guardians of all kindergarten and pre-primary children attending the three mainstream schools. Questionnaires were mailed to the primary caregivers who chose to participate and

completed questionnaires were mailed directly back to the researcher. Children were individually administered the ToM tasks and the nonverbal ability test in separate sessions in a quiet room at the child's regular centre. Each of the testing sessions lasted approximately 10 minutes. Approximately half of the children received one of the ToM task batteries and the other half received the other.

Results

Each ToM task was scored as 1 (passed) or 0 (failed), and to pass each task the child had to answer the target and relevant memory and/or control questions correctly. For the typically developing children, the total ToM scores (maximum possible score of 8) were not significantly different between the two task batteries, t (90) = 1.03, p = .31. Therefore, the results were collapsed across the two versions of the ToM task battery. Parental responses to individual conversation skill items were scored from one to seven such that higher scores reflected greater conversation skill. A conversation skill score was calculated for each child by summing the responses to the 7 items.

Phase Two: Typically Developing Children

Principal Components Analysis of the Conversation Skills Scale

As for phase one, the factor structure of all 7 items was examined using an unrotated PCA. A significant Bartlett's test of sphericity indicated that the factorability of these 7 items was acceptable. Examination of the scree plot and eigenvalues greater than one both supported the extraction of one component, which accounted for 69.19% of the variance. All 7 items had component loadings of greater than .77 on this first component. The reliability of the 7-item scale was good (α = .92).

Relationship between Conversation Skill and ToM in Typical Development

Inspection of the distributions for both variables (conversation skill, total ToM score) revealed that the distributions were approximately normal. The mean conversation skill score was 40.87 (SD = 6.17) and the mean ToM score was 3.85 (SD = 1.97). As predicted, a significant correlation (r(92) = .33, p < .001) was found between the conversation skill and ToM scores and this remained significant after controlling for age and nonverbal IQ (r(88) = .27, p = .01).

Phase Three: Group Comparison on Conversation Skill

Summary statistics for age, gender, and nonverbal ability for the group of children with SLI and a subgroup of the sample of typically developing children matched in terms of these variables are displayed in Table 2. These groups had the same gender distribution and did not differ in terms of age, t(58) = 0.07, p = .94, or nonverbal IQ, t(58) = 0.12, p = .91. For the two groups, summary statistics for conversation skill

are presented in Table 2. As predicted, this group of children with SLI were found to have significantly lower conversation skill scores, $t(58) = 6.72$, $p < .001$, than the matched group of typically developing children.

Table 2

Matched Groups - Summary Statistics

	SLI (n = 30)		Typically Developing (n = 30)	
	M	*SD*	*M*	*SD*
Child's Age in Months	63.0	9.0	62.8	8.4
Nonverbal IQ	105.67	13.74	105.27	12.84
Gender (males: females)	26:4		26:4	
Conversation Skill	30.67	7.04	41.80	5.73

Discussion

The aim of the present study was to validate a measure of children's conversation skill suitable for use in research investigating the relationship between conversation skill and ToM with typically developing children and children with SLI. A parent report measure of children's conversation skill that focuses on the conversational ability aspects of pragmatic skill was tested with a typically developing sample in the first phase. The validity of this measure was then assessed with a different sample of typically developing children (phase two) and with a group of children with SLI (phase three).

In the first and second phases of the study, the factor structure of the 7-item conversation skill scale was found to be sound, with all 7 items loading well onto a single component accounting for over half of the total variance. The reliability of this 7-item scale was good across the two different samples of typically developing children (phases one and two). Furthermore, as predicted, typically developing children's scores on the conversation skill scale were significantly correlated with their ToM ability (phase two). This finding is consistent with the theorized relationship between conversation skill and ToM (Baron-Cohen, 1988, 1995; Gopnik & Meltzoff, 1997; Harris, 1992, 1996; Hutto, 2008, 2009; Racine & Carpendale, 2007a, 2007b; Vygotsky, 1987) and with previous research that has found relationship between children's conversation skill and ToM ability (Fernandez, 2007; James, 2002). Thus, the present findings for typically developing children attest to the reliability and construct validity

of the conversation skill scale. The finding that the children with SLI had significantly lower scores on the conversation skill scale than a sub-group of the typically developing children matched for age, gender, and non-verbal ability (phase three) also supports the validity of the conversation skill scale.

Conclusions

The results of the analyses with the typically developing children, when combined with the results of group comparisons involving children with SLI and a matched group of typically developing children converge in supporting the reliability and validity of the conversation skill scale. Thus, this measure is suitable for use in research investigating the relationship between conversation skill and ToM with typically developing children and children with SLI.

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Appendix: Detailed Procedure for ToM Tasks

Diverse Desires

Wellman and Liu's (2004) diverse desires task assesses whether the individual understands that other people can have desires that differ from his/her own. The child is shown a doll and a page depicting a carrot and a cookie. "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." The child is asked the own-desire question: "Which snack would you like best? Would you like a carrot or a cookie best?" If the child chooses the cookie (carrot): "Well, that's a good choice, but Mr. Jones really likes carrots (cookies). He doesn't like cookies (carrots). What he likes best are carrots (cookies)." The child is asked the target question: "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?" The child is asked the control question: "Which snack does Mr Jones like best? Carrots or cookies?" To be scored correct, the child must answer the target and control questions with the opposite answer to the answer given to the own-desire question. The second (analogue) version of the diverse desires task was identical to the first except that the child was told it was playtime and that "Teddy" the teddy bear wanted a toy to play with and could choose between a doll and a truck.

Diverse Beliefs

Wellman and Liu's (2004) diverse beliefs task assesses whether the individual understands that other people can have beliefs that differ from his/her own. The child is shown a doll and a page depicting bushes and a shed. "Here's Mr. Jones. Mr. Jones wants to find his cat. His cat might be hiding in the bushes or in the shed." The child is asked the own-belief question: " Where do you think the cat is? In the bushes or in the shed?" If the child chooses the bushes (shed): "Well, that's a good idea, but Mr. Jones thinks his cat is in the shed (bushes). He thinks his cat is in the shed (bushes)." The child is asked the target question: "So where will Mr. Jones look for his cat? In the bushes or the shed?" The child is asked the control question: "Where does Mr. Jones thinks his cat is? In the bushes or the shed?" To be scored correct, the child must answer the target and control questions with the opposite answer to the answer given to the own-belief question. The procedure for the second diverse beliefs task was identical to the first except that the child was told that "Teddy" was looking for the jam which might be in the cupboard or in the fridge.

Knowledge Access

Wellman and Liu's (2004) knowledge access task assesses if the individual understands that whether or not someone knows something depends on whether they have had access to the relevant information. The child is shown a nondescript opaque plastic box with a closed drawer containing a small plastic toy dog inside. "Here's a drawer. What do you think is inside the drawer?" (The child's answer is immaterial.) The drawer is opened and the child is shown the content of the drawer: "Let's see … it's really a dog inside!" The drawer is closed and the child asked the control question: "Okay, what is in the drawer?" A doll is produced: "Mr. Jones has never seen inside this drawer. Now here comes Mr. Jones." The child is asked the target question: "So, does Mr. Jones know what is in the drawer?"; followed by the memory question: "Did Mr. Jones see inside this drawer?" To be scored correct, the child must answer "dog" to the control question and "no" to both the target and memory questions. The procedure for the second knowledge access task was identical to the first except that the props were the teddy bear and a nondescript case containing a cracker biscuit.

Contents False Belief

Wellman and Liu's (2004) contents false belief task assesses whether the individual understands that people can hold false beliefs about reality. The child is shown a clearly identifiable closed Band-Aid box with a small plastic toy pig inside. "Here's a Band-Aid box. What do you think is inside the Band-Aid box?" "Let's see … it's really a pig inside!" The Band-Aid box is closed and the child is asked the control question: "Okay, what is in the Band-Aid box?" A doll is produced: "Mr. Jones has never seen inside this Band-Aid box. Now here comes Mr. Jones." Then the child is asked the first target question (others false belief): "So what does Mr. Jones think is in the box? Band-Aids or a pig?" Followed by the memory question: "Did Mr. Jones see inside this box?" and the second Target Question (own false belief): "What did you first think was inside the Band-Aids box before we opened it? Band-Aids or a pig?" To be scored correct on the first target question, the child must answer "Band-Aids" to the target question, and "no" to the memory question. To be scored correct on the second target question, the child must answer "pig" to the control question, and "Band-Aids" to the target question. The procedure for the second contents false belief task was identical to the first except that the props were the teddy bear and a Smarties box with crayons inside.

Low Verbal False Belief

To check the child's understanding of "thought bubbles"**,** the child is shown two pictures, one depicting a girl thinking about a bottle (a girl with an attached thought bubble containing a bottle) and the other depicting a girl holding a bottle and is asked "Which girl is thinking about a bottle?" The child is shown a picture of a boy holding a fishing rod with the line going into the water and a flap (which depicts a plausible obstruction (reeds)) that covers what is on the end of the line (a boot). "See this water? Look. It has fish in it. This is Fred. Fred thinks he has caught a fish on the fishing-line. Can you cover Fred with your hand while we have a look at what is really on the fishing-line?" This emphasises Fred's ignorance of what is on the fishing-line. After the flap is replaced, the child is shown a separate picture of Fred with a blank thought bubble above his head. Next to this picture are four small pictures. Two of these pictures are of distracter items, one shows the content of Fred's belief (a fish) and the other shows the actual object (a boot). Then the child is asked the target question: "Can you point to what Fred thinks is on the fishing-line?" Followed by the control question: "Can you point to what is really on the fishing-line?" To be scored correct, the child must point to the fish in response to the target question and to the boot in response to the control question. The procedure for the second low verbal false belief task was identical to the first except that the protagonist Charlie thinks there is a fish under the reeds when it is really a mermaid.

Second Order False Belief

The child is shown a picture of a boy and his mum. "This is Andrew, and this is his Mum. Tonight it's Andrew's birthday, and Mum is surprising him with a kitten. Mum wants it to be a secret, so she has hidden the kitten in the garden shed. Andrew says, 'Mum, I really hope you get me a kitten for my birthday.' Remember, Mum wants to surprise Andrew with a kitten. So, instead of telling Andrew she got him a kitten, Mum says, 'Sorry Andrew, I did not get you a kitten for your birthday. I got you a really great toy instead.'" The child is then asked the first order false belief question: "So what does Andrew think his Mum got him for his birthday? A kitten or a toy?" (If correct: That's right, Andrew thinks he's getting a toy; If incorrect: But remember, Andrew thinks he's getting a toy) Followed by the first memory control question: "What did Mum really get Andrew for his birthday? A kitten or a toy?" (If correct: That's right, Mum wants to surprise Andrew with a kitten; If incorrect: But remember, Mum wants to surprise Andrew with a kitten) "Now, Andrew says to Mum, 'I'm going outside to play.' On his way outside, Andrew decides to get his roller-skates from the garden shed.

When he opens the door to the garden shed, Andrew finds the birthday kitten! (Child is shown a picture of a kitten in a shed) Andrew says to himself, 'Wow, Mum didn't get me a toy, she really got me a kitten for my birthday.' Now, the important thing is that Mum did not see Andrew go to the garden shed and find the birthday kitten." The child is then asked the second memory control question: "Does Andrew know that his Mum got him a kitten for his birthday?" (If yes: That's right, Andrew saw the kitten in the garden shed; If no: But remember, Andrew saw the kitten in the garden shed) Followed by the third memory control question: "Does Mum know that Andrew saw the birthday kitten in the garden shed?" (If no: That's right, Mum did not see Andrew go to the garden shed and find the kitten; If yes: But remember, Mum did not see Andrew go to the garden shed and find the kitten) "While Andrew is outside, Andrew's grandmother drops in for a chat with Andrew's mum. (Child is shown a picture of mum and grandma) Grandma asks Mum, 'Does Andrew know what you really got him for his birthday?'" The child is then asked the second order ignorance question: "What does Mum say to Grandma?" "Now remember, Mum does not know that Andrew saw what she got him for his birthday. Then, Grandma asks Mum, 'What does Andrew think you got him for his birthday?'" The child is then asked the second order false belief question: "What does Mum say to Grandma?" Followed by the justification question: "Why does Mum say that?" To be scored correct on the first order false belief, the child must answer both the first order false belief question and the first memory control question correctly. To be scored correct on the second order false belief, the child must all of the questions correctly. The procedure for the other second order false belief task was identical to the first except that the child (Molly) wants a bike for her birthday but her dad tells her he got her a really great toy instead.

Chapter 3

Socio-Emotional Engagement, Joint Attention, Imitation and Conversation Skill**:** Analysis in Typical Development and Specific Language Impairment

Brad M. Farrant, Murray T. Maybery, and Janet Fletcher

Abstract

According to Racine and Carpendale's (2007b) constructivist theory, the acquisition of shared linguistic practice is grounded in the development of competence in shared forms of activity such as joint attention which are naturally embedded in socio-emotional engagement. The present study investigated the relationships among socio-emotional engagement, joint attention, imitation, and conversation skill by establishing a model of these relationships in 94 typically developing children (*M* age = 64.0 months) and further assessing this model in another group of 93 typically developing children (*M* age = 61.3 months) and 30 children with specific language impairment (*M* age = 63.0 months). Joint attention and imitation were found to mediate the relationship between socio-emotional engagement and conversation skill.

Keywords: communication development, imitation, joint attention, conversation skill, socio-emotional engagement

Socio-Emotional Engagement, Joint Attention, Imitation and Conversation Skill**:** Analysis in Typical Development and Specific Language Impairment

Joint attention refers to the skills involved in identifying the focus of another person's attention or in drawing his or her attention to one's own focus of attention (Williams, Whiten, Suddendorf, & Perrett, 2001). The importance of joint attention in children's language development has long been recognised (e.g., Bruner, 1981; Tomasello & Todd, 1983). More recently, Racine and Carpendale (2007b) argued that shared practices such as joint attention are naturally embedded in socio-emotional engagement and that the acquisition of shared linguistic practice is grounded in the development of competence in shared forms of activity such as joint attention. The present study investigated the relationships among socio-emotional engagement, joint attention, imitation, and conversation skill in typically developing children and children with specific language impairment.

Socio-Emotional Engagement, Joint Attention, Imitation and Language Development

Racine and Carpendale's (2007b) focus on the developmental importance of shared practices and the natural embedding of these practices in socio-emotional engagement suggests that shared practices such as imitation and joint attention emerge out of the child's socio-emotional engagement with others and that these shared practices provide the foundation for the development of language/communication skills. As is generally the case with the most useful theoretical advances, Racine and Carpendale argue that one of the advantages of their constructivist approach is that it allows the researcher to make use of what is already established in existing research paradigms via the reframing and/or reinterpretation of extant theory and research.

Thus, Racine and Carpendale's (2007a, 2007b) constructivist position is consistent with Trevarthen's argument that primary intersubjectivity (including socio-emotional engagement) precedes secondary intersubjectivity (joint attention) (e.g., Trevarthen, 1979; Trevarthen & Hubley, 1978)[1]. According to this argument, socio-emotional engagement (primary intersubjectivity) facilitates the development of joint attention skills (secondary intersubjectivity) by ensuring that the relevant brain systems receive sufficient social input (Mundy & Acra, 2006; Trevarthen & Aitken, 2001). Similarly, Racine and Carpendale's (2007a, 2007b) constructivist position is also consistent with the argument that socio-emotional interactions are precursors of joint

[1] The two positions are consistent if we put aside any possible theoretical disagreements about the nature of cognition (Racine & Carpendale, 2007b, for example, argue that meaning precedes both language and thought and that meaning is grounded in shared practices).

attention behaviours such as protodeclarative or showing gestures (Gomez, Sarria, & Tamarit, 1994), and the argument that socio-emotional engagement puts the 'jointness' into joint attention (Hobson, 2005).

Turning to the extant research, the argument that socio-emotional engagement provides the foundation from which communication skills develop is supported by several lines of research. For over half a century it has been recognized that marked deficits in the development of communication skills are among the outcomes associated with severe emotional deprivation during infancy and early childhood (Greenspan & Shanker, 2004; Spitz, 1946). Therapeutic interventions designed to increase socio-emotional engagement have a positive effect on the linguistic competence of the communicatively impaired (Zeedyk, 2006). Similarly, quality or security of infant-carer attachment has been found to be positively related to later communicative and linguistic competence for both typically developing children and children with Down syndrome (Kaneko, 1997; Klann-Delius & Hofmeister, 1997; Main, 1983; Murray & Yingling, 2000; Rauh & Calvet, 2004; Salerni, Calvo, & D'Odorico, 2001). Conversely, disturbed attachment in early childhood is associated with language development problems (Shin, Lee, Min, & Emde, 1999). Indeed, on the basis of their meta-analysis that revealed a strong association between quality of attachment and language development, van Ijzendoorn, Dijkstra, and Bus (1995) argued that the enhanced communicative development associated with more secure attachment may result from secure caregivers being better 'teachers' and securely attached children being more motivated 'students'.

A relationship between joint attention and language/communication development in typically developing children has long been recognised. In a five month long study involving children initially aged between 12 and 13 months, Tomasello and Todd (1983) found that, during mother-child play, a maternal interaction style that initiated joint attention more by redirecting their child's focus of attention (as opposed to identifying and following the child's focus of attention) was associated with a lower proportion of object names and a higher proportion of personal-social words. Furthermore, the child's overall vocabulary size (maternal diary reports) was positively correlated with the proportion of mother-child joint interactions that were maintained by both parties actively manipulating each other's attention (jointly led joint attention, as opposed to joint interactions that were maintained by the mother or the child continually manipulating the other's attention). Similarly, the frequency of joint attention episodes in mother-child play when children are six months of age has been found to be positively correlated with children's vocabulary production (as measured by the

MacArthur Communicative Developmental Inventory [CDI]; Fenson, et al., 1993) at 17 and 24 months (Saxon, 1997). More recent research has also found a developmental relationship between joint attention and language in both typically developing children and children with autism (Charman, 2003; Charman et al., 2003; Poon, 2005) and that joint attention training improves the communicative ability of children with autism (Whalen, 2001).

Consistent with Racine and Carpendale's (2007b) argument that meaning precedes both language and thought and that meaning is grounded in shared practices, Tomasello and Todd (1983) argued that the observed relationship between joint attention and the development of language/communication skills is a product of the fact that the provision of a language model during episodes of joint attention provides an effective way to learn word-object mappings. The relationships among joint attention, word-object mappings, and vocabulary acquisition have also been investigated.

The maternal interaction styles observed by Tomasello and Todd (1983) with children aged between 12 and 13 months (initiating shared attention by redirecting their child's focus of attention versus identifying and following the child's focus of attention) can be observed with infants as young as 6 months and mothers adopt a predominant style by the time the infant is 8 months (Saxon, Frick, & Colombo, 1997). Evidence also indicates that the interaction style of following the child's focus of attention enhances the child's lexical acquisition at 18 months (Dunham, Dunham, & Curwin, 1993) and that by 16 months of age children are able to establish new word-object mappings when an adult follows the child's focus of attention to the object before uttering the word/label (Baldwin, 1991, 1993b).

However, if an adult utters a novel word/label without following the child's focus of attention, it is not until around 18 to 20 months of age that children can use the practice of following the adult's focus of attention to an object (using cues such as the adult's gaze direction) and make new word-object mappings (Baldwin, 1993a, 1993b; Baldwin, Markman, Bill, Desjardins, & Irwin, 1996). Even more interesting for present purposes is the finding that children can use the practice of following an adult's focus of attention to an object (using cues such as the adult's gaze direction) to find the target of the adult's emotional outburst and make mappings between objects and affective states by 12 months of age (Moses, Baldwin, Rosicky, & Tidball, 2001). Together, these findings indicate that the child's ability to use the practice of following another's focus of attention to achieve joint attention develops with respect to the communication of emotion prior to being used to support language development/lexical acquisition. This

pattern of development provides some support for the argument that shared practices such as joint attention emerge out of the child's socio-emotional engagement (e.g., Racine & Carpendale, 2007b).

A similar transition from the emotional to the lexical content of adult utterances has been observed with respect to children's behaviour regulation in social referencing studies. This research has found that the vocal emotional paralanguage of adults is an effective regulator of child behaviour by 12 months of age (e.g., Mumme, Fernald, & Herrera, 1996). Indeed, Friend (2001) found that prior to around 15 months children's behaviour was better regulated by emotional paralanguage (vocal and facial) than it was by the lexical content of adult utterances and that the transition to better regulation by lexical content was predicted by the child's receptive vocabulary measured by the MacArthur CDI.

Thus, particularly with respect to typical development, there is evidence to support the roles of both socio-emotional engagement and joint attention in children's language/communication development as well as some evidence of a developmental relationship between socio-emotional engagement and joint attention. Turning to the role of imitation in this process, the hypothesis that imitation is a precursor of communication/language skills is supported by research that has found a developmental relationship between imitation and language in both typically developing children and children with autism (Charman, 2003; Charman, et al., 2000; Charman, et al., 2003; Rogers, Hepburn, Stackhouse, & Wehner, 2003; Stone & Yoder, 2001) and by the finding that imitation training improves the communicative ability of children with autism (Ingersoll & Schreibman, 2006). Further evidence supporting a relationship between imitation and communication/language skills is provided by research with children with specific language impairment.

Imitation, Joint Attention, and Specific Language Impairment (SLI)

SLI involves intact nonverbal ability in the face of delayed or disordered language development (Bishop, 1997). Children with SLI have been found to demonstrate imitation deficits (e.g., Eadie, Fey, Douglas, & Parsons, 2002; Snow, 2001; van der Meulen, Janssen, & Os, 1997) and imitation tasks have been effectively used to screen for children with language difficulties (Gardner, Froud, McClelland, & van der Lely, 2006). Unsolicited imitation by children with SLI has been found to facilitate the production of the imitated words on a post-test, possibly by providing additional practice at producing these words (Schwartz & Leonard, 1985). Research also supports the efficacy of interventions involving the use of imitation with children with SLI

(Camarata, Nelson, & Camarata, 1994; Connell, 1987; Connell & Stone, 1992; Fey & Proctor-Williams, 2000; Kouri, 2005). Although less extensive, there is also evidence indicating a relationship between joint attention and language development in children with SLI (Peek, 1998) and joint attention has been used to enhance the lexical acquisition of children with SLI (Kiernan & Gray, 1998).

The Present Study

While the existing data support the roles of socio-emotional engagement, imitation, and joint attention in children's early language/communication development and provides some evidence of a developmental relationship between socio-emotional engagement and joint attention, there is a dearth of research investigating the relationships among socio-emotional engagement, imitation, joint attention, and language/ communication development in the same study. There is also a lack of research investigating Racine and Carpendale's (2007b) argument that shared practices such as joint attention emerge out of the child's socio-emotional engagement with others and that these shared practices provide the foundation for the development of children's subsequent communication skills. However, an association between socio-emotional engagement and the subsequent development of conversation skills (communication skills that involve the contextually appropriate use and understanding of gestures and speech) has long been recognized, especially in the case of autism (e.g., Baron-Cohen, 1988). Thus, the overall aim of the current research was to investigate the relationships among the socio-emotional engagement, joint attention, imitation, and children's subsequent conversation skill. The first phase of the study aimed to establish a model of these relationships. This model was then tested with another group of typically developing children (phase two), and by comparing a group of children with SLI with a group of typically developing children matched for non-verbal ability, gender, and age (phase three).

Drawing on Racine and Carpendale's (2007a, 2007b) constructivist position and Trevarthen's argument (e.g., Trevarthen, 1979; Trevarthen & Hubley, 1978) it was hypothesised that joint attention and imitation act as mediators of the relationship between socio-emotional engagement and conversation skill (the Affective Model; see Figure 1a). This model was contrasted with one in which socio-emotional engagement, joint attention, and imitation make separate unique contributions to the development of conversation skill (the Additive Model; see Figure 1b). In relation to the comparisons between the group of children with SLI and the sub-group of typically developing children matched for non-verbal ability, gender and age, consistent with previous

research it was predicted that SLI would be associated with deficits in imitation and joint attention.

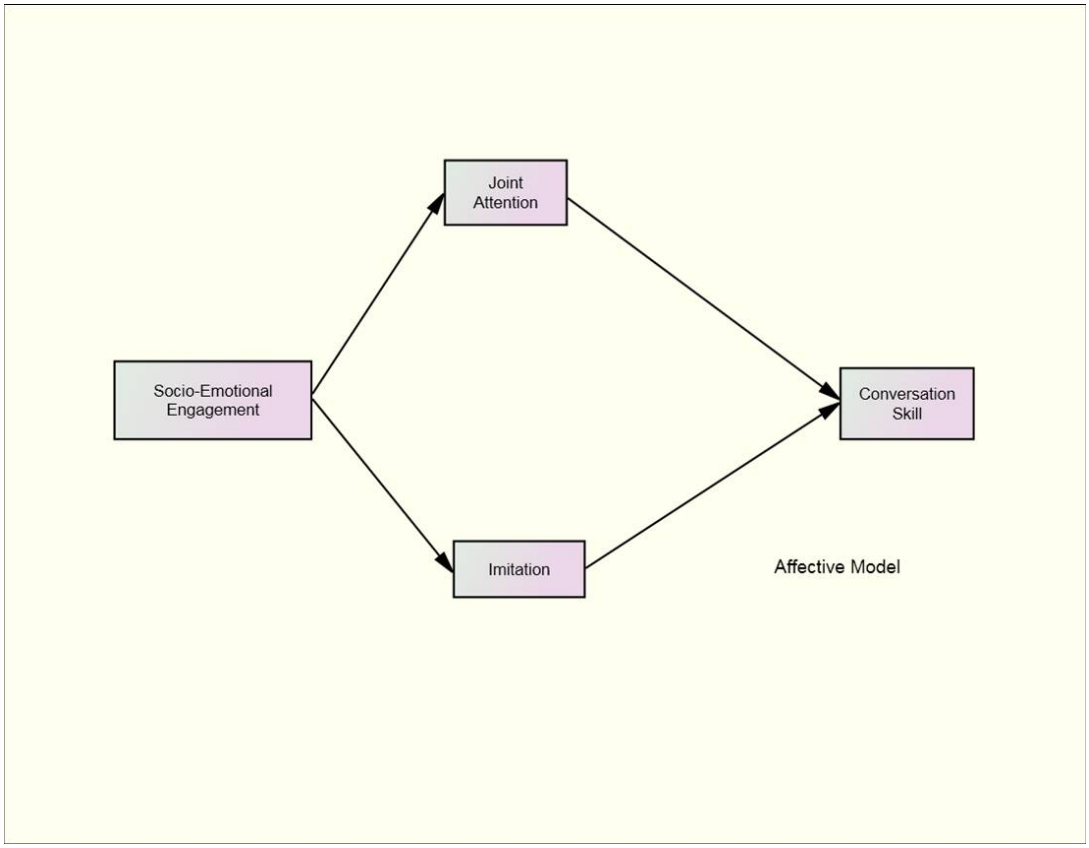

Figure 1a. Affective Model of the development of conversation skill

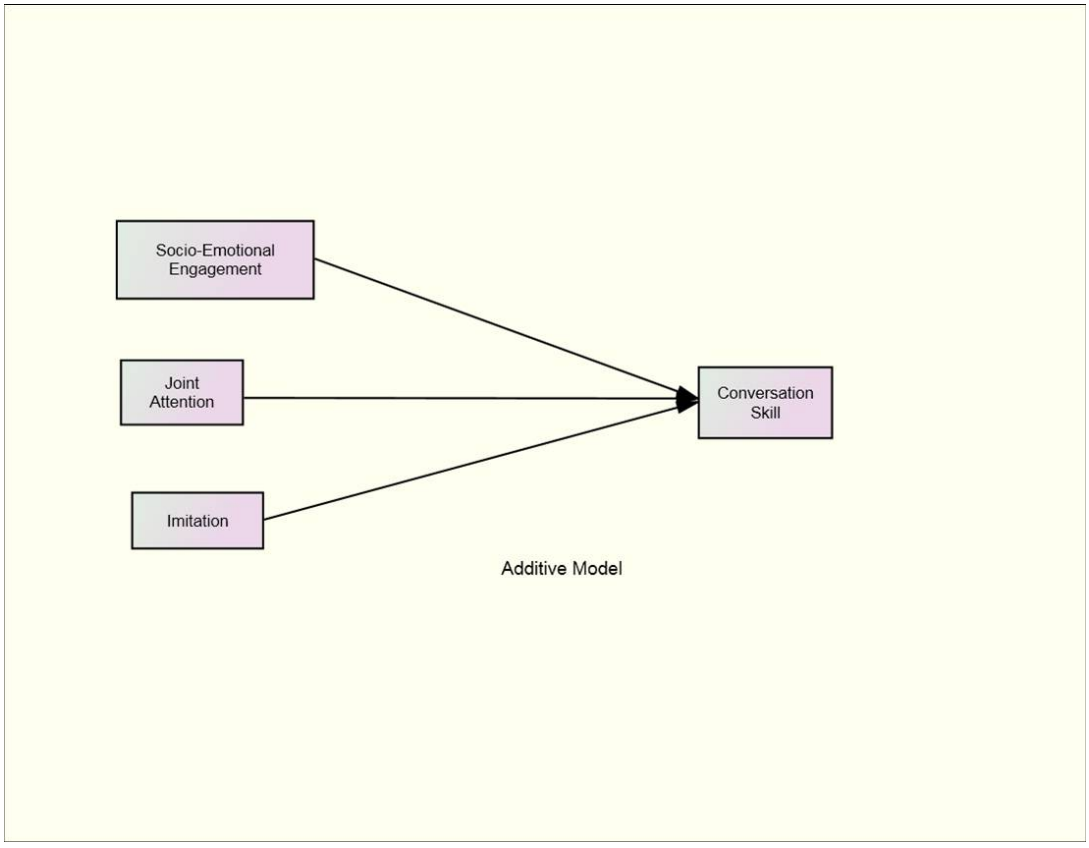

Figure 1b. Additive Model of the development of conversation skill

Phase One: Establishing a Model of the Relationships among Socio-Emotional Engagement, Joint Attention, Imitation, and Conversation Skill

Method

Participants

Ninety five primary caregivers (89 mothers, 6 fathers) of children aged between 48 and 84 months (M = 64.2 months, SD = 10.0 months) participated. All of the children had English as their first language and 47 were female. Participants were recruited via three primary schools spread across working class to upper middle class areas. Questionnaires along with information sheets and consent forms were sent home with all Kindergarten, Pre-primary, and Year 1 children at each of the three schools. Primary caregivers who chose to participate mailed their completed questionnaires directly back to the researcher. A total of 348 sets of questionnaires were sent out and return rates varied between 23% in the working class area and 31% in the upper middle class area, with an overall return rate of 27%.

Measures

Children's Conversation Skill

A Conversation Skill Scale comprised of six items from the Conversation Skills Rating Scale (Girolametto, 1997) and an additional item devised specifically for the current research project was used as a measure of children's conversation skill (see Appendix). Thus, the Conversation Skill Scale used in phase one of the present study was a 7-item instrument in which primary caregivers rated how often their child displayed the described conversation skill on a 5-point scale ranging from almost never to almost always with a maximum possible score of 35. As previously reported (Farrant, Fletcher, & Maybery, submitted), the factor structure of the 7-item Conversation Skill Scale in the present sample is sound with all 7 items loading well (component loadings > .52) onto a single component accounting for over half of the total variance (57.49%). The reliability of this 7-item scale is also good (α > .86) across the two different samples of typically developing children in the present study (Farrant, et al., submitted) and scores on this scale have also been found to significantly correlate with children's theory of mind scores (using standard theory of mind tasks) providing an indication of the construct validity of this Conversation Skill Scale (Farrant, et al., submitted).

Children's Socio-Emotional Engagement, Joint Attention, and Imitation

Children's socio-emotional engagement, joint attention, and imitation were measured retrospectively using scales developed specifically for the current research project. In phase one, primary caregivers rated how often in early childhood their child

displayed the described attention or behaviour on a 5-point scale ranging from almost never to almost always with a maximum possible score of 20 for the Socio-Emotional Engagement and Joint Attention scales, and 15 for the Imitation scale.

The reliability of the Socio-Emotional Engagement scale is acceptable (α = .74) in the present sample with all four items (see Appendix) loading positively (component loadings > .71) onto one component accounting for 57.13% of the variance. In the present sample the reliability of the Imitation scale (see Appendix) is good (α = .80) with all three items loading positively (component loadings > .72) onto one component accounting for 72.16% of the variance. All four items in the Joint Attention scale (see Appendix) load positively (component loadings > .64) onto one component accounting for 55.10% of the variance in the present sample and the scale has acceptable reliability (α = .71). The predictive validity of parent reports of child joint attention behaviours has been demonstrated in screening instruments for the detection of autism in toddlers (e.g., Baron-Cohen, et al., 2000; Robins, Fein, Barton, & Green, 2001).

Data analytic strategy

The Additive and Affective Models were tested according to the conventional method for testing such models within a structural equation model (SEM) framework (Bollen, 1989; Gignac, 2006). Because of the relatively small sample size, a two index strategy (Hu & Bentler, 1999) involving the Incremental Fit Index (IFI; an incremental close-fit index) and the Standardized Root Mean-square Residual (SRMR; an absolute close-fit index) were used to evaluate model fit (Gignac, 2006). In conjunction with 95% of normalized residuals being less than |2.0|, IFI values of ≥ .95 and SRMR values of ≤ .08 were considered indicative of a well-fitting model (Gignac, 2006). Maximum likelihood estimation was used as the basis for all SEM analyses.To control for the possibility that any of the observed findings were a result of age- or gender-related variance, correlation analyses were conducted including chronological age and gender. Where either of these variables was found to be significantly correlated with the main study variables it was included in the models as a control variable.

Results

Parental responses to individual items were scored from one to five, such that higher scores reflected greater socio-emotional engagement, joint attention, imitation, and conversation skill. Scores were calculated for each child by summing the responses to the items in each scale. Prior to analysis, the data for the main study variables (socio-emotional engagement, joint attention, imitation, conversation skill) were checked for multivariate outliers using Mahalanobis distance with $p < .001$ (critical value = 18.47).

This resulted in the data from one participant being excluded from subsequent analysis. For the remaining 94 participants (47 female), descriptive and frequency statistics for the study variables are presented in Table 1. Inspection of the correlations between the measures revealed that the degree of multicollinearity between the predictor variables was acceptable (see Table 2).

Table 1

Mean and Standard Deviation of scores for phase one study variables

Variable	*M*	*SD*
Socio-Emotional Engagement	17.49	1.86
Joint Attention	15.54	2.19
Imitation	10.98	1.88
Conversation Skill	31.41	3.51

$N = 94$

Table 2

Intercorrelations between phase one variables

Variable	1	2	3	4	5	6
1. Socio-Emotional Engagement	--					
2. Joint Attention	.58†	--				
3. Imitation	.31†	.44†	--			
4. Conversation Skill	.42†	.58†	.43†	--		
5. Gender	.08	.16	.11	.16	--	
6. Age in Months	.10	.05	-.09	-.12	-.16	--

*$p < .05$, †$p < .005$, $N = 94$

Determining the Best Model

As chronological age and gender failed to correlate significantly with any of the main study variables (see Table 2) they were not included in the models as control variables. The Additive Model converged after six iterations with $\chi^2_{(3)} = 58.44$, $p < .001$, IFI = .45, and SRMR = .28. Standardized parameter estimates for the Additive Model are depicted in Figure 2. All of the factor loadings are in the expected (positive) direction (see Figure 2a). The unstandardized point estimates of the regression path between socio-emotional engagement and conversation skill was not significant; all

other unstandardized point estimates were significant ($p < .05$). However, there were five standardized residual covariances with values greater than 2.0 - between socio-emotional engagement and the other three variables as well as between imitation and both joint attention and conversation skill. The standardized residual covariances therefore indicated that socio-emotional engagement, joint attention, and imitation did not make separate unique contributions to the development of conversation skill. Thus, the Additive Model did not provide an adequate fit for the data.

The Affective Model converged after six iterations with $\chi^2_{(2)} = 12.78$, $p = .002$, IFI = .89, and SRMR = .10. Standardized parameter estimates for the Affective Model are depicted in Figure 2b. As can be seen in Figure 2b, all of the factor loadings are in the expected (positive) direction. All of the unstandardized point estimates were significant ($p < .05$). There was one standardized residual covariance with a value greater than 2.0 for the Affective Model - between imitation and joint attention.

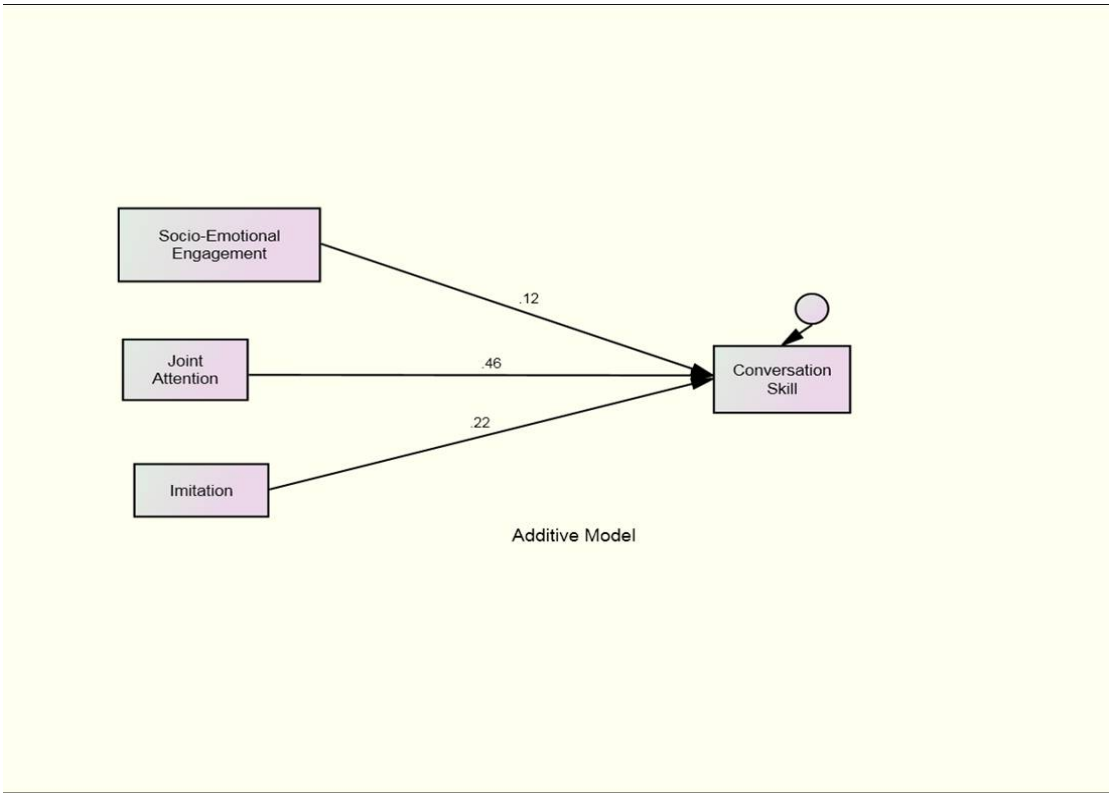

Figure 2a. Standardized parameter estimates for the Additive Model. All reported estimates are the maximum likelihood standardized point-estimates. The unstandardized point estimate of the regression path between socio-emotional engagement and conversation skill was not significant; all other unstandardized point estimates were significant ($p < .05$).

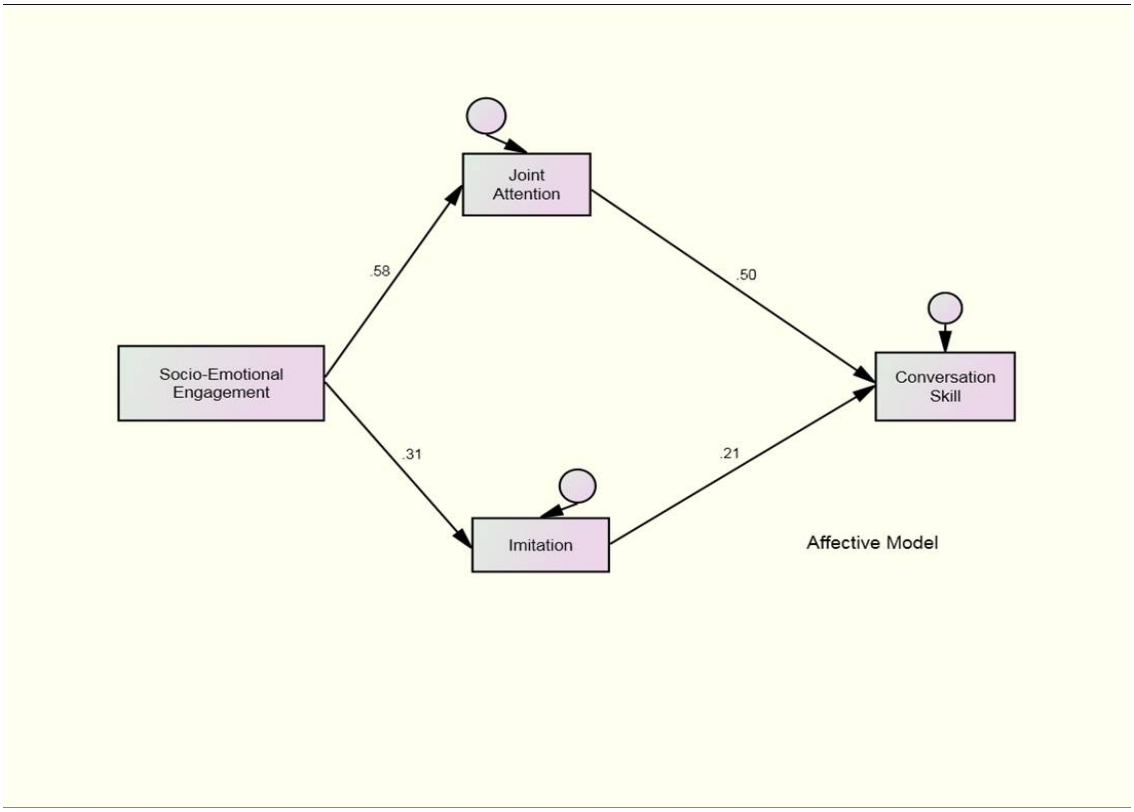

Figure 2b. Standardized parameter estimates for the Affective Model. All reported estimates are the maximum likelihood standardized point-estimates. All unstandardized point estimates were significant ($p < .05$).

As the Additive Model did not provide an adequate fit for the data (because the results indicated that socio-emotional engagement, joint attention, and imitation did not make separate unique contributions to the development of conversation skill) it was not considered further and the Affective Model was considered to demonstrate the best model fit. Examination of the standardized residual covariances for the Affective Model revealed a value of 2.52 between imitation and joint attention and the modification indices indicated that imitation explained more variance in joint attention than vice versa. In the absence of any contrary theoretical argument it was considered acceptable to add a regression path between imitation and joint attention.

The Revised Affective Model converged after six iterations with $\chi^2_{(1)} = 1.28$, $p = .26$ and IFI = .99, SRMR = .02. Standardized parameter estimates for the Revised Affective Model are depicted in Figure 3. All of the factor loadings are in the expected direction. All of the unstandardized point estimates were significant ($p < .05$). Examination of the standardized residual covariances for the Revised Affective Model revealed none over the |2.0| mark. Thus, because all indices were in the acceptable

range, the Revised Affective Model was considered to have acceptable model fit. For this model $R^2 = .38$ ($p < .001$).

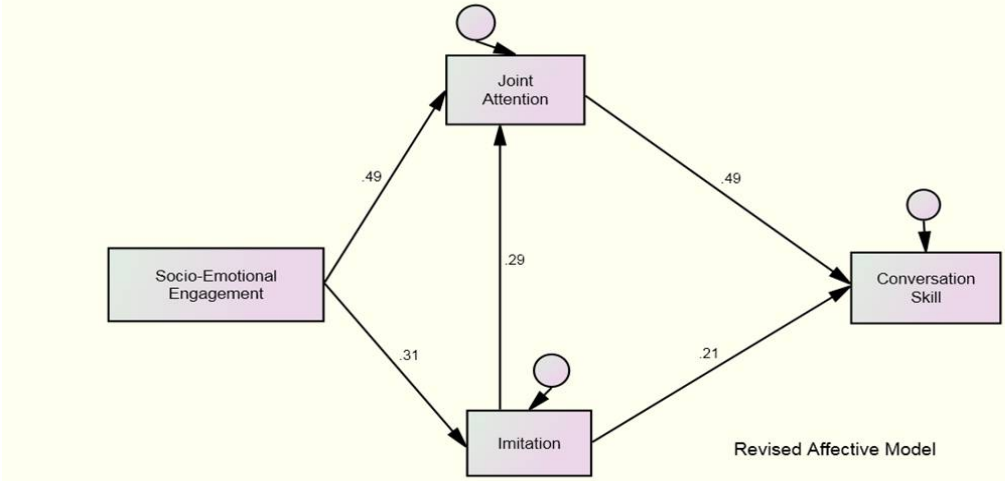

Figure 3. Standardized parameter estimates for the Revised Affective Model. All reported estimates are the maximum likelihood standardized point-estimates. All unstandardized point estimates were significant ($p < .05$).

Phases Two and Three

The findings from the first phase of the study provided support for the hypothesis, drawn from Racine and Carpendale's (2007a, 2007b) constructivist position and Trevarthen's argument (e.g., Trevarthen, 1979; Trevarthen & Hubley, 1978), that joint attention and imitation act as mediators of the relationship between socio-emotional engagement and conversation skill. Given that socio-emotional engagement is by nature a shared activity, a measure of maternal socio-emotional engagement was included in phases two and three of the study so as to also investigate the hypothesis that maternal socio-emotional engagement facilitates child socio-emotional engagement and the subsequent development of the shared practices of imitation, joint attention, and conversation skill. The central model tested was therefore the Revised Affective Model with the addition of a path from maternal to child socio-emotional engagement.

Method

Participants

The data reported here represent part of a larger ongoing longitudinal research project. The children were recruited via three primary schools spread across working class to upper middle class areas (none of these children had participated in phase 1 of the present study). In total,105 typically developing Australian children were tested, and completed questionnaires were received from the primary caregiver for 93 of these children. All 93 typically developing children (46 male) spoke English as their first language and they were aged between 46 and 76 months (M = 61.3 months, SD = 8.3 months).

Thirty children with SLI (26 males) aged between 48 and 74 months (M = 63.0 months, SD = 9.0 months) were recruited from a metropolitan Language Development Centre (LDC). In order to receive a place in the LDC, children must have a significant primary language disability in the presence of normal non-verbal intelligence and sound adaptive behaviour skills. The placement committee (including a School Psychologist and Speech Pathologist) assess eligibility on the basis of standardised cognitive assessments and speech pathology referral. In most cases, linguistic ability is assessed with the Clinical Evaluation of Language Fundamentals-Preschool (Semel, Wiig, & Secord, 1997) and non-verbal intelligence via the performance scale of the Wechsler Preschool and Primary Scale of Intelligence – Third Edition (Wechsler, 2002). To be considered for a place in the LDC, children's language performance must be 1 *SD* or more below age norms.

Measures

Children's Socio-Emotional Engagement, Joint Attention, Imitation, and Conversation Skill

The scales used in phase one were used as measures of children's socio-emotional engagement, joint attention, imitation, and conversation skill. To increase the sensitivity of the measures, the reporting scales were changed to 7-point scales ranging from never to always with a maximum possible score of 49 for the Conversation Skills Scale, 28 for the Socio-Emotional Engagement and Joint Attention scales, and 21 for the Imitation scale.

Nonverbal Ability

A measure of nonverbal ability was included for the purpose of matching the SLI group to a subgroup of the sample of typically developing children. The Fluid Reasoning composite score from the Leiter International Performance Scale-Revised

(Leiter-R; Roid & Miller, 1997) was used in this regard since it was not part of the psychometric testing performed by the LDC. The Fluid Reasoning composite score is calculated from age-adjusted scores on the Sequential Order and Repeated Patterns subtests and provides a measure of the child's nonverbal IQ.

Maternal Socio-Emotional Engagement

The close scale from Collins and Read's (1990) adult attachment scale was used as a measure of maternal socio-emotional engagement. The close scale contains six items that assess the degree to which individuals are comfortable being emotionally close to others and therefore the degree to which they are likely to emotionally engage with others. Participants rate how well each item describes them on a scale ranging from (1) not at all characteristic to (5) very characteristic, with a maximum possible score of 30. The close scale has been found to have good construct validity and acceptable internal and test-retest reliability (Collins & Read, 1990). With the present sample of mothers of typically developing children, the reliability of the close scale was acceptable (α = .76) with all six items loading positively (component loadings > .51) onto one component accounting for 48.71% of the variance.

Procedure

Consent forms and information sheets were sent to parents/guardians of all kindergarten and pre-primary children attending the three mainstream schools. Questionnaires were mailed to the primary caregivers who chose to participate and completed questionnaires were mailed directly back to the researcher. Children were individually administered the nonverbal ability test in a quiet room at the child's regular centre. The testing session lasted approximately 10 minutes.

Results

Maternal responses to individual items were scored such that higher scores reflected greater maternal socio-emotional engagement and child socio-emotional engagement, joint attention, imitation, and conversation skill.

Phase Two: Testing the Revised Affective Model in Another Sample of Typically Developing Children

Prior to analysis, the data for the main study variables (maternal socio-emotional engagement and child socio-emotional engagement, joint attention, imitation, conversation skill) were checked for multivariate outliers using Mahalanobis distance with $p < .001$ (critical value = 20.52), but none were found. Descriptive statistics for the study variables are presented in Table 3. Inspection of the correlations between the

measures revealed that the degree of multicollinearity between the predictor variables was acceptable (see Table 4).

Table 3

Mean and Standard Deviation of scores for phase two study variables

Variable	*M*	*SD*
Maternal Socio-Emotional Engagement	23.23	4.28
Child Socio-Emotional Engagement	22.94	3.00
Child Joint Attention	19.60	2.94
Child Imitation	13.82	2.99
Child Conversation Skill	40.92	6.16

$N = 93$

Table 4

Intercorrelations between phase two variables

Variable	1	2	3	4	5	6	7
1. Maternal S-E Engagement	--						
2. Child S-E Engagement	.31†	--					
3. Child Joint Attention	.28*	.40†	--				
4. Child Imitation	.40†	.37†	.30†	--			
5. Child Conversation Skill	.32†	.33†	.37†	.43†	--		
6. Child Gender	-.17	-.19	-.14	.06	.02	--	
7. Child Age in Months	-.02	.19	.16	.17	.13	.04	--

$^{*}p < .05$, $^{\dagger}p < .005$, $N = 93$

Determining Model Fit

As child chronological age and gender failed to correlate significantly with any of the main study variables (see Table 4) neither of these variables was included in the model as a control variable. In this sample, the Revised Affective Model (with the addition of maternal socio-emotional engagement) converged after five iterations with $\chi^2_{(1)} = 14.19$, $p = .007$ and IFI = .87, SRMR = .11. Examination of the standardized residual covariances for the Revised Affective Model revealed a value of 2.71 between maternal socio-emotional engagement and child imitation and the modification indices indicated that maternal socio-emotional engagement explained more variance in child imitation than vice versa. In the absence of any contrary theoretical argument it was

considered acceptable to add a regression path between maternal socio-emotional engagement and child imitation. This model converged after five iterations with $\chi^2_{(1)} = 4.14$, $p = .25$ and IFI = .99, SRMR = .05. Standardized parameter estimates for the Revised Affective Model are depicted in Figure 4. All of the factor loadings are in the expected direction. The unstandardized point estimate of the regression path between imitation and joint attention was not significant; all other unstandardized point estimates were significant ($p < .05$). Examination of the standardized residual covariances for the Revised Affective Model revealed none over the |2.0| mark. Because all indices were in the acceptable range, the Revised Affective Model was considered to have acceptable model fit. For this model $R^2 = .27$ ($p < .001$). Thus, the results of phase three provided further support for the hypothesised relationships among child socio-emotional engagement, joint attention, imitation, and conversation skill and also provided some support for the hypothesis that maternal socio-emotional engagement facilitates child socio-emotional engagement and the subsequent development of the shared practices of imitation, joint attention, and conversation skill.

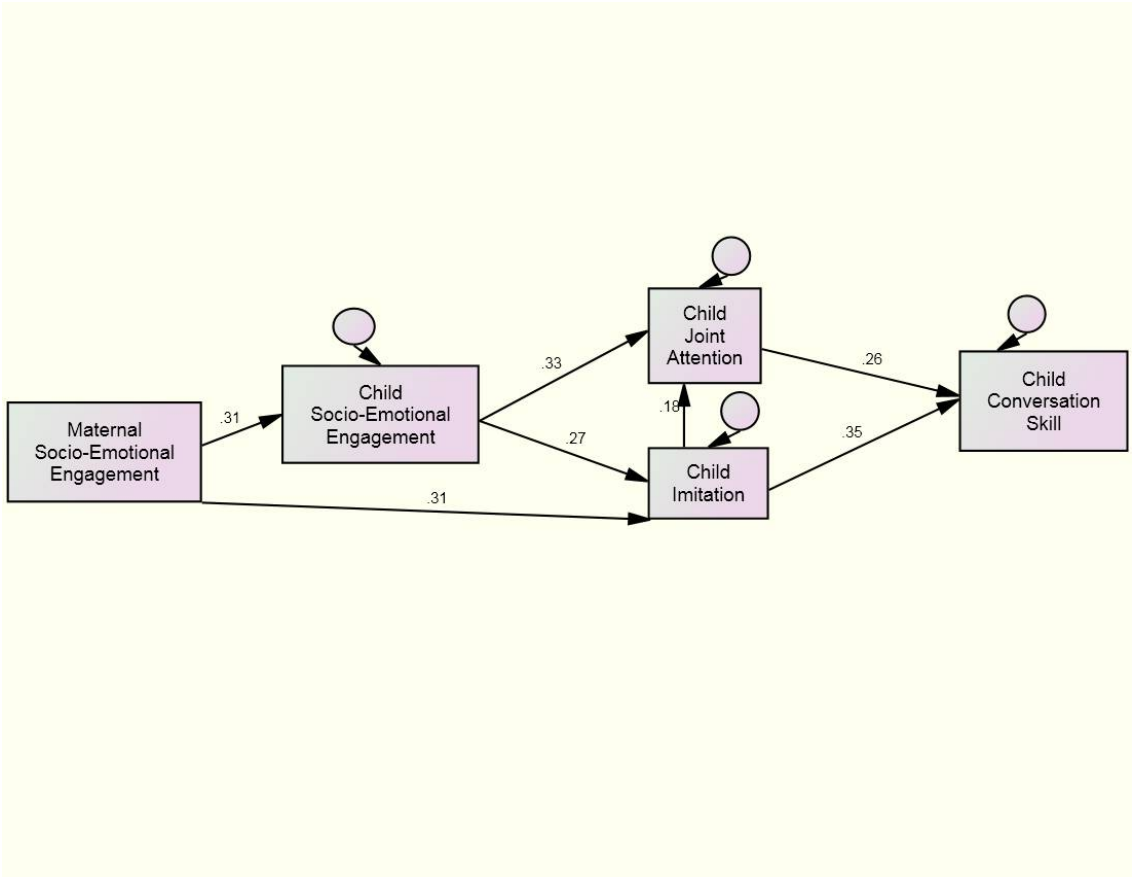

Figure 4. Standardized parameter estimates for the Revised Affective Model with the second sample (phase 2). All reported estimates are the maximum likelihood standardized point-estimates. The unstandardized point estimate of the regression path

between imitation and joint attention was not significant; all other unstandardized point estimates were significant ($p < .05$).

Phase Three: Group Comparison on Socio-Emotional Engagement, Joint Attention, Imitation, and Conversation Skill

Summary statistics for age, gender, and nonverbal ability for the group of children with SLI and a subgroup of the sample of typically developing children matched in terms of these variables are displayed in Table 5. These groups had the same gender distribution and did not differ in terms of age, $t(58) = 0.07$, $p = .94$, or nonverbal IQ, $t(58) = 0.12$, $p = .91$. For the two groups, summary statistics for maternal socio-emotional engagement and child socio-emotional engagement, joint attention, imitation, conversation skill are presented in Table 5. In addition to their previously reported (Farrant, et al., submitted) impaired conversation skill, $t(58) = 6.72$, $p < .001$, partial-$\eta^2 = .44$, this group of children with SLI were also found to have significantly lower socio-emotional engagement, $t(58) = 2.68$, $p = .010$, partial-$\eta^2 = .11$, joint attention, $t(58) = 5.22$, $p < .001$, partial-$\eta^2 = .32$, and imitation, $t(58) = 5.99$, $p < .001$, partial-$\eta^2 = .38$, relative to the children of typical development. Maternal socio-emotional engagement was also significantly lower for the SLI group, $t(58) = 2.25$, $p = .028$, partial-$\eta^2 = .08$.

Table 5

Matched Groups (phase 3) - Summary Statistics

	SLI ($n = 30$)		Typically Developing ($n = 30$)	
	M	*SD*	*M*	*SD*
Child's Age in Months	63.0	9.0	62.8	8.4
Nonverbal IQ	105.67	13.74	105.27	12.84
Gender (males:females)	26:4		26:4	
Maternal S-E Engagement	22.67	3.10	24.73	3.96
Child S-E Engagement	21.40	4.18	23.90	2.95
Child Joint Attention	15.40	4.54	20.53	2.91
Child Imitation	9.90	3.38	14.80	2.94
Child Conversation Skill	30.67	7.04	41.80	5.73

To further examine the observed deficits in the SLI group, a stepwise discriminant functions analysis was performed in which group membership was predicted by entering maternal socio-emotional engagement and child socio-emotional engagement, joint attention, and imitation scores. The analysis indicated that only child joint attention and imitation scores made significant contributions to accurately predicting group membership (chi square = 33.31, $p < .001$). Imitation entered at the first step with a Wilk's Lambda of .62 and joint attention, with a Wilk's Lambda of .56, entered at the second step. Utilisation of imitation and joint attention scores in the discriminant function correctly predicted 80.0% of membership in the SLI group and 80.0% of membership in the typically developing group. The strength of the relationship between the groups and the predictors was good, as indicated by a Wilk's Lambda of .56.

Thus, the phase three results provided further support for the hypothesised relationships among socio-emotional engagement, joint attention, imitation, and conversation skill, since performance in all of these domains was impaired for the SLI sample compared to the matched sample of typically developing children. Furthermore, the results of the discriminant functions analysis also indicated that, as predicted, SLI is characterised by deficits in imitation and joint attention.

Discussion

The overall aim of the current research was to further investigate the relationships among socio-emotional engagement, joint attention, and imitation with respect to the development of conversation skill in children. This was achieved by establishing a model of the relationships among socio-emotional engagement, joint attention, imitation, and conversation skill (phase one) and by testing this model with another group of typically developing children (phase two). The relationships among socio-emotional engagement, joint attention, imitation, and conversation skill were then investigated in a group of children with SLI who were matched to a group of typically developing children in terms of non-verbal ability, gender, and age (phase three).

Relationships among Socio-Emotional Engagement, Joint Attention, Imitation, and Conversation Skill in Typically Developing Children (Phases One and Two)

Consistent with previous research, the present study found significant relationships between socio-emotional engagement, joint attention, imitation, and conversation skill. The issues addressed in the present study include the question of whether socio-emotional engagement provides the foundation from which communication skills develop. The finding that the Affective Model provided a better

fit for the data than the Additive Model suggests that, consistent with Racine and Carpendale's (2007a, 2007b) constructivist argument, Trevarthen's position (e.g., Trevarthen, 1979; Trevarthen & Hubley, 1978), and Hobson's (2004) argument, socio-emotional engagement provides the foundation from which communication skills develop.

The results of phases two and three also provided some support for the hypothesis, drawn from Racine and Carpendale's (2007a, 2007b) constructivist position and Trevarthen's argument (e.g., Trevarthen, 1979; Trevarthen & Hubley, 1978), that maternal socio-emotional engagement facilitates child socio-emotional engagement and the subsequent development of the shared practices of imitation, joint attention, and conversation skill. The phase two results went further in suggesting that there may be a direct relationship between maternal socio-emotional engagement and child imitation**.** Also, as the regression path between imitation and joint attention was not significant in phase two of the present study, further research is required to assess the relationship between these skills.

Socio-Emotional Engagement, Joint Attention, Imitation, and Conversation Skill in Children with Specific Language Impairment (Phase Three)

The delayed conversation skill development found in the present sample of children with SLI has been reported previously (Farrant, et al., submitted). However, in phase three of the study, the children with SLI were also found to have significant deficits in socio-emotional engagement, joint attention, and imitation, relative to children of typical development. The results of the discriminant functions analysis, when taken in conjunction with the findings for the typically developing children, also indicate that, consistent with previous research, SLI is characterised by deficits in joint attention and imitation. The finding that maternal socio-emotional engagement was significantly lower for the SLI group is worthy of further investigation in future research. Indeed, consistent with several of the arguments presented in this paper, it could be that small deficits in parent-child socio-emotional engagement result in larger deficits in child imitation, joint attention, and conversation skill.

Theoretical Implications

The results of the present study are consistent with Racine and Carpendale's (2007a, 2007b) constructivist argument that shared practices such as joint attention are naturally embedded in socio-emotional engagement and that the acquisition of shared linguistic practice is grounded in the development of competence in shared forms of activity such as joint attention. The present results are also consistent with the argument

that socio-emotional engagement (primary intersubjectivity) facilitates the development of joint attention skills (secondary intersubjectivity; Mundy & Acra, 2006; Trevarthen & Aitken, 2001) and indicate that socio-emotional interactions may very well be precursors of joint attention behaviours (Gomez, et al., 1994), or that socio-emotional engagement puts the 'jointness' into joint attention (Hobson, 2005). Indeed, the present findings add to the plausibility of the proposal that by paying attention to social partners (by engaging socio-emotionally or being socially motivated; Dawson, et al., 2002) infants take the first step towards achieving joint attention (Hobson, 2005; Pruden, Hirsh-Pasek, & Golinkoff, 2006). That is, for the typically developing infant, socio-emotional engagement (being socially motivated) ensures that the relevant brain systems receive sufficient social input to develop joint attention skills (Mundy & Acra, 2006; Trevarthen & Aitken, 2001).

Retrospective Parent Reports and Directions for Future Research

By assessing socio-emotional engagement, joint attention, imitation, and conversation skill together, the present study avoided a major limitation inherent in much of the previous research in this area (which did not assess these factors together). As is evidenced by much of the research cited in this paper, parent reports of child joint attention (Baird, et al., 2000; Baron-Cohen, et al., 2000; Robins, et al., 2001), conversation/pragmatic skill (Bishop, 1998; Girolametto, 1997; Norbury, Nash, Baird, & Bishop, 2004), and other parent report child language measures such as the MacArthur CDI (Fenson, et al., 1993) are widely accepted and used in developmental research (e.g., Friend, 2001; Tomasello & Todd, 1983). Retrospective parent reports of child characteristics have also been found to be reliably related to earlier concurrent parent reports of the same characteristics (Bates, Pettit, Dodge, & Ridge, 1998) and earlier behavioural data (Werner, 2003) with some emerging evidence that retrospective parent reports of children's early communicative behaviours are reliably related to later child communication skills (Highman, Hennessey, Sherwood, & Leitao, 2008). Although the use of retrospective parent reports has proven to be effective in developmental research their use has so far been limited to studies of atypical development (e.g., Baird, et al., 2000; Robins, et al., 2001). Despite the possible limitations of a retrospective parent report design, the time consuming and expensive nature of long term longitudinal research means that the use of this type of data provides a viable starting point for investigating the kinds of long-term relationships that were the subject of the current study (Highman, et al., 2008).

Nevertheless, it is also important to note that, although a number of studies have reported significant relationships between parent reports and laboratory measures of child communication/language skills (e.g., Dale, 1991; Girolametto, 1997; Klee, et al., 1998; Miller, Sedey, & Miolo, 1995; Ring & Fenson, 2000), there is some evidence that parent reports of their child's language skills are systematically higher than laboratory measures (Harris & Chasin, 1999) and that this may be more pronounced during the early stages of language acquisition (Salerni, Assanelli, D'Odorico, & Rossi, 2007). However, as noted by Salerni et al. (2007), parent reports are likely to be more representative of their child's communication skills because parents have multiple opportunities to make naturalistic observations of their child in varied interactive contexts rather than the restricted 'snapshot' of child behaviour obtained in experimental settings or clinical evaluations (Bonifacio, et al., 2007).

Parent reports also avoid many of the difficulties associated with experimental or clinical assessment including the child's unfamiliarity with the environment and the examiner (Boudreau, 2005). They are also particularly useful for behaviours that are difficult to observe in formal settings (Diamond & Squires, 1993) such as socio-emotional engagement and conversation skill. Thus, although parent reports of child characteristics have some limitations, there are a number of reasons why they were well suited to the aims of the present study. However, future longitudinal research should attempt to confirm the mediated pathways identified in the present study by using experimental measures of socio-emotional engagement, joint attention, and imitation either in isolation or in combination with parental reports. Such research could also investigate the validity of parent reports of children's socio-emotional engagement and imitative behaviour and provide further evidence regarding the reliability of retrospective parent reports. Future research should also investigate the role that primary caregivers play in the development of conversation skill by further assessing how parental characteristics such as maternal socio-emotional engagement influence the mediated pathways identified in the present study.

Conclusions

The results of this study suggest that in typical development both joint attention and imitation mediate the relationship between socio-emotional engagement and conversation skill and that SLI is characterised by deficits in joint attention and imitation. These findings have important theoretical implications for theories of communication skills development. The present findings also have practical implications. Although previous research has shown that interventions that focus on

either joint attention, imitation, or socio-emotional engagement have beneficial effects on language/communication skills (Greenspan & Shanker, 2004; Ingersoll & Schreibman, 2006; Whalen, 2001), the present findings open the possibility of reducing later deficits in children with SLI via early identification of deficits in joint attention and imitation and appropriate intervention targeting both. Nevertheless, more research is required to further investigate the relationships between the affective and cognitive factors involved in the development of communication skills in typically developing children and in those with SLI.

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Appendix

Items in the Conversation Skill, Socio-Emotional Engagement, Joint Attention, and Imitation scales

Conversation Skill scale

1. My child's answers are connected to what I asked. *
2. My child's responses follow what I am talking about. *
3. When I ask my child a question to check what s/he means, s/he answers me. *
4. If I ask my child to repeat something I haven't understood, s/he does. *
5. My child's sounds/gestures/words match my topic of conversation with him/her. *
6. In a conversation, my child stays on the same topic for two or more turns. *
7. My child's answers are appropriate (e.g. does not give too much or too little information).

* Items from the Conversation Skills Rating Scale (Girolametto, 1997)

Socio-Emotional Engagement scale

1. In early childhood, how often did your child enjoy being hugged and cuddled by familiar people?
2. In early childhood, how often did your child raise her/his arms to request being picked up?
3. In early childhood, how often did your child show affection toward familiar people?
4. In early childhood, how often did your child enjoy simple interaction games like peekaboo?

Joint Attention scale

1. In early childhood, how often did your child look at things that you were looking at?
2. In early childhood, how often did your child show you things to engage your attention?
3. In early childhood, how often did your child follow other people's points when they pointed at objects? (e.g., you pointed at a toy across the room and your child looked at it)
4. Children often direct other people's attention by switching their eye contact between the person and an object and back again. How often did your child engage in this type of behaviour?

Imitation scale

1. In early childhood, how often did your child imitate people's facial expressions? (e.g., you made a face and your child imitated it)
2. Before s/he could talk, how often did your child imitate/copy the preverbal noises (vocal noises other than words) made by adults?
3. Before s/he could talk, how often did your child imitate/copy the words made by adults?

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Chapter 4

Language, Cognitive Flexibility, and Explicit False Belief: Longitudinal Analysis in Typical Development and Specific Language Impairment

Brad M. Farrant, Murray T. Maybery, and Janet Fletcher

Abstract

The hypothesis that language plays a role in theory of mind (ToM) development is supported by a number of lines of evidence (e.g., Lohmann & Tomasello, 2003). The current study sought to further investigate the relationships between maternal language input, memory for false sentential complements skill, cognitive flexibility, and the development of explicit false belief understanding in 91 English speaking typically developing children (*M* age = 61.3 months) and 30 children with specific language impairment (*M* age = 63.0 months). Concurrent and longitudinal findings converge in supporting a model in which maternal language input predicts the child's memory for false complements, which in turn predicts cognitive flexibility and explicit false belief understanding, with cognitive flexibility partially mediating the effect of memory for false complements on explicit false belief understanding.

Keywords: theory of mind, false belief, maternal input, linguistic determinism, sentential complements, language development, cognitive flexibility, cognitive complexity and control theory

Language, Cognitive Flexibility, and Explicit False Belief: Longitudinal Analysis in Typical Development and Specific Language Impairment

The ability to "read the minds" of other individuals requires a "theory of mind" (ToM) which involves the cognitive capacity to impute causal mental states in order to explain and predict behavior (Premack & Woodruff, 1978). A key and much studied milestone in the development of ToM is the understanding of false belief (Wellman & Liu, 2004). False belief understanding is measured using tasks that assess whether children recognize that people can have mistaken beliefs about reality and whether they can predict what an individual who has a false belief will do, say, or think (Peterson, 2003).

Language Acquisition and ToM Development

A number of different lines of evidence including research with typically developing children (e.g., Astington & Jenkins, 1999), profoundly deaf children (e.g., Peterson, 2003) and children with specific language impairment (e.g., Farrant, Fletcher, & Maybery, 2006) converge in supporting the hypothesis that language acquisition plays a role in ToM development (see Milligan, Astington, & Dack, 2007, for a recent meta-analysis). Correlational research with typically developing children supports the existence of a relationship between language acquisition and ToM development (e.g., Hughes & Dunn, 1997; Jenkins & Astington, 1996). However, this research does not provide definitive support for the hypothesis that language plays a role in ToM development because the results of correlational studies are equally consistent with causality in either direction. The findings of longitudinal research provide more convincing support for this hypothesis.

Typically developing children's language ability at 24 months, measured by a combination of maternal reports and experimenter assessment, significantly predicted their performance on false belief tasks at 48 months (Watson, Painter, & Bornstein, 2001). The relationship between children's vocabulary at 24 months and their false belief performance at 48 months remained significant after controlling for vocabulary and memory for sentences at 48 months, as did the relationship between grammatical complexity at 27 months and false belief performance at 48 months (Farrar & Maag, 2002). Astington and Jenkins (1999) found that three year-olds' language ability (semantic and syntactic) significantly predicted their ToM ability seven months later, whereas ToM ability at three did not predict language ability seven months later. Thus, the findings of correlational and longitudinal research with typically developing

children converge in supporting the hypothesis that language plays a role in ToM development. Further support for this hypothesis is provided by recent research that has investigated ToM development in children with specific language impairment.

Specific Language Impairment and ToM Development

A number of studies have found delayed ToM development in children with specific language impairment (SLI). Because SLI involves intact nonverbal ability in the face of delayed or disordered language development (Bishop, 1997), investigating ToM development in children with SLI offers an important way to gain insight into the relationship between language and ToM (Miller, 2004). Although accounts of SLI have traditionally focused on difficulties with phonology and syntax (Bishop, Chan, Adams, Hartley, & Weir, 2000), a number of subtypes including grammatical (e.g., van der Lely, Rosen, & McClelland, 1998) and pragmatic (e.g., Bishop, et al., 2000) language impairment have been proposed. However, the debate about SLI subtypes is ongoing and there is also some evidence that individual patterns of impairment change over the course of development (cf. Parisse & Maillart, 2009).

The findings of early ToM research were interpreted as demonstrating intact ToM in children with SLI (Leslie & Frith, 1988; Perner, Frith, Leslie, & Leekam, 1989; Ziatas, Durkin, & Pratt, 1998). However, as noted by Tucker (2004; see also Farrant et al., 2006), this earlier research used false belief tasks and involved children with SLI whose average chronological age was much older than the age at which false belief understanding typically develops (3-5 years).

Miller (2001, 2004) provided mixed evidence for delayed ToM development in children with SLI. Miller (2001) found that a group of 10 children with SLI (mean age of 66 months) performed significantly worse on false belief tasks involving think and pretend questions but not on false belief tasks involving look and show questions when compared to chronological age matched typically developing children. For example, the think question was "Where does Happy think the yo-yo is?" and the look question was "Where will Happy look for the yo-yo?" However, in a second study involving 15 children with SLI (mean age of 59 months) and a group of chronological age matched typically developing children, Miller (2004) failed to find any significant group differences on the false belief tasks. The four conditions in the Miller (2004) study were the think, pretend, and show conditions from the previous study (Miller, 2001) and a new less-verbal condition.

The results of Miller (2001) and Miller (2004) should be interpreted with care due to issues of limited power to detect group differences (due to the small sample sizes

used) and a focus on false belief tasks. However, the finding of impaired performance by children with SLI on false belief tasks involving think and pretend questions (Miller, 2001) is consistent with other recent research that has found delayed ToM development in children with SLI.

Farrant et al. (2006) found that a group of 20 children with SLI (mean age of 63 months) performed significantly worse on a battery of ToM tasks than a group of typically developing children matched for nonverbal ability, gender, and age. Similarly, using a battery of ToM tasks, Holmes (2002) found a significant delay in ToM acquisition for children with SLI aged 4-7 years and Tucker (2004) found that, in comparison with typically developing children, false belief understanding was delayed by 12-18 months in children with SLI aged between 5 and 6.5 years. Thus, when taken as a whole, the research to date supports the existence of delayed ToM development in children with SLI, which adds further support to the hypothesis that language plays a role in ToM development. However, theorists are divided as to the mechanism that underlies the relationship between language and ToM development.

Linguistic Determinism Theory

According to linguistic determinism theory, the mastery of syntactic structures called sentential complements, in which a sentence takes a full clause as its object complement (e.g., "Peter thinks Mummy's home"), facilitates ToM development (J. G. de Villiers & de Villiers, 2000). Under this theory, language acquisition plays a causal role in socio-cognitive development because the mastery of sentential complements provides the child with the representational power required to represent different points of view (J. G. de Villiers, 2005). That is, children must master the embedding of complements (e.g., "Mummy's home") under verbs (e.g., "thinks") before they will have the representational power required to understand perspectives that conflict with their own and/or with reality (J. G. de Villiers, 2005; J. G. de Villiers & de Villiers, 2000). It is important to note that this theory is consistent with Vygotsky's (1981) argument that language acquisition provides the individual with a set of psychological tools; this point is addressed further below.

Children are considered to have mastered the complement structure associated with a particular verb when they can hold the structure in memory and reliably make computations across it (J. G. de Villiers, 2005). For example, mastery of the complement structure associated with the mental state verb "think" can be assessed using a standard memory for false complements task such as:

The woman thought it was a spider.
But look, it was really hair.
What did the woman think it was?

A criticism of standard memory for false complements tasks is that they are actually akin to standard explicit false belief tasks (Low, in press). However, it should be noted that all that is required to pass standard memory for false complements tasks (such as the one above) is to remember and restate the false sentential complement, whereas in standard explicit false belief tasks the child is never explicitly told what the protagonist thinks and therefore must draw inferences in order to correctly predict the contents of the protagonist's false belief and/or predict the protagonist's behavior based on that false belief.

Support for de Villiers and de Villiers' (2000; J. G. de Villiers, 2005) linguistic determinism theory is provided by studies that have found that typically developing children as well as deaf children and children with SLI master false complement structures associated with mental or communication verbs before they pass false belief tasks and that training on sentential complements improves false belief performance (J. G. de Villiers & de Villiers, 2000; J. G. de Villiers & Pyers, 2002; P. A. de Villiers, 2005; P. A. de Villiers, Burns, & Pearson, 2003; Hale & Tager-Flusberg, 2003; Lohmann & Tomasello, 2003; Pyers, 2005; Schick, de Villiers, de Villiers, & Hoffmeister, 2007). On the other hand, the findings of a number of studies have been interpreted as evidence against de Villiers and de Villiers' (2000; J. G. de Villiers, 2005) linguistic determinism theory.

Cheung et al. (2004) and Cheung (2006) argued, based on findings with English- and Cantonese-speaking children, that mastery of sentential complements does not play a unique role in the development of false belief understanding once the effect of general language comprehension is taken into account. However, the tasks used by Cheung et al. (2004) and Cheung (2006) were more complicated than the standard memory for false complements tasks in terms of both the complexity of the story and what was required from the child in order to pass each task. The tasks used by Cheung et al. (2004) with English speaking children involved the main story character failing to realize what s/he had previously promised to do, and to pass each task the child had to report both the contents of the promise and the actual state of affairs. The tasks used by Cheung et al. (2004) with Cantonese speaking children involved the main story character failing to do what s/he had previously been asked to do, and to be scored as

correct the child had to report both the actual state of affairs and either the contents of a lie (say version) or what the main character said s/he wanted to do (want version). Similarly, in Study 1 by Cheung (2006), Cantonese speaking children were told stories in which the main character lies about achieving something that s/he had previously been asked to do, and in order to be scored as correct the child had to report both the contents of the lie and the actual state of affairs. Hence, although it should be noted that Cheung et al. (2004) and Cheung (2006) did not draw any strong conclusions against de Villiers and de Villiers' (2000; J. G. de Villiers, 2005) linguistic determinism theory, differences in the structure and complexity of the complements tasks that were used in these studies means that these findings should be interpreted with care.

Based on the results of their research with Cantonese speaking children, Tardif, So and Kaciroti (2007) argued that mastery of sentential complements does not play a unique role in the development of false belief understanding once the effects of general language skills and short term memory are taken into account. Using standard memory for false complements tasks, Tardif et al. found significant positive correlations between memory for false complements and false belief scores both concurrently (Study 1) and longitudinally over four time points approximately two months apart (Study 2). In the longitudinal analyses, general language skills and short term memory significantly predicted false belief scores after controlling for age and prior false belief performance whereas memory for false complements did not. Because languages such as Cantonese mark false belief differently than does English, Tardif et al. refrained from drawing strong conclusions against de Villiers and de Villiers' (2000; J. G. de Villiers, 2005) linguistic determinism theory and instead argued that the correlation between memory for false complements and false belief scores in Cantonese is likely to be a function of the combined effects of general language skills and short term memory. However, as noted by Tardif et al., Cantonese marks the distinction between beliefs that are true and those which are false via the use of different lexical items for false beliefs. Thus, in terms of Vygotsky's (1981) argument, it is possible that English and Cantonese provide the developing child with different psychological tools for the mastery of false belief understanding. This would also help explain Tardif et al.'s finding that children's memory for false complements did not significantly improve between time 2 and time 4 (using hierarchical linear modeling, changes in performance were modeled from time 2 to time 4) whereas their performance on false belief tasks did.

Perner, Sprung, Zauner and Haider (2003) found that German speaking children master false complements with respect to what someone else wants well before they

master these same structures with respect to what someone else thinks (and pass standard false belief tasks). Perner et al. interpreted their findings as indicating that mastery of sentential complements in and of itself is not enough to facilitate false belief understanding and that, therefore, their findings contributed evidence against de Villiers and de Villiers' (2000; J. G. de Villiers, 2005) linguistic determinism theory. Importantly however, in contrast to standard memory for false complements tasks, in Perner et al.'s testing of this structure in relation to what someone else thinks, the children were never explicitly told what the main story character thought and therefore had to infer it from what the main story character said. Perner et al.'s results are also completely consistent with the hypothesis that the mastery of sentential complements makes an independent and essential contribution to children's explicit false belief understanding (Schick, et al., 2007).

More recently with English speaking children, Low's (in press) findings supported the distinction between implicit and explicit false belief understanding and also indicated that the mastery of sentential complements plays a role in the development of children's explicit but not implicit false belief understanding. Using standard explicit false belief tasks and implicit false belief (eye gaze) tasks, across three studies Low found that, although there was no relationship between memory for false complements and implicit false belief performance, memory for false complements did significantly predict performance on standard explicit false belief tasks after controlling for children's age, vocabulary, non verbal ability, and implicit false belief scores.

In summary, although Low's (in press) findings suggest that the contribution of sentential complements mastery to the development of false belief understanding may be limited to explicit reasoning, the interpretation of other recent research findings that have been put forward as evidence against de Villiers and de Villiers' (2000; J. G. de Villiers, 2005) linguistic determinism theory is complicated by factors including differences in the structure and complexity of the complements tasks that were used and the possibility that different languages provide the developing child with different psychological tools for the mastery of false belief understanding. In particular, there is no evidence that English speaking children can pass standard explicit false belief tasks without first mastering the complement structure associated with the relevant verb. Thus, for English speaking children at least, the available evidence is completely consistent with the hypothesis that the mastery of sentential complements makes an independent and essential contribution to children's explicit false belief understanding (Schick, et al., 2007).

Cognitive Complexity and Control Theory

According to cognitive complexity and control theory, in either its original (CCC) or revised (CCC-r) form, ToM development relies on the development of cognitive flexibility in the form of flexible perspective taking (Frye, Zelazo, & Burack, 1998; Jacques & Zelazo, 2005; Zelazo, Muller, Frye, & Marcovitch, 2003). In particular, the embedding of one set of judgments (or rules) within another allows the ability to reason correctly in social situations by flexibly shifting between conflicting perspectives (Frye, et al., 1998). Language facilitates ToM development because labeling experiences allow them to become the object of consideration at a higher level of consciousness which facilitates the ability to reason from different cognitive perspectives (Jacques & Zelazo, 2005). In other words, language facilitates ToM development because the higher order rules that are required to flexibly shift between conflicting perspectives are formulated linguistically in potentially silent self-directed speech (linguistically mediated thought) (Zelazo, et al., 2003). CCC-r also acknowledges the role of parent-child interaction and parent's verbal scaffolding in the development of children's cognitive flexibility and ToM (Zelazo, et al., 2003). Thus, to rephrase in terms of Vygotsky's (1981) argument, language acquisition facilitates ToM development by providing a set of psychological tools that enable the developing child to flexibly shift between conflicting perspectives.

CCC and CCC-r (Frye, et al., 1998; Zelazo, et al., 2003) are supported by a number of studies that have found a correlation between performance on ToM tasks and performance on the dimension change card sort (DCCS) task (Zelazo, 2006) in both typically developing children and children with autism (Colvert, Custance, & Swettenham, 2002; Frye, et al., 1998; Frye, Zelazo, & Palfai, 1995; Lang & Perner, 2002; Muller, Zelazo, & Imrisek, 2005; Perner, Lang, & Kloo, 2002). The DCCS task assesses the capacity to flexibly shift between two sorting rules (based on color and shape), thereby purportedly requiring the representation of a hierarchy of rules.

Mastery of Sentential Complements, Cognitive Flexibility, and Explicit False Belief

P. A. de Villiers (2005) provided some preliminary findings indicating that both cognitive flexibility and the mastery of sentential complements facilitate explicit false belief understanding. More recently Low (in press) found that both memory for false complements and cognitive flexibility (as measured by the DCCS task) concurrently predicted English speaking children's scores on standard explicit false belief tasks after controlling for children's age, vocabulary, non verbal ability, and implicit false belief scores.

A central hypothesis of CCC-r theory (Zelazo, et al., 2003), is that language facilitates ToM development because the higher order rules that are required to flexibly shift between conflicting perspectives are formulated linguistically in potentially silent self-directed speech (linguistically mediated thought). Based on his findings, Low (in press) extended this hypothesis by arguing that linguistically mediated thought involving complex language (e.g., sentential complements) is partly responsible for advances in cognitive flexibility. Thus, Low's findings suggest an additional hypothesis that the mastery of sentential complements facilitates the development of both cognitive flexibility and explicit false belief understanding. This hypothesis is also consistent with Racine and Carpendale's (2007a, 2007b) constructivist position. Racine and Carpendale argue that reflective understanding of psychological concepts (the kind of understanding required for standard explicit false belief tasks) necessarily involves language because this form of understanding occurs via the use of shared public concepts and that the only way to master the use of these shared public concepts is via shared linguistic practice (e.g., mastery of sentential complements).

Consistent with Low's (in press) findings, Racine and Carpendale also argued that although there are levels of understanding that do not require shared linguistic practice (they emerge from other forms of shared practice), true mastery, or reflective understanding, of psychological concepts is intertwined with learning the shared practice of being able to talk about them (Racine & Carpendale, 2007a, 2007b; Racine, Carpendale, & Turnbull, 2007). Thus, Racine and Carpendale's constructivist position is also consistent with CCC-r theory's acknowledgement of the role of parent-child interaction and parent's verbal scaffolding in the development of children's cognitive flexibility and ToM (Zelazo, et al., 2003). Both of these positions are supported by Taumoepeau and Ruffman's (2008) finding that maternal references to others' thoughts and knowledge when children were 24 months was the most consistent predictor of children's mental state language at 33 months. Further evidence is provided by research that has investigated the relationship between maternal language input and children's ToM development.

Maternal Language Input and ToM Development

Two related lines of research provide support for the hypothesis that maternal language input plays an important role in the development of children's ToM. Maternal mind-mindedness refers to the tendency of mothers to think of and describe their young child in terms of their mental attributes and to act towards their child as an individual with a mind (Meins & Fernyhough, 1999). In contrast, maternal mental state talk more

specifically refers to the proclivity of mothers to talk about mental states and use mentalistic language when talking to their young child (Peterson & Slaughter, 2003).

A number of studies have found that the degree of maternal mind-mindedness when the child is young (e.g., when the child is 20 months or 3 years of age) is predictive of the child's later ToM development (e.g., when the child is 4 or 5 years of age) (Meins & Fernyhough, 1999; Meins, Fernyhough, Russell, & Clark-Carter, 1998; Meins, et al., 2003; Meins, et al., 2002; Ruffman, Slade, Devitt, & Crowe, 2006). Several correlational studies using either questionnaire or observational methods have found a relationship between proclivity of mothers to talk about mental states and use mentalistic language and their child's ToM development (Adrian, Clemente, Villanueva, & Rieffe, 2005; Peterson & Slaughter, 2003; Ruffman, Slade, & Crowe, 2002). Longitudinal research by Ruffman et al. (2002) found that maternal use of mentalistic language when generating stories for their 3 year old child predicted the child's ToM development at age 4 whereas children's earlier ToM ability did not predict later maternal use of mentalistic language, indicating that maternal use of mentalistic language facilitates children's ToM development and not vice versa.

Thus, there is evidence supporting a relationship between maternal language input and children's subsequent ToM development. These findings, when combined with evidence supporting a relationship between maternal use of mental state language and children's subsequent mental state language (e.g., Taumoepeau & Ruffman, 2008), provide support for the emphasis that both CCC-r theory (Zelazo, et al., 2003) and Racine and Carpendale's (2007a, 2007b) constructivist position place on maternal language input and children's subsequent language skills in the development of children's ToM. These data when combined with the hypothesis that the mastery of sentential complements facilitates the development of both cognitive flexibility and explicit false belief understanding suggest a further hypothesis that children's mastery of sentential complements mediates the relationship between maternal language input and the development of children's explicit false belief understanding.

The Present Study

The aim of the current research was to further investigate relationships between language acquisition and ToM development in human ontogeny. This was achieved by examining the relationships between maternal language input and children's memory for false complements, cognitive flexibility, and false belief understanding both concurrently (phase one) and longitudinally (phase three) in typically developing

children, and by comparing a group of children with SLI with a sub-group of typically developing children matched for non-verbal ability, gender, and age (phase two).

In the first phase of the study, based on CCC-r theory (Zelazo, et al., 2003) and Racine and Carpendale's (2007a, 2007b) constructivist position, it was hypothesized that the proclivity of mothers to use mental state language would predict their child's sentential complements skill, which would in turn predict the child's cognitive flexibility. Further, based on the findings of P. A. de Villiers (2005) and Low (in press), it was also hypothesized that both sentential complements skill and cognitive flexibility would predict explicit false belief understanding. Following from these two sets of hypothesized relationships, it was further expected that cognitive flexibility would partially mediate the relationship between sentential complements skill and explicit false belief understanding (see Figure 1).

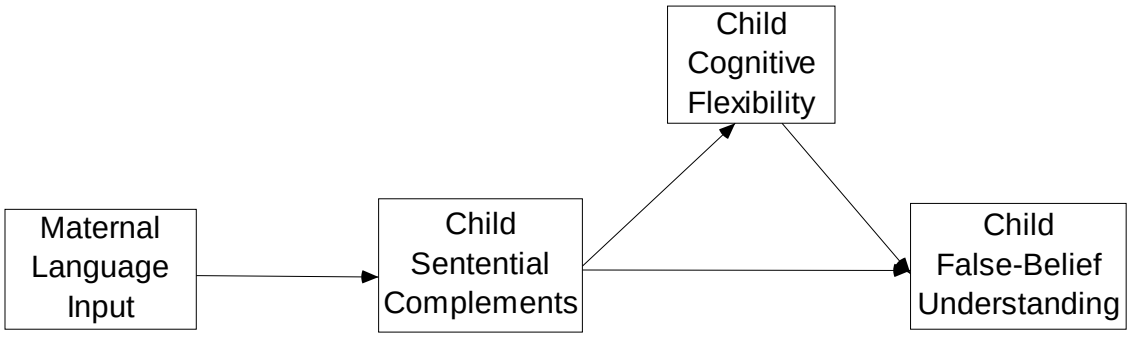

Figure 1. Hypothesized model of the relationships between maternal language input, memory for false complements skill, cognitive flexibility, and explicit false belief.

In the second phase of the study, consistent with CCC-r theory (Zelazo, et al., 2003), Racine and Carpendale's (2007a, 2007b) constructivist position and de Villiers and de Villiers' (2000; J. G. de Villiers, 2005) linguistic determinism theory and previous research demonstrating delayed ToM development in children with SLI, it was predicted that the children with SLI would have significantly lower sentential complements, cognitive flexibility and explicit false belief scores, relative to children of typical development.

In relation to the longitudinal analyses for the typically developing children (phase three), consistent with the hypothesis that sentential complements skill has both a direct effect, and an indirect effect (mediated through advances in cognitive flexibility), on explicit false belief understanding, the following hypotheses were made. First, it was hypothesized that first year (Y1) sentential complements and cognitive flexibility scores would predict second year (Y2) explicit false belief scores after controlling for Y1

explicit false belief scores such that Y1 cognitive flexibility scores would be a significant predictor even when additionally controlling for Y1 sentential complements scores. Second, it was hypothesized that Y1 sentential complements would predict Y2 cognitive flexibility after controlling for Y1 cognitive flexibility and that Y1 explicit false belief scores would not add significantly to the prediction of Y2 cognitive flexibility. The third hypothesis was that neither Y1 cognitive flexibility or explicit false belief scores would predict Y2 sentential complements after controlling for Y1 sentential complements.

Method

Participants

The data reported here represent part of a larger ongoing longitudinal research project conducted by the first author. The children were recruited via three primary schools spread across working class to upper middle class areas. In total 105 typically developing Australian children were tested, and completed questionnaires were received from the primary caregiver for 91 of these children (81 Caucasian, 10 Asian). All 91 typically developing children (46 male) spoke English as their first language and they were aged between 46 and 76 months (M = 61.3 months, SD = 8.3 months) at the commencement of the study. Thirty children with SLI (26 males) aged between 48 and 74 months (M = 63.0 months, SD = 9.0 months) were recruited from a metropolitan Language Development Centre (LDC). In order to receive a place in the LDC, children must have a significant primary language disability in the presence of normal non-verbal intelligence and sound adaptive behavior skills. The placement committee (comprised of the LDC Principal, School Psychologist and Speech Pathologist) assess eligibility on the basis of standardized cognitive assessments, speech pathology referral, and information from teachers and carers. In most cases, linguistic ability is assessed with the Clinical Evaluation of Language Fundamentals-Preschool (Semel, Wiig, & Secord, 1997) and non-verbal intelligence via the performance scale of the Wechsler Preschool and Primary Scale of Intelligence – Third Edition (Wechsler, 2002).

Measures

Explicit False Belief

Children's explicit false belief ability was measured using two sets of tasks each including one of the versions of Wellman and Liu's (2004) contents false belief task used by Farrant et al. (2006) and one of Sullivan and Tager-Flusberg's (1999) second order false belief tasks (see Appendix A). For the present study, the two versions of Wellman and Liu's (2004) contents false belief task were extended to include an own

false belief question. Each of the four explicit false belief questions was scored as 1 (passed) or 0 (failed), and to pass each false belief question the child had to answer the target and relevant memory and/or control questions correctly. Item scores were summed to give total explicit false belief scores with a maximum of 4.

Memory for False Complements

Two memory for false complements task sets were used. Each involved modified versions of items from de Villier's Complement Comprehension battery (J. G. de Villiers & Pyers, 2002) along with new items devised specifically for the present study. Items were selected to keep the wording as consistent as possible across the "thought" and "said" items and between the two tasks sets. Each task set contained two "thought" and two "said" items (see Appendix B). Each item was presented along with a set of two pictures. For both the thought and said items the child had to answer with the relevant noun or verb (e.g., "spider") in order to be scored as correct. Each memory for false complements item was scored as 1 (passed) or 0 (failed). Item scores were summed to give total memory for false complements scores with a maximum possible score of 4.

Cognitive Flexibility

Cognitive flexibility was assessed using the border version of the dimension change card sort (DCCS) task (Zelazo, 2006). The DCCS task requires children to sort a series of bivalent multidimensional test cards. In the pre-switch phase children sort these cards according to one dimension (e.g., color), in the post-switch phase they then sort them according to the other dimension (e.g., shape), and those children who pass the post-switch phase also complete the border phase which involves alternating between sorting on each dimension depending on whether the card has a border or not. The children sorted six cards in each of the pre- and post-switch phases and had to correctly sort five or more in order to pass each of these phases and move on to the next phase. Twelve cards were sorted in the border phase and children had to correctly sort 9 or more in order to pass this phase. Following Zelazo (2006), each child's performance was scored as 0 (failed pre-switch phase), 1 (passed pre- but failed post-switch phase), 2 (passed pre- and post-switch, but failed the border phase) or 3 (passed all phases).

Maternal Language Input

Maternal language input was assessed using Peterson and Slaughter's (2003) Maternal Mental State Input Inventory (MMSII). The MMSII involves mothers ranking four possible responses to each of 12 vignettes involving an everyday interaction between a protagonist mother and a four year old child. In previous research, each of the

possible response options (elaborated mental state, non-elaborated mental state, elaborated non-mental state, non-elaborated non-mental state) has demonstrated acceptable internal reliability (Cronbach's alphas ranging between 0.61 and 0.72) across the 12 vignettes (Peterson & Slaughter, 2003). See Appendix C for an example of one of the vignettes and the four associated response options.

For each of the 12 vignettes, mothers rank the four possible responses giving a 1 to their most preferred choice through to a 4 for their least preferred choice. In the present study the elaborated mental state scale score was used as a measure of the proclivity of mothers to talk about mental states and use mentalistic language with their child. Following Peterson and Slaughter (2003), mother's rankings for the elaborated mental state option of each vignette in the MMSII were transformed into scores that ranged from 4 (for most preferred choice) to 1 (for least preferred choice) giving a maximum possible score of 48 across the 12 vignettes. The Cronbach's alpha for the elaborated mental state option in the present sample (0.53) was lower than those found by Peterson and Slaughter for the elaborated mental state scale in their two samples (both 0.72). However, inspection of the data did not reveal any systematic reason for this.

Nonverbal Ability

The Fluid Reasoning composite score from the Leiter International Performance Scale-Revised (Roid & Miller, 1997) was used as a measure of nonverbal ability since it was not part of the psychometric testing performed by the LDC. The Fluid Reasoning composite score is calculated from age-adjusted scores on the Sequential Order and Repeated Patterns subtests and provides a measure of the child's nonverbal IQ.

Procedure

Consent forms and information sheets were sent to parents/guardians of all kindergarten and pre-primary children attending the three mainstream schools. Questionnaires were mailed to the primary caregivers who chose to participate and completed questionnaires were mailed directly back to the researcher. Children were individually tested in a quiet room at the child's regular center. In the first year of the study, for both groups of children, each of the three testing sessions lasted approximately 15 minutes, and the maximum period between the first and final session for each participant was three weeks. Similarly, for the typically developing children, in the second year of the study (approximately one year later), each of the two testing sessions lasted approximately 15 minutes, and the maximum period between the first and final session was three weeks. In the first year, the false belief tasks, memory for

false complements tasks and the DCCS task were completed in separate sessions (the nonverbal ability test was completed after the DCCS task in the same session). The sessions were completed in a counterbalanced order and the within-session order of presentation of the individual tasks was also counterbalanced. Approximately half of the children completed one version of the memory for false complements task set in the first year and the other half completed the other version. Similarly, approximately half of the children received one of the false belief task sets in the first year and the other half received the other. Each typically developing child received the alternate versions of the memory for false complements task set and the false belief task set in the second year.

Results

For the Y1 data for the typically developing children, total sentential complements scores (maximum possible score of 4) were not significantly different between the two task sets, t (89) = 1.30, p = .20. Therefore, the results were collapsed across the two versions of the memory for false complements task set. Similarly, for the typically developing children, the Y1 total false belief scores (maximum possible score of 4) were not significantly different between the two task sets, t (89) = 1.32, p = .19. Therefore, the results were collapsed across the two versions of the false belief task set.

Phase One: Year One Data for the Typically Developing Children

Inspection of the distribution for each variable (maternal language input, sentential complements score, total false belief score, cognitive flexibility (DCCS) score) revealed that the distributions were approximately normal. Prior to analysis, the data for the main study variables (those listed above plus chronological age and nonverbal IQ) were checked for multivariate outliers using Mahalanobis distance with $p < .001$ (critical value = 22.46) and one was found and removed. The remaining 90 typically developing children (44 male; 80 Caucasian, 10 Asian) were aged between 46 and 76 months (M = 61.4 months, SD = 8.3 months) at the commencement of the study. Descriptive statistics for the Y1 study variables for these 90 typically developing children are presented in Table 1. Inspection of the correlations between the measures revealed that the degree of multicollinearity between the predictor variables was acceptable (see Table 2).

Table 1

Means and Standard Deviations of Scores for Year 1 Study Variables for Typically Developing Children

Variable	*M*	*SD*
Maternal Language Input (max. score 48)	29.96	4.84
Sentential Complements (max. score 4)	2.82	1.44
Cognitive Flexibility (DCCS, max. score 3)	1.64	0.53
False Belief (max. score 4)	1.36	0.92
Nonverbal IQ	106.22	13.07

$N = 90$

Table 2

Intercorrelations between Year 1 Variables for Typically Developing Children

Variable	1	2	3	4	5	6
1. Maternal Language Input	--					
2. Sentential Complements	.24*	--				
3. Cognitive Flexibility (DCCS)	.24*	.45†	--			
4. False Belief	.20*	.57†	.43†	--		
5. Child's Age in Months	.14	.43†	.36†	.38†	--	
6. Nonverbal IQ	.13	.20*	.24*	.12	-.16	--

*$p < .05$, †$p < .005$, $N = 90$

Data analytic strategy

The hypothesized model was tested according to the conventional method for testing such a model within a structural equation model (SEM) framework (Bollen, 1989; Gignac, 2006). SEM was selected over traditional partial correlation and/or multiple regression analyses because SEM allows multiple mediated pathways to be tested in the same analysis and because SEM also provides goodness of fit statistics. Because of the relatively small sample size, a two index strategy (Hu & Bentler, 1999) involving the Incremental Fit Index (IFI; an incremental close-fit index) and the Standardized Root Mean-square Residual (SRMR; an absolute close-fit index) was used to evaluate model fit (Gignac, 2006). In conjunction with 95% of normalized residuals being less than |2.0|, IFI values of ≥ .95 and SRMR values of ≤ .08 were considered indicative of a well-fitting model (Gignac, 2006). Maximum likelihood estimation was used as the basis for all SEM analyses.

The following precautions were taken to control for the possibility that any of the observed findings were a result of age-related variance and/or nonverbal ability. Correlation analyses were conducted including chronological age and nonverbal IQ and where either variable was found to be significantly correlated with the dependent variable (false belief scores) it was included in the model as a control variable.

Evaluating Model Fit

As chronological age correlated significantly with the dependent variable (false belief scores; see Table 2) it was included in the model as a control variable whereas because nonverbal IQ did not correlate significantly with false belief scores it was not included as a control variable. The hypothesized model converged after five iterations with $\chi^2_{(3)} = 3.851$, $p = .278$ and IFI = .990, SRMR = .066. (The hypothesized model was also examined with the addition of a regression path between maternal language input and cognitive flexibility; however this factor loading was not significant). All of the factor loadings were in the expected direction. The unstandardized point estimate of the regression path between chronological age and false belief was not significant; all other unstandardized point estimates were significant ($p < .05$). Examination of the standardized residual covariances revealed no values over the |2.0| mark. Standardized parameter estimates for the hypothesized model are depicted in Figure 2. Therefore, because all indices were in the acceptable range, the hypothesized model was considered to have acceptable model fit. For the hypothesized model, $R^2 = .37$ ($p < .001$). Thus, the phase one results supported the hypothesized relationships between language, cognitive flexibility and explicit false belief. The hypothesized relationships were further examined in phase two of the study.

Phase Two: Group Comparison on the Main Study Variables

Summary statistics for age, gender, and nonverbal ability for the group of children with SLI and a sub-group of the phase one sample of typically developing children matched in terms of these variables are displayed in Table 3. These groups had the same gender distribution and did not differ in terms of age, $t(58) = 0.07$, $p = .94$, or nonverbal IQ, $t(58) = 0.12$, $p = .91$. For the two groups, summary statistics for each of the Y1 study variables are displayed in Table 3 (complete maternal report data were available for 29 of the matched pairs).

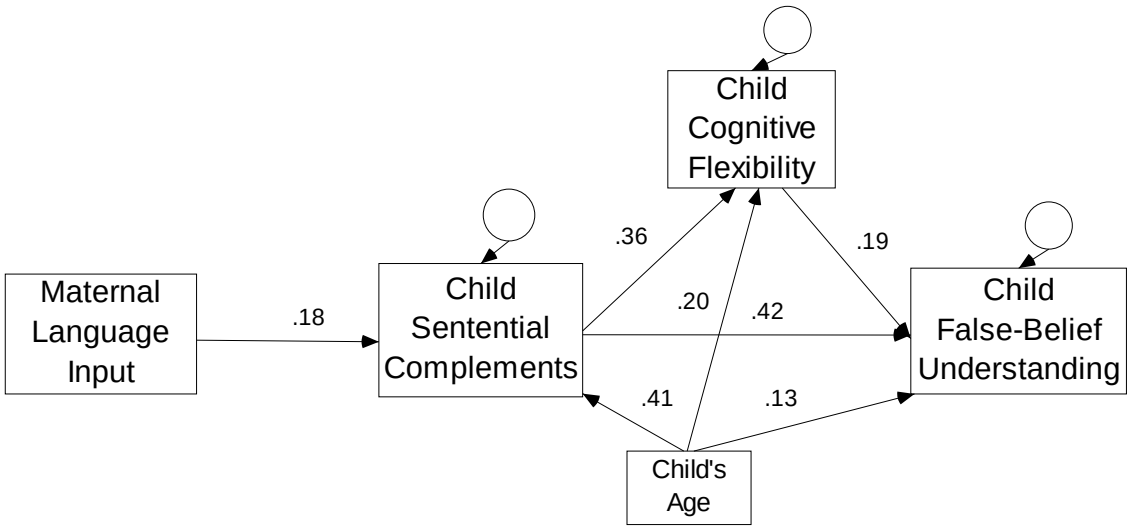

Figure 2. Standardized parameter estimates for the hypothesized model. All reported estimates are the maximum likelihood standardized point-estimates. All unstandardized point estimates were significant ($p < .05$).

Table 3

Matched Groups - Summary Statistics for Year 1 Variables

	SLI ($n = 30$)		Typically Developing ($n = 30$)	
	M	*SD*	*M*	*SD*
Child's Age in Months [a]	63.0	9.0	62.8	8.4
Nonverbal IQ [a]	105.67	13.74	105.27	12.84
Gender (males:females)	26:4		26:4	
Sentential Complements [a]	2.70	1.49	3.47	0.78
Cognitive Flexibility (DCCS) [a]	1.30	0.47	1.67	0.55
False Belief [a]	0.73	0.91	1.40	0.81
Maternal Language Input [b]	28.52	5.89	30.24	5.42

[a] $n = 30$ matched pairs, [b] $n = 29$ matched pairs

The typically developing group performed significantly better on the sentential complements, $t(58) = 2.50$, $p = .015$, partial-$\eta^2 = .10$, cognitive flexibility, $t(58) = 2.80$, $p = .007$, partial-$\eta^2 = .12$, and false belief tasks, $t(58) = 3.00$, $p = .004$, partial-$\eta^2 = .13$. However, maternal input did not differ significantly between the two groups, $t(56) = 1.16$, $p = .251$. Thus, the phase two results provide further support for the hypothesized

relationships between sentential complements, cognitive flexibility and explicit false belief, since performance in each of these domains was impaired for the SLI sample compared to the matched sample of typically developing children. These relationships were then examined longitudinally in phase three of the study.

Phase Three: Longitudinal Analyses for the Typically Developing Children

Complete sets of the relevant longitudinal data were available for 79 (38 male) of the typically developing children (71 Caucasian, 8 Asian) aged between 46 and 76 months (M = 61.3 months, SD = 8.4 months) at Y1 and between 58 and 89 months (M = 73.7 months, SD = 8.4 months) at Y2. Prior to analysis, the data for the main study variables (Y1 chronological age, Y1 nonverbal IQ and the Y1 and Y2 scores for each of the sentential complements, cognitive flexibility (DCCS), and false belief tasks) were checked for multivariate outliers using Mahalanobis distance with $p < .001$ (critical value = 26.13) but none were found. Descriptive statistics for the Y1 and Y2 study variables are presented in Table 4. The typically developing children improved significantly from Y1 to Y2 on the sentential complements, $t(78) = 6.25$, $p < .001$, partial-$\eta^2 = .33$, cognitive flexibility, $t(78) = 7.45$, $p < .001$, partial-$\eta^2 = .42$, and false belief tasks, $t(78) = 4.80$, $p < .001$, partial-$\eta^2 = .23$.

Table 4

Means and Standard Deviations of Scores for Year 1 and Year 2 Study Variables for Typically Developing Children

Variable	Year 1		Year 2	
	M	*SD*	*M*	*SD*
Sentential Complements	2.86	1.42	3.84	0.52
Cognitive Flexibility (DCCS)	1.63	0.54	2.11	0.55
False Belief	1.38	0.94	1.91	0.80
Nonverbal IQ	106.96	13.26		

$N = 79$

Inspection of the correlations between the measures revealed that the degree of multicollinearity between the predictor variables was acceptable (see Table 5). As nonverbal IQ did not correlate significantly with any of the Y2 dependent variables (see Table 5) it was not included in the regression analyses as a control variable. Because chronological age correlated significantly with only one out of the three Y2 dependent

variables (Y2 cognitive flexibility; see Table 5) it was only included as a control variable in the regression analysis predicting Y2 cognitive flexibility.

Table 5

Intercorrelations between Year 1 and Year 2 Variables for Typically Developing Children

Variable	1	2	3	4	5	6	7	8
1. Child's Age in Months (Y1)	--							
2. Y1 Sentential Complements	.46†	--						
3. Y1 Cognitive Flexibility	.37†	.45†	--					
4. Y1 False Belief	.43†	.59†	.46†	--				
5. Y2 Sentential Complements	.14	.25*	.20	.29*	--			
6. Y2 Cognitive Flexibility	.34†	.40†	.45†	.33†	.02	--		
7. Y2 False Belief	.19	.38†	.46†	.37†	.27*	.22*	--	
8. Nonverbal IQ (Y1)	-.17	.15	.20	.13	.05	.03	.06	--

$^{*}p < .05$, $^{\dagger}p < .005$, $N = 79$

The hypothesized relationships between sentential complements, cognitive flexibility, and explicit false belief were further assessed via a series of hierarchical regressions. In the first hierarchical regression predicting Y2 false belief scores, after controlling for Y1 false belief scores at the first step, as hypothesized, Y1 sentential complements was a (marginally, $p = .05$) significant predictor at the second step and Y1 cognitive flexibility was a significant predictor at the third step (see Table 6).

In the second hierarchical regression predicting Y2 cognitive flexibility scores, contrary to the hypothesis, after controlling for chronological age and Y1 cognitive flexibility scores at the first step, Y1 sentential complements was not a significant predictor at the second step, but, as hypothesized, Y1 false belief scores failed to add significantly to the prediction when entered at the third step (see Table 7). Because chronological age failed to significantly predict Y2 cognitive flexibility scores even at the first step in the previous analysis (see Table 7), the hierarchical regression predicting Y2 cognitive flexibility scores was re-run without the inclusion of chronological age as a control variable. In this analysis, after controlling for Y1 cognitive flexibility scores at the first step, as hypothesized, Y1 sentential complements was a significant predictor at the second step and Y1 false belief scores failed to add significantly to the prediction

when entered at the third step (see Table 7). In the final hierarchical regression, after controlling for Y1 sentential complements at the first step, as hypothesized, neither Y1 cognitive flexibility nor Y1 false belief scores was a significant predictor of Y2 sentential complements scores at the second step (see Table 8).

Table 6

Summary of Hierarchical Regression Analysis for Variables Predicting Year 2 False Belief

Variable	*b*	*SE* (*b*)	*β*	*p*	Squared part correlation	ΔR^2
Step 1						.14*
Y1 False Belief	.32	.09	.37	<.01	.14	
Step 2						.04†
Y1 False Belief	.19	.11	.22	.09	.03	
Y1 Sentential Complements	.14	.07	.25	.05	.04	
Step 3						.08*
Y1 False Belief	.10	.11	.12	.34	.01	
Y1 Sentential Complements	.09	.07	.16	.21	.02	
Y1 Cognitive Flexibility	.50	.17	.33	<.01	.08	

*$p < .05$, †$p = .05$, $N = 79$

Table 7

Summary of Hierarchical Regression Analysis for Variables Predicting Year 2 Cognitive Flexibility

Variable	*b*	*SE* (*b*)	*β*	*p*	Squared part correlation	ΔR^2
Regression 1						
Step 1						.23*
Child's Age in Months (Y1)	.01	.01	.20	.07	.03	
Y1 Cognitive Flexibility	.38	.11	.37	<.01	.12	
Step 2						.03
Child's Age in Months (Y1)	.01	.01	.13	.24	.01	
Y1 Cognitive Flexibility	.32	.12	.31	<.01	.07	
Y1 Sentential Complements	.08	.05	.19	.11	.03	
Step 3						.00
Child's Age in Months (Y1)	.01	.01	.13	.28	.01	
Y1 Cognitive Flexibility	.31	.12	.30	.01	.06	
Y1 Sentential Complements	.07	.05	.18	.18	.02	
Y1 False Belief	.02	.08	.04	.78	.00	
Regression 2						
Step 1						.20*
Y1 Cognitive Flexibility	.46	.11	.45	<.01	.20	
Step 2						.05*
Y1 Cognitive Flexibility	.35	.12	.34	<.01	.09	
Y1 Sentential Complements	.10	.04	.24	.03	.05	
Step 3						.00
Y1 Cognitive Flexibility	.33	.12	.32	<.01	.08	
Y1 Sentential Complements	.08	.05	.21	.10	.03	
Y1 False Belief	.04	.08	.06	.63	.00	

*$p < .05$, $N = 79$

Table 8

Summary of Hierarchical Regression Analysis for Variables Predicting Year 2 Sentential Complements

Variable	*b*	*SE* (*b*)	*β*	*p*	Squared part correlation	ΔR^2
Step 1						.06*
Y1 Sentential Complements	.09	.04	.25	.03	.06	
Step 2						.03
Y1 Sentential Complements	.04	.05	.10	.47	.01	
Y1 Cognitive Flexibility	.05	.12	.06	.67	.00	
Y1 False Belief	.11	.08	.20	.15	.02	

*$p < .05$, $N = 79$

Discussion

The present study sought to clarify the relationships that have been found between language and explicit false belief understanding by further investigating the relationships between maternal language input, sentential complements, cognitive flexibility, and the development of explicit false belief understanding. This was achieved by analyzing these relationships both concurrently (phase one) and longitudinally (phase three) in typically developing children and by comparing a group of children with SLI with a sub-group of typically developing children matched for non-verbal ability, gender, and age (phase two).

Concurrent and Longitudinal Relationships between Language and Explicit False Belief Understanding in Typically Developing Children (Phases One and Three)

As predicted, in phase one, a relationship was found between maternal language input and the child's memory for false complements. Indeed, given the low internal reliability for the elaborated mental state scale of Peterson and Slaughter's (2003) Maternal Mental State Input Inventory observed in the present sample (Cronbach's alpha 0.53) the present study may well underestimate the relationships between maternal language input and the other variables. Nevertheless, as hypothesized, the previously observed relationship between maternal language input (the proclivity of mothers to talk about mental states and use mentalistic language) and the child's ToM

development (e.g., Peterson & Slaughter, 2003) was found to be completely mediated by memory for false complements and cognitive flexibility.

Consistent with P. A. de Villiers' (2005) and Low's (in press) findings, the results of the present study support the hypothesis that both memory for false complements and cognitive flexibility make contributions to the development of explicit false belief understanding that are independent of other age-related variance in English speaking children. Results of the phase one SEM analyses with the concurrent data support the hypothesis that memory for false complements facilitates the development of both cognitive flexibility and explicit false belief understanding such that memory for false complements has both a direct effect, and an indirect effect (mediated through advances in cognitive flexibility), on explicit false belief understanding. Furthermore, the hierarchical regression analyses with the longitudinal data indicate that memory for false complements predicts cognitive flexibility (but not vice versa) and also explicit false belief understanding (but not vice versa) and that cognitive flexibility also predicts explicit false belief understanding (but not vice versa).

The finding that Y1 memory for false complements did not significantly predict Y2 cognitive flexibility scores after the inclusion of chronological age as a control variable (even though chronological age did not uniquely predict Y2 cognitive flexibility) is worthy of further investigation. Given that Y1 memory for false complements significantly predicted Y2 cognitive flexibility scores when chronological age was not included as a control variable it could be that the non-significant finding is simply a result of limited power due to sample size. It could also be that there is substantial shared variance between chronological age and Y1 memory for false complements which is why each correlates moderately with Y2 cognitive flexibility, yet neither accounts for unique variance in Y2 cognitive flexibility when the two predictors are included together in a regression analysis. This pattern of results is consistent with maturational or broad experiential factors (for which chronological age is a proxy) contributing in some part to the development of both memory for false complements and cognitive flexibility. However, the finding that the relationship between memory for false complements and cognitive flexibility remained significant even after controlling for chronological age in the concurrent SEM analyses with the Y1 data indicates that experiential and not just maturational factors contribute to the relationship between false complements understanding and cognitive flexibility.

Alternatively, consistent with Vygotsky's (1981) argument that language acquisition provides the individual with a set of psychological tools, it is also possible

that other aspect(s) of complex language that develop around the same time as memory for false complements contribute to the child's ability to flexibly shift between conflicting perspectives in the DCCS task. For example, it could be that the ability to hold false complements in linguistic memory (which interacts with the child's implicit false belief understanding to facilitate explicit reasoning about false beliefs) develops around the same time as the ability to hold if-if-then rules in linguistic memory (which facilitates the child's ability to flexibly shift between conflicting perspectives in the DCCS task; Low, in press). Indeed, mastery of linguistically mediated thought using sentential complements with mental state verbs may facilitate the mastery of linguistically mediated thought using the if-if-then rules that give the child the ability to flexibly shift between conflicting perspectives in the DCCS and false belief tasks (Low, in press). Future research into these possibilities would enhance our understanding of the relationships between memory for false complements, cognitive flexibility, and explicit false belief understanding. In particular, research investigating whether training on sentential complements and/or if-if-then rules facilitates cognitive flexibility would go a long way toward deciding between these alternative interpretations. Given the potential utility in applied settings of explanations that focus on the role of language acquisition in providing the individual with a set of psychological tools (e.g., de Villiers & de Villiers 2000; J. G. de Villiers, 2005; Low, in press; Racine & Carpendale, 2007a, 2007b; Vygotsky, 1981; Zelazo, et al., 2003), research of this kind is vital to the resolution of long running theoretical debates, the advancement of the field, and the development of effective public policy and associated applied interventions.

Language and Explicit False Belief Understanding in Children with Specific Language Impairment (Phase Two)

As predicted, in phase two of the study, the children with SLI were found to have significantly lower memory for false complements, cognitive flexibility and explicit false belief scores. The current finding of impaired explicit false belief performance in children with SLI adds further support to a growing body of research indicating that SLI is associated with delayed ToM development (Farrant, et al., 2006; Holmes, 2002; Miller, 2001; Tucker, 2004). The findings for the children with SLI, when taken in conjunction with the findings for the typically developing children, also indicate that the delayed ToM development in children with SLI is plausibly underlaid by delays in the acquisition of memory for false complements and cognitive flexibility.

Theoretical Implications

The present finding that the relationship between maternal language input and the child's explicit false belief understanding was completely mediated by memory for false complements and cognitive flexibility provides additional support for the emphasis that both CCC-r theory (Zelazo, et al., 2003) and Racine and Carpendale's (2007a, 2007b) constructivist position place on maternal language input and children's subsequent language skills in the development of children's ToM. The results of the current study are also consistent with previous research which supported the role of cognitive flexibility (Colvert, et al., 2002; Frye, et al., 1998; Frye, et al., 1995; Lang & Perner, 2002; Muller, et al., 2005; Perner, et al., 2002) and memory for false complements (J. G. de Villiers & de Villiers, 2000; J. G. de Villiers & Pyers, 2002; P. A. de Villiers, 2005; P. A. de Villiers, et al., 2003; Hale & Tager-Flusberg, 2003; Lohmann & Tomasello, 2003; Pyers, 2005) in children's ToM development.

However, correlation is not causation, and it has been argued that convergence between the findings of correlational analyses of real-world relationships and the results of training studies allow more powerful inferences to be made because the particular strengths of each type of research compensate for the weaknesses of the other (Bradley & Bryant, 1983; Harris, 2005). Thus, for English speaking children, when combined with previous research that has found that training on sentential complements improves false belief performance (Hale & Tager-Flusberg, 2003; Lohmann & Tomasello, 2003) the present findings provide convergent support for de Villiers and de Villiers' (2000; J. G. de Villiers, 2005) linguistic determinism theory.

The present findings also help to clarify the relationships that have been found between language acquisition and ToM development in human ontogeny. As hypothesized, consistent with Low's (in press) findings, the present results indicate that memory for false complements predicts the development of both cognitive flexibility and explicit false belief understanding. The present findings are consistent with Racine and Carpendale's (2007a, 2007b) constructivist argument that reflective understanding of psychological concepts necessarily involves language because this form of understanding occurs via the use of shared public concepts and that the only way to master the use of these shared public concepts is via shared linguistic practice (e.g., mastery of sentential complements). The current results are also consistent with the CCC-r hypothesis (Zelazo, et al., 2003), that language facilitates ToM development because the higher order rules that are required to flexibly shift between conflicting

perspectives are formulated linguistically in potentially silent self-directed speech (linguistically mediated thought).

Conclusions

The results of the concurrent and longitudinal analyses with the typically developing children, when combined with the results of group comparisons involving children with SLI and a matched sub-group of typically developing children, converge in supporting the roles of language and cognitive flexibility in the development of explicit false belief understanding. The present findings also provide further support for key planks of linguistic determinism theory (de Villiers & de Villiers 2000; J. G. de Villiers, 2005), CCC-r theory (Zelazo, et al., 2003), and Racine and Carpendale's (2007a, 2007b) constructivist theory. Furthermore, given that research has found that training with sentential complement syntax improves explicit false belief understanding in typically developing children (Lohmann & Tomasello, 2003), the present findings also open up the possibility that sentential complements and/or cognitive flexibility training may facilitate the ToM development of children with SLI.

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Appendix A: Detailed Procedure for Explicit False Belief Tasks

Contents False Belief

Wellman and Liu's (2004) contents false belief task assesses whether the individual understands that people can hold false beliefs about reality. The child is shown a clearly identifiable closed Band-Aid box with a small plastic toy pig inside. "Here's a Band-Aid box. What do you think is inside the Band-Aid box?" "Let's see … it's really a pig inside!" The Band-Aid box is closed and the child is asked the control question: "Okay, what is in the Band-Aid box?" A doll is produced: "Mr. Jones has never seen inside this Band-Aid box. Now here comes Mr. Jones." Then the child is asked the first target question (others false belief): "So what does Mr. Jones think is in the box? Band-Aids or a pig?" This is followed by the memory question: "Did Mr. Jones see inside this box?" and the second Target Question (own false belief): "What did you first think was inside the Band-Aids box before we opened it? Band-Aids or a pig?" To be scored correct on the first target question, the child must answer "Band-Aids" to the target question, and "no" to the memory question. To be scored correct on the second target question, the child must answer "pig" to the control question, and "Band-Aids" to the target question. The procedure for the second contents false belief task was identical to the first except that the props were the teddy bear and a Smarties box with crayons inside.

Second Order False Belief

The child is shown a picture of a boy and his mum. "This is Andrew, and this is his Mum. Tonight it's Andrew's birthday, and Mum is surprising him with a kitten. Mum wants it to be a secret, so she has hidden the kitten in the garden shed. Andrew says, 'Mum, I really hope you get me a kitten for my birthday.' Remember, Mum wants to surprise Andrew with a kitten. So, instead of telling Andrew she got him a kitten, Mum says, 'Sorry Andrew, I did not get you a kitten for your birthday. I got you a really great toy instead.'" The child is then asked the first order false belief question: "So what does Andrew think his Mum got him for his birthday? A kitten or a toy?" (If correct: That's right, Andrew thinks he's getting a toy; If incorrect: But remember, Andrew thinks he's getting a toy) Followed by the first memory control question: "What did Mum really get Andrew for his birthday? A kitten or a toy?" (If correct: That's right, Mum wants to surprise Andrew with a kitten; If incorrect: But remember, Mum wants to surprise Andrew with a kitten) "Now, Andrew says to Mum, 'I'm going outside to play.' On his way outside, Andrew decides to get his roller-skates from the garden shed. When he opens the door to the garden shed, Andrew finds the birthday kitten! (Child is

shown a picture of a kitten in a shed) Andrew says to himself, ‘Wow, Mum didn’t get me a toy, she really got me a kitten for my birthday.’ Now, the important thing is that Mum did not see Andrew go to the garden shed and find the birthday kitten.” The child is then asked the second memory control question: “Does Andrew know that his Mum got him a kitten for his birthday?” (If yes: That’s right, Andrew saw the kitten in the garden shed; If no: But remember, Andrew saw the kitten in the garden shed) Followed by the third memory control question: “Does Mum know that Andrew saw the birthday kitten in the garden shed?” (If no: That’s right, Mum did not see Andrew go to the garden shed and find the kitten; If yes: But remember, Mum did not see Andrew go to the garden shed and find the kitten) “While Andrew is outside, Andrew’s grandmother drops in for a chat with Andrew’s mum. (Child is shown a picture of mum and grandma) Grandma asks Mum, ‘Does Andrew know what you really got him for his birthday?’” The child is then asked the second order ignorance question: “What does Mum say to Grandma?” “Now remember, Mum does not know that Andrew saw what she got him for his birthday. Then, Grandma asks Mum, ‘What does Andrew think you got him for his birthday?’” The child is then asked the second order false belief question: “What does Mum say to Grandma?” Followed by the justification question: “Why does Mum say that?” To be scored correct on the first order false belief, the child must answer both the first order false belief question and the first memory control question correctly. To be scored correct on the second order false belief, the child must answer all of the questions correctly. The procedure for the other second order false belief task was identical to the first except that the child (Molly) wants a bike for her birthday but her dad tells her he got her a really great toy instead.

Appendix B: Memory for False Complements Tasks

Memory for False Complements Task Set 1

Thought

1. (First picture) The woman thought it was a spider.
   (Second picture) But look, it was really hair.
   (Pointing back at first picture) What did the woman think it was?
2. (First picture) The boy thought it was a horse.
   (Second picture) But look, it was really a donkey.
   (Pointing back at first picture) What did the boy think it was?

Said

1. (First picture) The girl said there was a bug in her cereal.
   (Second picture) But look, it was really a raisin.
   (Pointing back at first picture) What did the girl say was in her cereal?
2. (First picture) The woman said she was eating an egg.
   (Second picture) But look, it was really a ball.
   (Pointing back at first picture) What did the woman say she was eating?

Memory for False Complements Task Set 2

Thought

1. (First picture) Teacher thought the girl was reading a book.
   (Second picture) But look, the girl was really playing cards.
   (Pointing back at first picture) What did Teacher think the girl was doing?
2. (First picture) The woman thought it was a ghost.
   (Second picture) But look, it was really a sheet.
   (Pointing back at first picture) What did the woman think it was?

Said

1. (First picture) Teacher said there was a bug in the girl's hair.
   (Second picture) But look, it was really a leaf.
   (Pointing back at first picture) What did Teacher say was in the girl's hair?
2. (First picture) The girl said she drew a face.
   (Second picture) But look, it was really a scribble.
   (Pointing back at first picture) What did the girl say she drew?

Appendix C: Example Vignette from Peterson and Slaughter's (2003) Maternal Mental State Input Inventory

(classification of each of the four associated response options is shown in parentheses)

'Lost Keys'

Mum tossed her keys onto the seat of the sofa and then rushed out of the room to answer the phone. While she was gone, the keys slid down a big crack between the cushions and disappeared from view. Emma, age 4, watched at this happening. Now Mum is coming back. She needs the keys and decides to search for them. First she looks all over the sofa and the table beside it. Then she has an idea. Firmly believing she left the keys on the bedside table where the phone is, she heads back to the bedroom to retrieve them. Emma follows her, asking "Why are you going into the bedroom again, Mum?" Mum says:

(a) "To get the keys: I need the keys to unlock the garage. They are probably by the phone." (non-elaborated non-mental state)

(b) "To get the keys: I need them to unlock the garage, and I don't know where they are. I thought I put them on the sofa, but I could not see them there when I looked there just now. Maybe I just imagined putting them on the sofa. Really, I must have left them by the phone when I rushed in to answer it just now." (elaborated mental state)

(c) "To get the keys: I need them to unlock the garage. I'm just going into the bedroom again to get them, because they are probably by the phone. I am glad you are coming with me because we can both comb our hair in front of the big mirror in the bedroom once I get the keys." (elaborated non-mental state)

(d) "To get the keys: I need them to unlock the garage and I don't know where they are, so I'm going to look for them by the phone." (non-elaborated mental state)

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Chapter 5

Parenting, Language, and Perspective Taking: Advantages of Constructivist Approaches

Brad M. Farrant, Murray T. Maybery, and Janet Fletcher

Abstract

The current study analysed the relationships among parenting, socio-emotional engagement, shared practices, language, and perspective taking (cognitive, visual, emotional) in 105 typically developing children (*M* age = 61.9 months, *SD* = 8.6 months) and 30 children with specific language impairment (*M* age = 63.0 months, *SD* = 9.0 months). The results of concurrent, longitudinal, and pass-fail contingency analyses were most consistent with constructivist theories (e.g., Racine & Carpendale, 2007; Vygotsky, 1930/1981) and least consistent with the more nativistic theories (e.g., Baron-Cohen, 1995), highlighting the extent to which some theories underestimate the roles of parenting and the child's socio-linguistic environment. Directions for future research include further exploration of the emotional factors that motivate the use of explicit perspective taking skills for pro-social or Machiavellian ends.

Keywords: emotional perspective taking, visual perspective taking, cognitive perspective taking, theory of mind, maternal language input, socio-emotional engagement, shared practices, conversation skill, sentential complements, language development, conceptual development

Parenting, Language, and Perspective Taking: Advantages of Constructivist Approaches

Theory of mind (ToM) is a type of cognitive perspective taking which involves the ability to attribute mental states in order to explain and predict behavior (Premack & Woodruff, 1978). The origin of children's ToM understanding has been the subject of vast amounts of theorizing and research over the last 30 years. Over a decade ago, Astington (1996) lamented the dominance of the field by internalist views that downplay the roles of social interaction and language development and argued for an integration of internalist and externalist views into a social constructivist account based on Vygotsky's work. Since then a number of other social constructivist accounts have been put forward (e.g., Carpendale & Lewis, 2004; Nelson, et al., 2003; Symons, 2004) as alternatives to the dominant modular, simulation, and theory-theory theories. Such social constructivist accounts are often criticized for failing to provide adequate theoretical arguments and testable predictions that differentiate them from competing theories (e.g., Moore, 2007).

However, as Astington (1996) pointed out, many developmental theories draw either directly or indirectly on some aspects of Vygotsky's work. So perhaps it is time that, rather than selectively drawing on Vygotsky's theorizing, it was taken as a whole and predictions drawn from it that can be contrasted with those of the contemporary theories. The current study did so by investigating the relationships among parenting, socio-emotional engagement, shared practices, language, and perspective taking (visual, emotional, and cognitive) in typically developing children and children with specific language impairment.

Vygotsky's Developmental Theory

Vygotsky was among the first to argue that language acquisition provides the individual with a set of psychological tools; that semantic/conceptual development is only beginning when a new word is learned; and that the development of the meaningful aspects of speech is critical for children's cognitive development (e.g., Vygotsky, 1930/1981, 1987). Vygotsky (1930/1981) argued that, by becoming an intermediate link between a stimulus and a response, signs (e.g., words) become stimuli that alter the entire structure and flow of cognition, and can be used as psychological tools to influence the thinking and behavior of others and self. The words that are used by others as tools to influence the behavior of the child are subsequently used by the child to influence the behavior of others and then they are used by the child as a means of

influencing him/herself (Vygotsky, 1930/1981). Initially this self directed talk takes the form of vocalized egocentric speech prior to becoming completely internalized as silent self-directed speech (linguistically mediated thought) (Vygotsky, 1987). Vygotsky also recognized that the first function of vocal reactions is emotional (Vygotsky, 1997), and that thought is emotionally motivated (Vygotsky, 1987) (see, Hobson, 2004; Trevarthen & Aitken, 2001, for more recent arguments regarding the primacy of emotion).

Vygotsky (1998) argued that the newborn infant's mental life is characterized by a fusion of drive, emotion, and sensation in which the self is not differentiated from other social or physical objects. The emotional and intellectual aspects of consciousness are still inseparably merged into what Vygotsky called emotionally stressed states. The fact that the newborn infant is completely reliant on others for the satisfaction of even the most basic biological needs means that the infant's first contact with reality is socially mediated; it is in this sense that Vygotsky (1998) called the newborn a maximally social being. Vygotsky argued that because of this the infant's consciousness is dominated by the "great-we"; self-other and self-object relations are not yet separated and the presence of another person changes the significance and sense of every object situation such that the other person is the center of the object situation because it is through the other person that the child's emotional goals are achieved. Within this "great-we" consciousness, self and other form a single connected structure such that the infant's self exists more for the other than it does for the infant. Self development is thus a process of differentiating the self from others (see, Hobson, 1990, 2009, for a related argument about the role socio-emotional engagement plays in the development of self-other understanding via progressive differentiation of self and other).

Human infants are highly social, which is demonstrated by their active seeking of contact with others and by the emergence of socio-emotional reciprocity by two months of age (Vygotsky, 1998).[2] Because of their reliance on others for the satisfaction of even the most basic biological needs, infants have a great need to communicate with others and this is achieved by the means that infants have available to them, primitive vocalizations and gestures. Speech arises from this need to communicate (Vygotsky, 1998).

Building, in part, on Darwin's observations of his grandson's first words, Vygotsky (1998) argued that children's first words (e.g., oo-ah, bo-bo, poo-foo) represented a kind of autonomous speech involving complex meanings (e.g., a duck on

[2] See Campbell (2002) and Hobson (2009) on how socio-emotional reciprocity (where the emotional expressions of one can affect the emotional expressions of the other) provides the necessary foundation for experiencing joint attention and developing an understanding of psychological states of self and other.

the water is called a oo-ah, and subsequently, any liquid or picture of a duck is called a oo-ah). The child develops these meanings, and communication is only possible with those who are initiated into the code of the child's speech, and who are familiar with the child's use of the word. The words of the child's autonomous speech are tied to the concrete situation; their meanings are only understood by others with the help of the (usually visual) situation, and the child can communicate only about what s/he perceives. The meanings of the words are not fixed and vary from situation to situation. Therefore the words cannot have a symbolic function (there is no possibility of the words replacing absent objects), but rather can only be used to name or indicate separate parts of the situation (Vygotsky, 1998). Early word meaning is a unity of thinking and communication, a unity of abstraction, generalization, and social interaction that helps to explain the connection between children's cognitive and social development (Vygotsky, 1987). The development of the symbolic function of words, of speech and thinking that are not tied to the present situation, is a result of the development of the semantic/conceptual aspects of speech (Vygotsky, 1998).

The child's early concepts, which Vygotsky (1987) called spontaneous concepts, are grounded in perception and are used to communicate perceptual/emotional impressions. The child's spontaneous concepts have a closer and more immediate relationship to their objects than the corresponding adult concepts. Acquiring spontaneous concepts is a slow bottom-up process and, prior to the construction of a hierarchical system of concepts, the only connections between concepts that are possible are tied to perception, that is, the empirical connections between the objects themselves (Vygotsky, 1987). Conscious awareness of concepts, and thinking as an activity that is independent of perception, only become possible after the construction of hierarchical systems of concepts involving increasingly complex relationships of generality. The spontaneous concepts in a particular domain provide the foundation for the construction of a hierarchical conceptual structure (Vygotsky, 1987).[3]

The child forms new hierarchical conceptual structures on the basis of a few concepts and the addition of a superordinate, more abstract, concept which causes a sharp restructuring of the relationships among the concepts and between the concepts

[3] See Hutto (2005) for a similar argument that the child's first non-theoretical psychological "conceptions" originate in the capacity to perceptually re-identify certain relatively stable environmental kinds as a result of experience, and that these non-theoretical "conceptions" provide a platform for the development of full-fledged psychological concepts. Whereas, drawing on Wittgenstein's (1980) writings regarding the perceptual-relational underpinnings of our grasp of psychological concepts, Hobson (2009) argues that personal relatedness (socio-emotional engagement) provides a pre-conceptual means for children to apprehend and relate to the attitudes of other people. Both views are compatible with Vygotsky's theoretical perspective.

and their objects (Vygotsky, 1987). This restructuring therefore changes the meaning of the associated words and the range of cognitive operations they can be used for (a higher level of thought requires a different conceptual structure); the structural and functional aspects of thought are intertwined, as are knowledge and thinking (Vygotsky, 1987). The construction of a hierarchical system of concepts enables the child to "rise above" the situation. The child's thinking is no longer tied to perception because the higher-order concept has no direct connection to its object; rather, the connection to its object is mediated by other concepts. By engaging in conversation with, and being instructed by, more competent language users, the child is now (after the acquisition of a hierarchical conceptual structure) able to form new concepts from the top down by defining them via connections to existing concepts (Vygotsky, 1987). Vygotsky argued that the child has not mastered a particular concept system until s/he can subordinate the concepts under another higher-order concept (e.g., the decimal system is viewed as a particular kind of numerical system), and that this enables the freedom to move from one system to another, which is the criterion for conscious volitional thought. When the child has mastered this new hierarchical structure s/he can use this to restructure/reform existing conceptual structures (Vygotsky, 1987).

The meaning of a particular word is a generalization and the degree of generalization is dependent upon the structure of the hierarchical system of concepts of which it is part. Therefore, the structure of this system, that is, the connections among the various concepts, provides a particular way of reflecting reality in thought because it is these connections that provide "a group of predispositions toward particular movements of thought" (Vygotsky, 1987, p. 227). Thus, the way a concept is connected to other concepts determines the range of cognitive operations for which it is available, and any "errors" in a child's thinking/reasoning on a particular task stem from the underdevelopment of connections among the relevant concepts (Vygotsky, 1987).

In particular, the ability to sense a contradiction in one's own reasoning is only possible when the concepts expressed in the contradictory judgments are part of a structure under a single superordinate concept (Vygotsky, 1987). Prior to this, thinking/reasoning is driven by perception; the connection between perceptual impressions is taken as the connection between things (Vygotsky, 1987). Thus, the ability to identify and explicitly reason with conflicting or contradictory perspectives only becomes possible after the relevant concepts have been connected together in an appropriate hierarchical system. This makes sense of the finding that children's vocabulary is related to their perspective taking (ToM) ability (e.g., Ruffman, Slade,

Rowlandson, Rumsey, & Garnham, 2003). That is, the size of children's vocabulary serves as a proxy for the complexity of their conceptual structures and, more importantly, the likelihood of higher order/super ordinate concepts within these structures.

Vygotsky (1987) also recognized that the mastery of complex syntactic structures plays an important developmental role. In particular, he argued that mastering the embedding of subordinate clauses facilitates the development of hierarchical conceptual structures and that children use complex syntactic structures in their spontaneous speech prior to having a conscious awareness of the connections among the corresponding conceptual structures. It should be clear that Vygotsky did not the view the child as a "little scientist" constructing theories and testing and revising these theories[4] (cf. Vygotsky, 1998, p. 246; also see, Gellatly, 1997, for a cogent critique of such accounts). Nor did he argue that the child is a passive recipient of socialization/ enculturation. Indeed, Vygotsky (1987) argued that the child is an active participant engaging in conversations and co-constructing the meaning of words as part of a hierarchical system of concepts. Although the thinking the child can do in collaboration with a more competent "teacher" is more than what the child can do independently (otherwise education would be unnecessary), the thinking the child is able to imitate in collaboration with a more competent "teacher" is restricted by the child's zone of proximal development which is determined by the status of the relevant conceptual structure(s). Shortly before his untimely death in 1934, Vygotsky began to focus his theorizing about the development of word meaning on the mediating function words have in social practices, social interaction, and communication (Minick, 1987), and on the importance of children's learning experiences in the home outside of formalized education (Vygotsky, 1987).

Thus, Vygotsky's theory predicts that mother-child socio-emotional interaction, maternal language use, shared activities such as book reading, and child language development (particularly the mastery of complex syntactic structures and the ability to engage in conversation) will play important roles in the development of hierarchical conceptual structures. These structures enable children to switch between different perspectives (e.g., ToM, visual perspective taking (VPT), emotional PT). Accordingly, children with delayed language development should demonstrate delayed development of explicit perspective taking skills. Furthermore, Vygotsky's (1987) argument that once

[4] The child does not need to construct theories, thousands of years of cultural and language evolution have already provided a conceptual structure and this what the child learns and refines.

the child has mastered a hierarchical conceptual structure in a particular domain s/he can use this to restructure/reform existing conceptual structures also predicts that children's ToM, VPT, and emotional PT will develop around the same time.

Contemporary Theories

Constructivism

Racine and Carpendale (2007b) put forward a constructivist theory in which the acquisition of shared linguistic practice is grounded in the development of competence in shared forms of activity such as joint attention which are naturally embedded in socio-emotional engagement. (See also, Trevarthen & Aitken, 2001, on the relationship between socio-emotional engagement and joint attention). Racine and Carpendale (2007a, 2007b) argued that reflective understanding of psychological concepts (the kind of understanding required for explicit perspective taking tasks) necessarily involves language because this form of understanding occurs via the use of shared public concepts, and that the only way to master the use of these concepts is via shared linguistic practice. That is, although there are forms of understanding that do not require shared linguistic practice (they emerge from other forms of shared practice), true mastery, or reflective understanding, of psychological concepts is intertwined with learning the shared practice of being able to talk about them (Racine & Carpendale, 2007a, 2007b; Racine, Carpendale, & Turnbull, 2007).

Consistent with the argument that the acquisition of shared linguistic practice is grounded in the development of competence in shared forms of activity such as joint attention, Carpendale and Lewis (2004) hypothesized that children's use of verbs of visual perception is grafted onto their earlier joint attention behaviors and provides tools with which to direct and follow attention. This theory also predicts that mother-child socio-emotional interaction, maternal language use, and shared activities such as book reading will play important roles in the development of children's perspective taking skills (ToM, VPT, emotional PT), and that children with delayed language development will demonstrate delayed development of explicit perspective taking skills.

Narrative Practices Hypothesis

Hutto (2008, 2009) claimed that folk psychology (our everyday talk and thinking about mental states) is essentially a special type of narrative practice that involves our ability to construct and digest second- and third-person narratives using complex language. He also claimed that it is via exposure to folk psychological narratives (narratives that explicitly mention the roles that mental states play in people's lives and behavior) that children develop competence in making sense of their own and other's

intentional actions (the Narrative Practices Hypothesis, Hutto, 2009). Hutto (2009) argued that because it remains unclear what it implies to attribute some kind of "understanding" of mental states to children who cannot talk about them, a more cautious strategy is to reserve the attribution of understanding to those who can engage in narrative-based intersubjective engagements involving the systematic use of the network of folk psychological concepts. The child's earlier, "primary forms of social interaction are about shaping others, being 'transformed' by and 'transforming' others through unprincipled embodied engagements" (Hutto, 2009, p. 19). These primary forms of social interaction are elaborated and extended in complex ways in joint attention behaviors and language use.

Hutto (2009) argued that the natural human appetite for telling and consuming stories is central to the evolutionary and ontogenetic development of folk psychological competence. Thus, this theory also predicts that mother-child socio-emotional interaction, maternal language use, shared activities such as book reading, and the child's ability to engage in conversation will play important roles in the development of children's perspective taking skills (ToM, VPT, emotional PT), and that children with delayed language development will demonstrate delayed development of explicit perspective taking skills.

Linguistic Determinism

The linguistic determinism position advanced by de Villiers and de Villiers (2000; de Villiers, 2005) argues that the mastery of syntactic structures called sentential complements, in which a sentence takes a full clause as its object complement (e.g., "Peter thinks Mummy's home"), allows children to reason from conflicting perspectives or points of view. That is, in addition to learning the meaning of the relevant verbs, children must master the embedding of complements (e.g., "Mummy's home") under verbs (e.g., "thinks") before they will have the representational power required to understand perspectives that conflict with their own and/or with reality (de Villiers, 2005; de Villiers & de Villiers, 2000).

de Villiers and de Villiers (2000; de Villiers, 2005) argued that the development of an understanding that verbs of communication can take false complements (e.g., "The girl said there was a bug in her cereal" when it was really a raisin) provides a bootstrap for understanding that mental state verbs can take false complements and subsequent false belief understanding. Thus, this theory predicts that the mastery of sentential complements will predict children's perspective taking ability and that children with delayed language development will demonstrate delayed development of

explicit perspective taking skills. It also predicts that the mastery of sentential complement structures associated with communication verbs precedes the mastery of sentential complement structures associated with mental state verbs which, in turn, precedes the ability to reason with beliefs that conflict with one's own.

Simulation Theory

Simulation theory argues that ToM involves a process of setting aside your current point of view and imaginatively sharing another's perspective (Harris, 1996). According to Harris (1992), the first step in development of this ability is when children echo another person's intentional stance toward a target (object, person, etc.) by identifying the other person's visual target and/or emotional stance and making that the target of his/her own cognition. The second step involves using the processes of step one, but instead of echoing the other person's intentional stance the child attributes the simulated intentional stance to the other person. For example, the child codes the other person as "seeing X" or "liking/wanting Y" (Harris, 1992). The third step in Harris' account involves the child using the processes of step two offline to imagine or anticipate an intentional stance other than their own current one without monitoring a visible target or the other person's current intentional stance. The child can now anticipate or pretend that another person wants an object that the child does not, or can see an object that the child cannot. The fourth and final step involves the child using hypothetical counterfactual situations to drive the processes used in step three. For example, the child can now imagine someone thinking or seeing something that runs directly counter to what the child currently thinks or sees (Harris, 1992).

Regarding the relationship between language and perspective taking, Harris (1996) argued that language facilitates the development of the ability to simulate another's perspective because conversation involves a constant exchange of differing points of view. By highlighting the existence of alternative points of view, conversation encourages the individual to imaginatively adopt another person's perspective (Harris, 1996). Well-coordinated conversation requires ongoing predictions as to what the other person will understand, and repairs and clarifications are called for when these predictions are incorrect (Harris, 1996). Conversation therefore provides rapid feedback concerning the success of the simulation process and this feedback is likely to improve the individual's ability to accurately imagine what other people perceive, desire, believe, etc. (Harris, 1996).

Thus, Harris' (1992, 1996) theory predicts that children's conversation skill will predict the development of their perspective taking skills and that children with delayed

language development will demonstrate delayed development of explicit perspective taking skills. It also predicts that the ability to infer what objects another person does and does not see (level 1 VPT) develops prior to both the ability to recognize that an object that is simultaneously visible to both self and other will nonetheless give rise to different visual impressions if their viewing circumstances differ (level 2 VPT) and the ability to represent beliefs that conflict with their own. Harris' theory also predicts that children's ability to represent desires that are different to their own (step three) precedes both level 2 VPT ability and the ability to represent beliefs that conflict with their own (step four).

Theory-Theory

Theory-theory, sometimes called theory-formation theory, draws analogies between advances in scientific knowledge and children's cognitive development in particular domains (e.g., Gopnik, 1996). According to this theory, children's ToM is indeed a theory and ToM development is a product of theory changes (Gopnik & Wellman, 1992). Children's ToM theories are abstract entities that are acquired from elsewhere or postulated by the child to provide causal-explanatory accounts of empirical evidence (e.g., the social behavior of others) (Gopnik & Wellman, 1992). The theoretical terms and entities postulated by a theory are parts of coherent systems characterized by laws and/or structure which make predictions that go beyond the evidence that led to the construction of the theory (Gopnik & Wellman, 1992). Thus, a theory is open to defeat by the accumulation of evidence that is contrary to its predictions and this is the source of theory change. The first response to such counter evidence may be akin to some kind of denial. The next stage may involve the development of ad hoc auxiliary hypotheses which attempt to account for the counter evidence in the vocabulary of the earlier theory. However, the accumulation of auxiliary hypotheses undermines the original theory's strengths (its coherence and relative simplicity), makes it ugly and messy, and leads to the acquisition or formulation of a new theory which can account for all the available evidence (Gopnik & Wellman, 1992).

Infants are argued to have some highly abstract notions of internal mental states and innate theory formation mechanisms (starting-state nativism) that are evident in their socio-emotional engagement and imitation behaviors, and later more clearly in their social referencing and joint attention behaviors (Gopnik, 1996; Gopnik & Wellman, 1992). Gopnik, Slaughter and Meltzoff (1994, p. 162) argued that it is the infant's experience in shared imitative activities that provides a tutorial in the

correspondence between eye/body movements and visual experience and leads the infant to some kind of understanding of "the basic premise of joint attention: When you and I look in the same direction, we see the same thing." The two year old's ToM is largely comprised of concepts related to perception and desire (desire-perception theory) which together allow the powerful folk psychological prediction that "if an agent desires X, and sees it exists, he will do things to get it" (Gopnik & Wellman, 1992, p. 151).

Around the age of three, the child's ToM incorporates the first conception of belief which is based on a re-working of the earlier desire-perception theory such that a direct causal link is postulated between actual states of affairs and people's beliefs (Gopnik & Wellman, 1992). Thus, children's understanding of verbs of visual perception bootstraps their understanding of mental state terms such as belief (Gopnik, et al., 1994). The subsequent accumulation of evidence that people's beliefs can be false leads to the formation of auxiliary hypotheses and subsequently, by around four or five years, to the acquisition or formulation of a new ToM where mental states involve representations of reality rather than the actual states of affairs. This representational ToM provides a new view of the existing evidence and allows new explanations, interpretations, and predictions including the ability to predict people's behavior when they have a false belief (Gopnik & Wellman, 1992).

Regarding the relationship between language and ToM, Gopnik and Meltzoff (1997) argued that cognitive development depends on language development and that children are born into a language community that has already developed a folk ToM which is reflected in its language and semantic structure. Adult language is an important source of information that children use in theory construction and by untangling the structure of language in one domain the child arrives at solutions that can be applied to solutions in other domains (Gopnik & Meltzoff, 1997).

Thus this theory predicts that level 1 VPT reasoning develops prior to the ability to reason with beliefs that conflict with the actual state of affairs, and that the ability to reason with desires that are different to their own also precedes the ability to reason with beliefs that conflict with the actual state of affairs. It also predicts that maternal language input and children's conversation skill will predict the development of perspective taking skills, that children's ToM, VPT, and emotional PT will develop around the same time, and that children with delayed language development will demonstrate delayed development of explicit perspective taking skills.

Modular/Nativistic Theories

Nativistic arguments about the development of children's perspective taking skills generally propose some kind of innate theory of mind mechanism/module. Indeed, Langdon (2003) argued that the idea of a domain specific theory of mind mechanism was promoted as an explanation for a series of findings that were interpreted as demonstrating that children with autism have impaired ToM and intact visual perspective taking (VPT) skills (see Baron-Cohen, 1993, for a review).

There are two dissociable components to Leslie's (e.g., German & Leslie, 2001; Leslie, 1994a, 1994b) modular theory; the theory of mind mechanism and selection processing. The theory of mind mechanism is an innate cognitive module that attends to other people's behaviors and, using innate psychological concepts, spontaneously and post-perceptually computes the mental states that contributed to those behaviors (German & Leslie, 2001; Scholl & Leslie, 2001). Thus, according to this theory, ToM has a specific genetically determined basis where specialized representations (specialized in the sense that these representations do not apply in other cognitive domains) are applied by a specialized theory of mind mechanism/module (Scholl & Leslie, 2001). In typical development this module begins to mature during the child's second year (German & Leslie, 2001).

One of the most important properties, if not the essence, of modules is that they are informationally encapsulated (Fodor, 1983, 2000; Scholl & Leslie, 2001). The informational encapsulation of modules means that the processing that occurs within a module (e.g., theory of mind mechanism) is completely independent of the information or processing in another module (e.g., a language module) or in central systems (Fodor, 1983). Thus, although the theory of mind mechanism can develop/mature on the basis of its limited input (Scholl & Leslie, 2001), the development of its concepts from mechanistic forms of attending (to specific properties or sets of properties in sensory input) to mature explicitly represented concepts (German & Leslie, 2001) will be independent of the child's general language development. Furthermore, Leslie's modular theory predicts that ToM acquisition is cognitively impenetrable to the influence of higher level thought (Scholl & Leslie, 1999). In contrast, selection processing is a general executive process which inhibits salient but unwanted responses (Scholl & Leslie, 2001). For example, the theory of mind mechanism automatically attributes beliefs that are true, which need to be inhibited in false belief situations by selection processing (Scholl & Leslie, 2001). Thus, according to Leslie's modular

theory, if language development plays a role in ToM development it must be via facilitating the general executive processes behind selection processing.

The impaired ToM observed in children with autism is, according to this argument, a result of an impaired theory of mind mechanism whereas typically developing children have an intact theory of mind mechanism but fail false belief tasks prior to the age of four because of immature selection processing (German & Leslie, 2001). Leslie and Frith (1988) argued that VPT need not be thought of as involving a mental state concept but rather can be viewed as a purely geometric-causal notion involving some kind of understanding of line of sight (at least in the case of level 1 VPT), and that children with autism can pass these tasks in spite of their impaired ToM. Thus, although German and Leslie (2001) do not rule out the possibility that the theory of mind mechanism is involved in providing some specialized concepts to do with perceiving, these are not involved in early VPT. With respect to the relationship between socio-emotional engagement and perspective taking, Leslie and Frith (1990) rejected Hobson's (e.g., 1990) argument that ToM development is grounded in and emerges from socio-emotional engagement and instead asserted that the affective disorder associated with autism is a product of a primary cognitive disorder (impaired ToM).

Baron-Cohen (1995) also argued that ToM (mindreading) relies on specific neurocognitive mechanisms. These mechanisms (in order of appearance in development) are the intentionality detector, the eye direction detector, the shared attention mechanism, and the theory of mind mechanism. In typical development the intentionality detector and the eye direction detector are available to the infant from birth, the shared attention mechanism comes on board between 9 and 18 months, and the theory of mind mechanism comes on board between 18 and 48 months. The shared attention mechanism is typically activated by input from the eye direction detector but it can also be activated by the intentionality detector. The theory of mind mechanism is triggered in development by the output of the shared attention mechanism (Baron-Cohen, 1995).

The intentionality detector interprets behavior in terms of the volitional mental states of desire and goal (Baron-Cohen, 1995). Baron-Cohen (1995, 1998) presented a range of evidence in support of a neurocognitive eye direction detector and argued that this mechanism is an innate brain module that interprets eye gaze in terms of the perceptual mental state of seeing by detecting the presence of another organism's eyes and representing what those eyes are looking at. By comparing the perceptual states of

self and other to determine whether self and other are currently attending to the same thing, the shared attention mechanism (in combination with the intentionality detector and eye direction detector) detects the presence of shared (joint) attention (Baron-Cohen, 1995). The theory of mind mechanism enables the representation of epistemic mental states (e.g., knowing, believing) as M-Representations (meta-representations) of the form [Agent-Attitude-"Proposition"], for example, [Mr Jones-thinks-"there are Band-Aids in the Band-Aid box"] (Baron-Cohen, 1995).

Thus, according to Baron-Cohen's (1995) theory, individuals can have intact processing of the perceptual mental state of seeing (i.e., eye direction detector functionally intact) while having impaired processing of epistemic mental states (i.e., functionally impaired shared attention mechanism and/or theory of mind mechanism).[5] Therefore, Baron-Cohen's theory does not predict that impaired/delayed ToM will necessarily be associated with impaired/delayed VPT (Langdon & Coltheart, 2001) because processing of the perceptual mental state of seeing that is required for VPT only requires a functionally intact eye direction detector. Indeed, Baron-Cohen (1993) drew a clear distinction between epistemic mental states and perceptual mental states by arguing that mental states such as belief are opaque (suspend normal truth conditions about the propositions they prefix) whereas verbs of perception are transparent (normal truth conditions apply to the propositions they prefix).

Regarding the relationship between language development and ToM, Baron-Cohen (1995) argued that mindreading preceded language in evolution and although he allowed that the existence of language might benefit the development of ToM in ontogeny the processes or mechanism by which it could do so were left unspecified. However, the fact that Baron-Cohen (1995, 1998) argued that the intentionality detector, eye direction detector, and shared attention mechanism are innate brain modules means that if language were to have any effect it would have to be via the theory of mind mechanism because, as noted above, one of the most important properties, if not the essence, of modules is that they are informationally encapsulated (Fodor, 1983, 2000; Scholl & Leslie, 2001). The informational encapsulation of modules means that the processing that occurs within a module (e.g., the eye direction detector) is completely independent of the information or processing in another module (e.g., a language module) or in central systems (Fodor, 1983). Thus, Baron-Cohen's (1995) theory allows the possibility that delayed or disordered language acquisition may be associated with

[5] Baron-Cohen (1995) claimed that all the available evidence was consistent with a massively impaired shared attention mechanism in most children with autism.

impaired processing of epistemic mental states such as knowing and believing. However, this theory predicts that delayed or disordered language acquisition should have no impact on VPT ability because, unlike epistemic mental states, the perceptual mental state of seeing is processed by an innate module (the eye direction detector). Similarly, because the processing of other's behavior in terms of the volitional mental state of desire is the job of an innate module (the intentionality detector) Baron-Cohen's theory predicts that delayed or disordered language acquisition should have no impact on this ability.

Furthermore, the argument that ToM underlies children's conversation (pragmatic) skills (Baron-Cohen, 1988) means that, according to this theory, children's ToM should predict their conversation skill and not vice versa. Baron-Cohen (1988) also contrasted theories of autism proposing a primary cognitive (ToM) deficit with theories proposing a primary affective (socio-emotional engagement) deficit and concluded that, although there was some possibility of integrating the cognitive and affective theories, the cognitive theory (primary ToM deficit) provided a better explanation of the impaired perspective taking and associated social skills in autism.

Baron-Cohen (2005) changed the focus of his model from mindreading to empathizing and added two more neurocognitive mechanisms to the model, the emotion detector and the empathizing system. The emotion detector is available early in infancy, detects basic emotions in others, and builds dyadic representations of emotional states such as "Mother-is angry-with me" (Baron-Cohen, 2005, p. 472). When the shared attention mechanism comes on board between 9 and 18 months it can receive inputs from the emotion detector and use them to build triadic representations such as "Mother is unhappy that I am unhappy" (Baron-Cohen, 2005, pp. 472-473).

The empathizing system comes on board around 14 months, receives inputs from the shared attention mechanism, provides empathic reactions to other people's emotional states and a drive to help them, and enables E-Representations of the form Self-Affective state - [Self-Affective state -proposition], for example, "I feel sorry that - [Mom feels sad about - the news in the letter]" (Baron-Cohen, 2005, p. 473). If the empathizing system is functioning normally it produces emotional states in the self that are triggered by, and appropriate to, the other person's emotional state (e.g., social referencing). Thus, although the emotion detector may be intact in individuals with autism, the fact that they often do not display appropriate responses to other people's emotional states is explained by positing that the empathizing system is impaired. Baron-Cohen (2005) is non-committal as to whether the empathizing system mechanism

enables the development of sympathy and empathy beyond infancy or whether further mechanisms will need to be postulated to explain this development.[6]

The Present Study

The overall aim of the current research was to further investigate relationships among parenting, socio-emotional engagement, shared practices, language, and perspective taking in human ontogeny. This was achieved by examining the relationships among these factors both concurrently and longitudinally in typically developing children, and by comparing a group of children with SLI with a sub-group of typically developing children matched for non-verbal ability, gender, and age.

The first aim of the present study was to test the hypothesized relations among parenting, socio-emotional engagement, shared practices, language, and perspective taking (visual (VPT), emotional, and cognitive (ToM)) in typically developing children. Based on Vygotsky's (1987) and Gopnik and Meltzoff's (1997) arguments it was predicted that children's scores on the VPT, emotional PT, and ToM tasks would factor together to form a single perspective taking factor. Furthermore, consistent with Vygotsky's (1987), Racine and Carpendale's (2007a, 2007b), Hutto's (2008, 2009), Harris' (1992, 1996), and Gopnik and Meltzoff's (1997) arguments it was predicted that maternal language input would predict children's conversation skill which would in turn predict their perspective taking skills. Drawing on Vygotsky's (1987) and de Villiers and de Villiers' (2000; de Villiers, 2005) arguments it was also predicted that children's sentential complements skill would partially mediate the relationship between conversation and perspective taking skills. Based on Vygotsky's (1987, 1998), Racine and Carpendale's (2007a, 2007b), and Hutto's (2008, 2009) arguments it was predicted the maternal socio-emotional engagement would predict child socio-emotional engagement and these would both predict the mother-child shared activity of book reading which would in turn predict child conversation skill.[7] The foregoing hypothesized relations are depicted in Figure 1. In contrast, because Baron-Cohen's (1995, 2005) theory posits that VPT, emotional PT, and ToM are processed by separate neurocognitive mechanisms, this theory does not predict that children's scores on the associated tasks would factor together to form a single perspective taking factor.

In terms of longitudinal relations, drawing on Vygotsky's (1987), Racine and Carpendale's (2007a, 2007b), Hutto's (2008, 2009), Harris' (1992, 1996), and Gopnik

[6] As Baron-Cohen's (2005) model already contains six specific neurocognitive mechanisms, adding even more surely would further undermine the evolutionary plausibility of the model.

[7] Book reading was used as a measure of mother-child shared practices because it was viewed as a good indicator of the quality of these shared practices as well as being theoretically linked to the development of children's conversation skill.

and Meltzoff's (1997) arguments it was predicted that children's conversation skill would predict their perspective taking skills one year later after controlling for initial perspective taking skills but the reverse prediction would not be significant. In contrast, based on Baron-Cohen's (1995) theory it was predicted that children's ToM would predict their conversation skill one year later after controlling for initial conversation skill but the reverse prediction would not be significant.

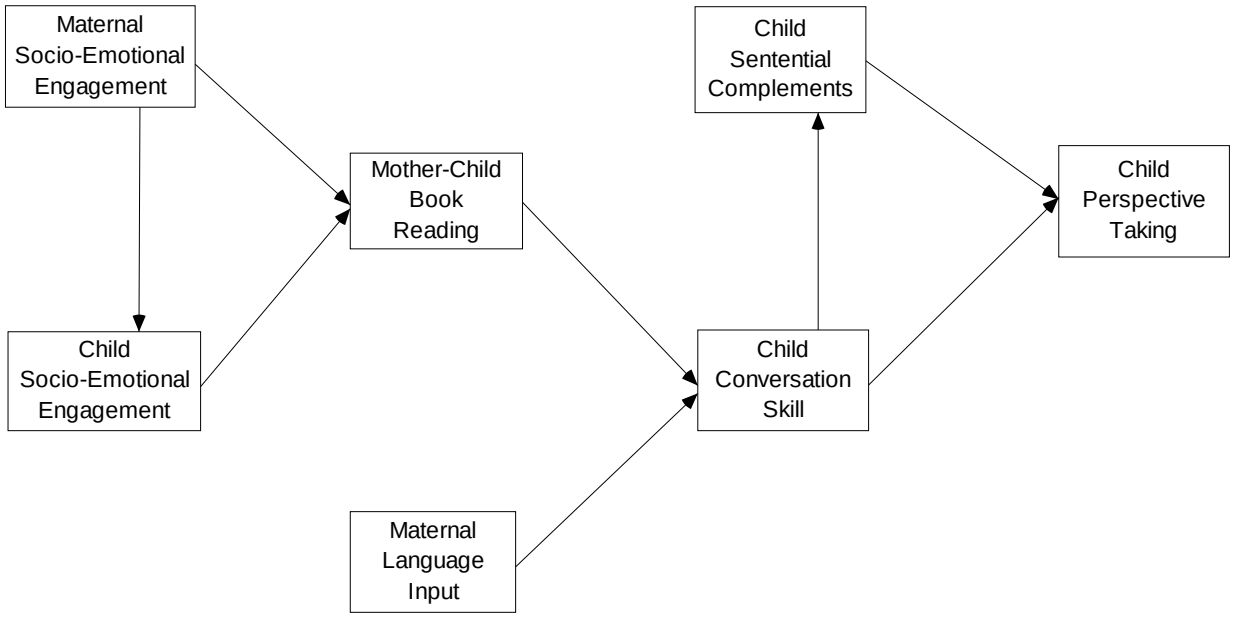

Figure 1. Hypothesized model.

The second aim of the study was to analyze the pass-fail contingencies among the ToM and VPT tasks and to test the hypothesized relationships among the sentential complements, VPT, emotional PT, and ToM tasks. Based on de Villiers and de Villiers' (2000; de Villiers, 2005) argument, it was predicted that the mastery of sentential complement structures associated with communication verbs would precede the mastery of sentential complement structures associated with mental state verbs which, in turn, would precede the ability to reason with beliefs that conflict with one's own.

Based on Gopnik and Wellman's (1992) argument it was predicted that children's ability to reason with desires that are different to their own would precede the ability to reason with beliefs that conflict with the actual state of affairs. Consistent with Gopnik and Meltzoff's (1997) argument, it was predicted that the ability to reason with different visual perspectives in the level 1 VPT task would also precede the ability to reason with beliefs that conflict with the actual state of affairs in the ToM tasks.

Similarly, based on Harris' (1992) argument, it was predicted that the ability to simulate different visual perspectives in the level 1 VPT task would precede the ability to simulate conflicting visual perspectives in the level 2 VPT task and conflicting beliefs in the ToM tasks, and that the ability to simulate different desires would precede the ability to simulate conflicting visual perspectives in the level 2 VPT task and conflicting beliefs in the ToM tasks. Consistent with the fourth step in Harris' (1992) theory and the findings of previous research (Bigelow & Dugas, 2009; Farrant, Fletcher, & Maybery, 2006) it was predicted that level 2 VPT and false belief understanding would develop around the same time.

Based on Vygotsky's (1987), Racine and Carpendale's (2007a, 2007b), Hutto's (2008, 2009), de Villiers and de Villiers' (2000; de Villiers, 2005), Harris' (1992, 1996), and Gopnik and Meltzoff's (1997) arguments it was predicted that the children with SLI would be significantly impaired on each of the ToM, emotional PT, and VPT tasks. In contrast, Leslie's (German & Leslie, 2001; Leslie & Frith, 1988) and Baron-Cohen's (1995) theories predict that VPT development will not be delayed in children with SLI. Furthermore, Baron-Cohen's theory predicts that reasoning involving the volitional mental state of desire should not be delayed in children with SLI.

Method

Participants

The data reported here represent part of a larger ongoing longitudinal research project conducted by the first author (see also, Farrant, Maybery, & Fletcher, submitted-a, submitted-b). All of the 135 Australian children (121 Caucasian, 13 Asian, 1 Indigenous Australian) who participated in the present study spoke English as their first language. The children were recruited via three primary schools spread across working class to upper middle class areas. In total 105 typically developing Australian children (52 boys), aged between 46 and 76 months (*M* age = 61.9 months, *SD* = 8.6 months) at the commencement of the study, were tested. Thirty children with SLI (26 boys) aged between 48 and 74 months (*M* = 63.0 months, *SD* = 9.0 months) were recruited from a metropolitan Language Development Centre (LDC). In order to receive a place in the LDC, children must have a significant primary language disability in the presence of normal non-verbal intelligence and sound adaptive behavior skills. The placement committee (comprised of the LDC Principal, School Psychologist and Speech Pathologist) assess eligibility on the basis of standardized cognitive assessments, speech pathology referral, and information from teachers and carers. In most cases, linguistic ability is assessed with the Clinical Evaluation of Language Fundamentals-Preschool

(Semel, Wiig, & Secord, 1997) and non-verbal intelligence via the performance scale of the Wechsler Preschool and Primary Scale of Intelligence – Third Edition (Wechsler, 2002).

Measures

Theory of Mind

Children's ToM ability was measured using two batteries of tasks, each including one of the versions of Wellman and Liu's (2004) ToM scale used by Farrant et al. (2006), one of Woolfe, Want and Siegal's (2002) low verbal false belief tasks, and one of Sullivan and Tager-Flusberg's (1999) second order false belief tasks (see Appendix A). These tasks range in difficulty from the diverse desires task that assesses whether the individual understands that other people can have desires that differ from his/her own through to the second order false belief task that assesses the ability to attribute second order or embedded mental states (e.g., he thinks that she thinks). Previous research has found that typically developing children, with few exceptions, pass the Wellman and Liu tasks in a fixed succession between the ages of 45 and 64 months (Peterson, Wellman, & Liu, 2005; Wellman & Liu, 2004). For the present study, the two versions of Wellman and Liu's (2004) ToM scale were modified to include control questions on the diverse desires and diverse beliefs tasks and an own false belief question in the contents false belief task.

Visual Perspective Taking

VPT ability was assessed using two batteries of tasks, each including the level 1, level 2, and array VPT tasks used by Farrant et al. (2006) and a new "level 3" VPT task developed specifically for the current research project (see Appendix B). The level 3 task was included to increase the sensitivity of the VPT batteries. It is similar in structure to the other tasks and piloting had indicated that children found it more difficult than the level 2 task but easier than the array task. For the present study, all VPT tasks were modified to include a control question that further assessed children's ability to switch between different visual perspectives.

Emotional Perspective Taking

Children's emotional PT ability was assessed using Harwood and Farrar's (2006) tasks (see Appendix C). The child's ability to receptively and expressively identify the relevant emotions (happy and sad) is initially assessed via an emotion labeling task. Then, after identifying his/her best friend, the child is told short stories involving him/herself and the identified friend in situations that would lead to the child

and the friend experiencing different emotions (one happy, the other sad) and the child is asked to identify how s/he would feel and how the friend would feel.

Memory for False Complements

Two memory for false complements task sets were used. Each involved modified versions of items from de Villier's Complement Comprehension battery (de Villiers & Pyers, 2002) along with new items devised specifically for the present research project. Items were selected to keep the wording as consistent as possible across the "thought" and "said" items and between the two tasks sets. Each task set contained two "thought" and two "said" items (see Appendix D). Each item was presented along with a set of two pictures. For both the thought and said items the child had to answer with the relevant noun or verb in order to be scored as correct. Each memory for false complements item was scored as 1 (passed) or 0 (failed).

Children's Conversation Skill

To produce a parent report measure of children's conversation skill that focused on the conversational ability aspects of pragmatic skill that Harris'(1992, 1996) simulation theory deems important, a composite scale was constructed by combining six items from the Conversation Skills Rating Scale (Girolametto, 1997) with an additional item devised specifically for the current research project. Thus, the composite scale is a 7-item instrument (see Appendix E) in which mothers rated how often their child displayed the described conversation skill on a 7-point scale ranging from never to always with a maximum possible score of 49. As previously reported (Farrant, Maybery, et al., submitted-b), the factor structure of the 7-item Conversation Skill Scale is sound with all 7 items loading well (component loadings > .52) onto a single component accounting for over half of the total variance (57.49%) and the reliability of the scale in the present sample is also good (α = .92). The finding that the present sample of children with SLI scored significantly lower on this measure provides an indication of the construct validity of this Conversation Skill Scale (Farrant, Maybery, et al., submitted-b).

Children's Socio-Emotional Engagement

Children's socio-emotional engagement was measured using a scale developed specifically for the current research project (see Appendix E). Mothers rated how often their child displayed the described socio-emotional engagement behaviour on a 7-point scale ranging from almost never to almost always with a maximum possible score of 21. For the present sample, the factor structure of this scale is sound with all items loading

positively (component loadings > .70) onto one component accounting for over half of the total variance (66.83%) with acceptable internal reliability ($\alpha > .75$).

Nonverbal Ability

The Fluid Reasoning composite score from the Leiter International Performance Scale-Revised (Roid & Miller, 1997) was used as a measure of children's nonverbal ability since it was not part of the psychometric testing performed by the LDC. The Fluid Reasoning composite score is calculated from age-adjusted scores on the Sequential Order and Repeated Patterns subtests and provides a measure of the child's nonverbal IQ.

Maternal Language Input

Maternal language input was assessed using Peterson and Slaughter's (2003) Maternal Mental State Input Inventory (MMSII). The MMSII involves mothers ranking four possible responses to each of 12 vignettes involving an everyday interaction between a protagonist mother and a four year old child. In previous research, each of the possible response options (elaborated mental state, non-elaborated mental state, elaborated non-mental state, non-elaborated non-mental state) has demonstrated acceptable internal reliability (Cronbach's alphas ranging between 0.61 and 0.72) across the 12 vignettes (Peterson & Slaughter, 2003). See Appendix F for an example of one of the vignettes and the four associated response options.

For each of the 12 vignettes, mothers rank the four possible responses giving a 1 to their most preferred choice through to a 4 for their least preferred choice. In the present study the elaborated mental state scale score was used as a measure of the proclivity of mothers to talk about mental states and use mentalistic language with their child. Following Peterson and Slaughter (2003), mother's rankings for the elaborated mental state option of each vignette in the MMSII were transformed into scores that ranged from 4 (for most preferred choice) to 1 (for least preferred choice) giving a maximum possible score of 48 across the 12 vignettes. As previously reported (Farrant, Maybery, et al., submitted-a), the Cronbach's alpha for the elaborated mental state option in the present sample of mother's of typically developing children (0.53) was lower than those found by Peterson and Slaughter for the elaborated mental state scale in their two samples (both 0.72). However, inspection of the data did not reveal any systematic reason for this.

Maternal Socio-Emotional Engagement

The close scale from Collins and Read's (1990) adult attachment scale was used as a measure of maternal socio-emotional engagement. The close scale contains six

items that assess the degree to which individuals are comfortable being emotionally close to others and therefore the degree to which they are likely to emotionally engage with others. Participants rate how well each item describes them on a scale ranging from (1) not at all characteristic to (5) very characteristic, with a maximum possible score of 30. The close scale has been found to have good construct validity and acceptable internal and test-retest reliability (Collins & Read, 1990). As previously reported (Farrant, Maybery, et al., submitted-b), for the present sample of mothers of typically developing children, the reliability of the close scale was acceptable (α = .76) with all six items loading positively (component loadings > .51) onto one component accounting for 48.71% of the variance.

Mother-Child Book Reading

The frequency of the mother-child book reading was measured using a single item ("I read to/with my child on most days") which mothers rated on a 5-point scale ranging from not like me at all to very much like me. As discussed above, mother-child book reading was included in the study as an indicator of the quality of mother-child shared practices and because it is theoretically linked to the development of children's conversation skill.

Procedure

Consent forms and information sheets were sent to parents/guardians of all kindergarten and pre-primary children attending the three mainstream schools. Questionnaires were mailed to the primary caregivers who chose to participate and completed questionnaires were mailed directly back to the researcher. Children were individually tested in a quiet room at the child's regular center. In the first year (Y1) of the study, for both groups of children, each of the three testing sessions lasted approximately 15 minutes, and the maximum period between the first and final session for each participant was three weeks. Similarly, in the second year (Y2) of the study (one year later), each of the two testing sessions lasted approximately 15 minutes, and the maximum period between the first and final session was three weeks. In Y1, the ToM tasks, memory for false complements tasks, and the nonverbal ability test were completed in separate sessions. The emotional PT tasks were completed after the memory for false complements tasks in the same session. The sessions were completed in a counterbalanced order and the within-session order of presentation of the individual tasks within each task set was also counterbalanced. Approximately half of the children completed one version of the memory for false complements emotional PT, VPT, and

ToM task sets in the first year and the other half completed the other versions. Each child received the alternate versions of the memory for false complements task set, emotional PT, VPT, and ToM task sets in the second year.

Results

Perspective Taking Skills Factor and Model Testing

Participants and Scoring

Complete sets of the relevant first year (Y1) data were available for 91 of the typically developing children (81 Caucasian, 10 Asian). All of these children (46 male) spoke English as their first language and they were aged between 46 and 76 months (M = 61.3 months, SD = 8.3 months) at the commencement of the study.

For the present analyses, each ToM target question was scored as 1 (passed) or 0 (failed), and to pass each target question the child also had to answer the relevant memory and/or control questions correctly. For the typically developing children, the Y1 total ToM scores (maximum possible score of 8) were not significantly different between the two task batteries, t (89) = 1.20, p = .23, therefore, the results were collapsed across the two versions of the ToM task battery. Each VPT target question was scored as 1 (passed) or 0 (failed), and to pass each target question the child also had to answer the relevant control question correctly. For the typically developing children, the Y1 total VPT scores (maximum possible score of 8) were not significantly different between the two task batteries, t (89) = 0.76, p = .45, therefore, the results were collapsed across the two versions of the VPT task battery. Each emotional PT question was scored as 1 (passed) or 0 (failed). For the typically developing children, the Y1 total emotional PT scores (maximum possible score of 4; 2 other perspective plus 2 self perspective) were not significantly different between the two task sets, t (90) = 0.49, p = .63, and so the results were collapsed across the two versions of the emotional PT tasks. Similarly, for the Y1 data for the typically developing children, total sentential complements scores (maximum possible score of 4) were not significantly different between the two task sets, t (90) = 1.30, p = .20, therefore, the results were collapsed across the two versions of the memory for false complements task set. Child gender was coded as zero for male and one for female.

Perspective Taking Factor

The hypothesis that children's scores on the VPT, emotional PT, and ToM tasks would factor together to form a single perspective taking factor was tested first. Prior to analysis, the data for the relevant study variables (child ToM, emotional PT, and VPT scores) were checked for multivariate outliers using Mahalanobis distance with $p < .001$

(critical value = 16.27) but none were found. Descriptive statistics for the Y1 study variables for the 91 typically developing children are presented in Table 1. Inspection of the correlations between the measures revealed that the degree of multicollinearity between the variables was acceptable (see Table 2).

The factor structure of the VPT, emotional PT, and ToM task scores was examined by an unrotated Principal Components Analysis. A significant Bartlett's test of sphericity indicated that the factorability of these scores was acceptable. Examination of the initial eigenvalues and the scree plot to determine the number of components that should be retained supported the extraction of one component accounting for 58.76% of the variance. All three items had component loadings of greater than .54 on this first component. The reliability of the perspective taking factor was acceptable (α = .76). Thus, as predicted children's scores on the VPT, emotional PT, and ToM tasks formed a single perspective taking factor.

Model Testing

Data analytic strategy

Structural equation modeling (SEM) was selected over traditional partial correlation and/or multiple regression analyses because SEM allows multiple mediated pathways to be tested in the same analysis and because SEM also provides goodness of fit statistics. The hypothesized model was tested according to the conventional method for testing such a model within a SEM framework (Bollen, 1989; Gignac, 2006) and maximum likelihood estimation was used as the basis for all SEM analyses. Because of the relatively small sample size, a two index strategy (Hu & Bentler, 1999) involving the Incremental Fit Index (IFI; an incremental close-fit index) and the Standardized Root Mean-square Residual (SRMR; an absolute close-fit index) was used to evaluate model fit (Gignac, 2006). In conjunction with 95% of normalized residuals being less than |2.0|, IFI values of $\geq$ .95 and SRMR values of $\leq$ .08 were considered indicative of a well-fitting model (Gignac, 2006).

The following precautions were taken to control for the possibility that any of the observed findings were a result of age- or gender-related variance and/or nonverbal ability. Correlation analyses were conducted including chronological age, gender, and nonverbal IQ and where any of these variables were found to be significantly correlated with any of the main study variables a regression path was included in the model as a control.

Table 1

Descriptive Statistics for Year 1 Study Variables

Variable	Typically Developing (n = 91)		SLI (n = 30)		Typical Matched Group (n = 30)	
	M	*SD*	*M*	*SD*	*M*	*SD*
Maternal S-E Engagement (max. score 30)	23.32	4.25	22.67	3.10	24.73	3.96
Maternal Language Input (max. score 48)	30.05	4.91	28.52	5.89	30.24	5.42
Mother-Child Book Reading (max. score 5)	4.43	.86	3.97	.89	4.53	.82
Child S-E Engagement (max. score 21)	17.04	2.72	17.27	2.99	17.47	2.87
Child Conversation Skill (max. score 49)	40.86	6.21	30.67	7.04	41.80	5.73
Child Sentential Complements (max. score 4)	2.81	1.44	2.70	1.49	3.47	.78
Child ToM (max. score 8)	3.88	1.96	2.27	1.66	4.07	1.80
Child Emotional PT (max. score 4)	3.25	1.02	2.63	1.07	3.33	.96
Child VPT (max. score 8)	3.97	2.03	2.57	1.48	4.33	2.01
Child Age in Months	61.3	8.3	63.0	9.0	62.8	8.4
Gender (males:females)	46:45		26:4		26:4	
Child Nonverbal IQ	106.26	13.00	105.67	13.74	105.27	12.84

Table 2

Intercorrelations between Year 1 Variables for Typically Developing Children

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Maternal S-E Engagement	--												
2. Maternal Language Input	.02	--											
3. Mother-Child Book Reading	.28*	.16	--										
4. Child S-E Engagement	.30†	-.09	.28*	--									
5. Child Conversation Skill	.33†	.23*	.43†	.43†	--								
6. Child Sentential Complements	-.05	.22*	.05	.07	.24*	--							
7. Child ToM	.09	.21*	.24*	.22*	.34†	.62†	--						
8. Child Emotional PT	.00	.18	.13	.12	.33†	.37†	.27*	--					
9. Child VPT	.07	.11	.15	.13	.18	.60†	.61†	.22*	--				
10. Perspective Taking Factor Score	.08	.21*	.23*	.21*	.35†	.70†	.87†	.55†	.84†	--			
11. Child Age in Months	-.02	.09	.08	.07	.13	.44†	.51†	.16	.55†	.56†	--		
12. Child Gender	-.19	.23*	.11	-.04	.02	.18	.28*	.18	.14	.26*	.04	--	
13. Nonverbal IQ	-.07	.14	-.08	-.12	.16	.20	.20	.14	.05	.16	-.16	.19	--

*$p < .05$, †$p < .005$, $N = 91$

Evaluating Model Fit

Prior to analysis, the data for the relevant study variables (maternal socio-emotional engagement and language input, mother-child book reading, and child socio-emotional engagement, conversation skill, sentential complements scores, and perspective taking factor scores) were checked for multivariate outliers using Mahalanobis distance with $p < .001$ (critical value = 24.32) but none were found. Descriptive statistics for the Y1 study variables for the 91 typically developing children are presented in Table 1. Inspection of the correlations between the measures revealed that the degree of multicollinearity between the variables was acceptable (see Table 2). As child age correlated significantly with child sentential complements and perspective taking factor scores (see Table 2) regression paths were added to the model accordingly. Similarly, as child gender correlated significantly with maternal language input and child perspective taking factor scores (see Table 2) regression paths were added to the model accordingly. However, because nonverbal IQ did not correlate significantly with any of the other variables it was not included as a control variable.

The hypothesized model converged after seven iterations with $\chi^2_{(24)} = 40.13$, $p = .02$ and IFI = .91, SRMR = .10. All of the factor loadings were in the expected direction. All unstandardized point estimates were significant ($p < .05$, one-tailed). Examination of the standardized residual covariances revealed one value over the |2.0| mark; between child socio-emotional engagement and conversation skill. Given that, theoretically, it seems highly likely that the shared practice of mother-child book reading does not completely mediate the relationship between child socio-emotional engagement and conversation skill it was considered acceptable to add a regression path from child socio-emotional engagement to conversation skill. This model converged after seven iterations with $\chi^2_{(23)} = 24.91$, $p = .36$ and IFI = .99, SRMR < .08. Standardized parameter estimates for the revised model are depicted in Figure 2. All of the factor loadings are in the expected direction. All unstandardized point estimates were significant ($p < .05$). Examination of the standardized residual covariances for the revised model revealed none over the |2.0| mark. Therefore, because all indices were in the acceptable range, the revised model was considered to have acceptable model fit. This model predicted 63% ($p < .001$) of the variance in perspective taking scores.

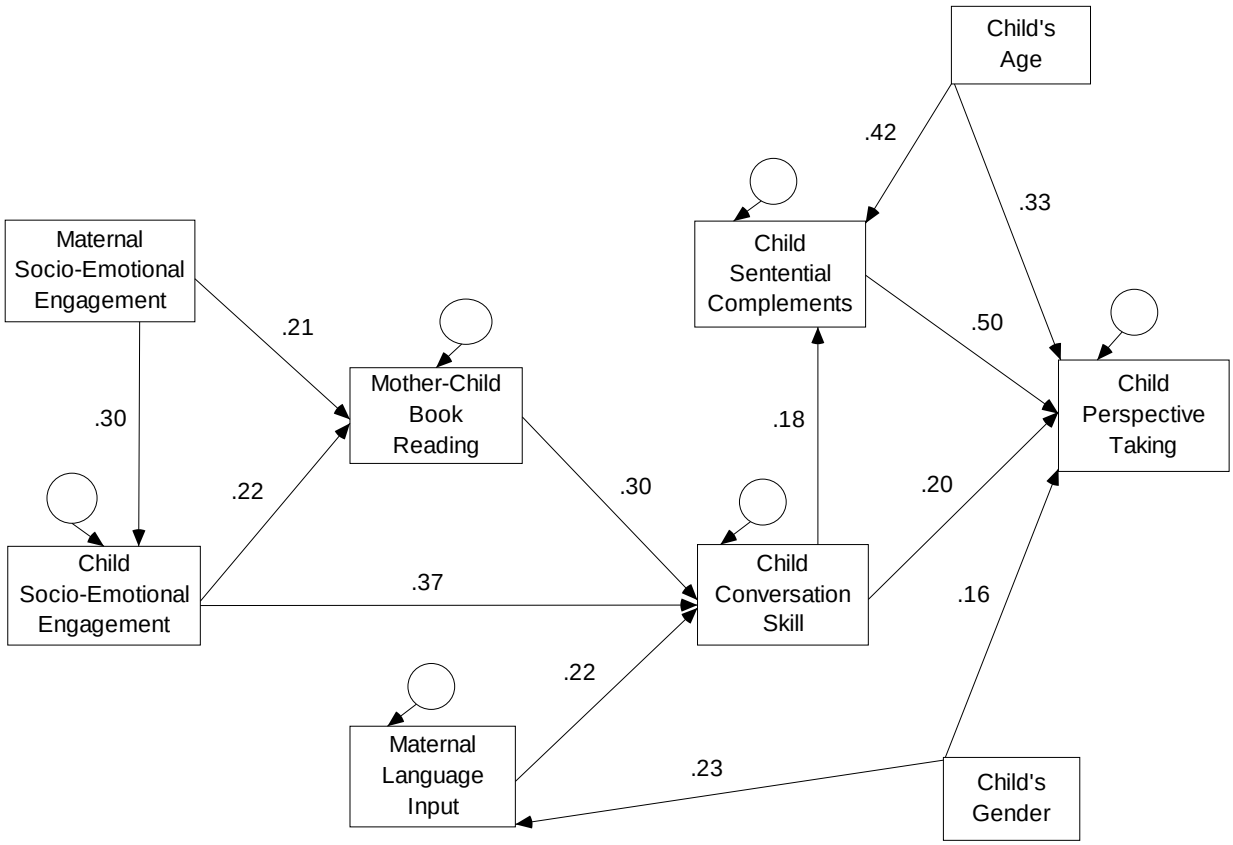

Figure 2. Standardized parameter estimates for the revised model. All reported estimates are the maximum likelihood standardized point-estimates. All unstandardized point estimates were significant ($p < .05$).

Longitudinal Analyses

Complete sets of the relevant longitudinal data were available for 70 (33 male) of the typically developing children (64 Caucasian, 6 Asian) aged between 47 and 76 months ($M = 61.4$ months, $SD = 8.3$ months) at the commencement of the study. Prior to analysis, the data for the main study variables (Y1 and Y2 conversation skill, ToM scores, and perspective taking factor scores) were checked for multivariate outliers using Mahalanobis distance with $p < .001$ (critical value = 22.46) and two were found and removed. The remaining 68 typically developing children (32 male; 62 Caucasian, 6 Asian) were aged between 47 and 76 months ($M = 61.7$ months, $SD = 8.3$ months) at Y1 and between 58 and 89 months ($M = 74.1$ months, $SD = 8.3$ months) at Y2. Descriptive statistics for these 68 typically developing children are presented in Table 3. Inspection of the correlations between the measures revealed that the degree of multicollinearity between the relevant predictor variables was acceptable (see Table 4). Chronological age, gender, and nonverbal IQ were included in the hierarchical regression analyses as control variables at the first step.

Table 3

Means and Standard Deviations of Scores for Year 1 and Year 2 Study Variables for Typically Developing Children

Variable	*M*	*SD*
Y1 Conversation Skill (max. score 49)	42.04	4.53
Y1 ToM (max. score 8)	4.18	1.82
Y2 Conversation Skill (max. score 49)	42.22	5.12
Y2 ToM (max. score 8)	5.43	1.44
Y1 Nonverbal IQ	106.43	13.31

N = 68

Longitudinal Relations between Conversation Skill and Perspective Taking Factor Scores

In the hierarchical regression predicting Y2 perspective taking factor scores, after controlling for Y1 perspective taking factor scores, chronological age, gender, and nonverbal IQ, at the first step, as hypothesized, Y1 conversation skill was a significant predictor at the second step (see Table 5).

Table 4

Intercorrelations between Year 1 and Year 2 Variables for Typically Developing Children

Variable	1	2	3	4	5	6	7	8	9
1. Y1 Conversation Skill	--								
2. Y1 ToM	.21*	--							
3. Y1 Perspective Taking Factor Score	.32*	.84†	--						
4. Y2 Conversation Skill	.81†	.27*	.33†	--					
5. Y2 ToM	.36†	.48†	.51†	.33†	--				
6. Y2 Perspective Taking Factor Score	.50†	.51†	.66†	.45†	.79†	--			
7. Y1 Age in Months	.09	.45†	.56†	.12	.25*	.31*	--		
8. Gender	.00	.24*	.20	-.05	.18	.14	.03	--	
9. Y1 Nonverbal IQ	.10	.26*	.17	.12	.08	.16	-.11	.20	--

*$p < .05$, †$p < .005$, $N = 68$

Table 5

Summary of Hierarchical Regression Analysis for Variables Predicting Year 2 Perspective Taking Factor Score

Variable	*b*	*SE* (*b*)	*β*	*p*	Squared part correlation	ΔR^2
Step 1						.43†
Y1 PT Factor Score	.67	.12	.69	<.01	.29	
Y1 Age in Months	-.01	.01	-.07	.57	.00	
Y1 Nonverbal IQ	.00	.01	.03	.76	.00	
Child Gender	.01	.18	.01	.95	.00	
Step 2						.09†
Y1 PT Factor Score	.55	.11	.56	<.01	.17	
Y1 Age in Months	-.00	.01	-.03	.80	.00	
Y1 Nonverbal IQ	.00	.01	.02	.83	.00	
Child Gender	.11	.16	.07	.50	.00	
Y1 Conversation Skill	.07	.02	.32	<.01	.09	

*$p < .05$, †$p < .005$, $N = 68$

In the hierarchical regression predicting Y2 conversation skill, after controlling for Y1 conversation skill, chronological age, gender, and nonverbal IQ, at the first step, as hypothesized, Y1 perspective taking factor score was not a significant predictor at the second step (see Table 6).

Table 6

Summary of Hierarchical Regression Analysis for Variables Predicting Year 2 Conversation Skill

Variable	*b*	*SE* (*b*)	*β*	*p*	Squared part correlation	ΔR^2
Step 1						.66†
Y1 Conversation Skill	.90	.08	.80	<.01	.62	
Y1 Age in Months	.03	.05	.05	.50	.01	
Y1 Nonverbal IQ	.02	.03	.06	.46	.00	
Child Gender	-.62	.77	-.06	.42	.00	
Step 2						.00
Y1 Conversation Skill	.88	.09	.77	<.01	.53	
Y1 Age in Months	.00	.06	.00	.96	.00	
Y1 Nonverbal IQ	.02	.03	.04	.60	.00	
Child Gender	-.74	.78	-.07	.35	.00	
Y1 PT Factor Score	.47	.54	.09	.39	.00	

*$p < .05$, †$p < .005$, $N = 68$

Longitudinal Relations between ToM and Conversation Skill

In the hierarchical regression predicting Y2 conversation skill scores, after controlling for Y1 conversation skill, chronological age, gender, and nonverbal IQ, at the first step, contrary to Baron-Cohen's (1995) theory, Y1 ToM was not a significant predictor at the second step (see Table 7).

Table 7

Summary of Hierarchical Regression Analysis for Variables Predicting Year 2 Conversation Skill

Variable	*b*	*SE* (*b*)	*β*	*p*	Squared part correlation	ΔR^2
Step 1						.66†
Y1 Conversation Skill	.90	.08	.80	<.01	.62	
Y1 Age in Months	.03	.05	.05	.50	.01	
Y1 Nonverbal IQ	.02	.03	.06	.46	.00	
Child Gender	-.62	.77	-.06	.42	.00	
Step 2						.01
Y1 Conversation Skill	.88	.09	.78	<.01	.58	
Y1 Age in Months	-.00	.05	-.01	.94	.00	
Y1 Nonverbal IQ	.01	.03	.02	.77	.00	
Child Gender	-.84	.78	-.08	.29	.00	
Y1 ToM	.35	.26	.13	.18	.01	

*$p < .05$, †$p < .005$, $N = 68$

In the hierarchical regression predicting Y2 ToM scores, after controlling for Y1 ToM, chronological age, gender, and nonverbal IQ, at the first step, contrary to Baron-Cohen's (1995) theory, Y1 conversation skill was a significant predictor at the second step (see Table 8).

Table 8

Summary of Hierarchical Regression Analysis for Variables Predicting Year 2 ToM

Variable	*b*	*SE* (*b*)	*β*	*p*	Squared part correlation	ΔR^2
Step 1						.24†
Y1 ToM	.37	.11	.46	<.01	.14	
Y1 Age in Months	.01	.02	.04	.79	.00	
Y1 Nonverbal IQ	-.01	.01	-.05	.65	.00	
Child Gender	.22	.33	.08	.50	.01	
Step 2						.07*
Y1 ToM	.32	.10	.41	<.01	.11	
Y1 Age in Months	.01	.02	.03	.80	.00	
Y1 Nonverbal IQ	-.01	.01	-.07	.54	.00	
Child Gender	.27	.31	.09	.40	.01	
Y1 Conversation Skill	.09	.03	.27	.01	.07	

*$p < .05$, †$p < .005$, $N = 68$

Typical Development versus SLI

Summary statistics for age, gender, and nonverbal ability for the group of children with SLI and a subgroup of the sample of typically developing children matched in terms of these variables are displayed in Table 1. These groups had the same gender distribution and did not differ in terms of age, $t(58) = 0.07$, $p = .94$, or nonverbal IQ, $t(58) = 0.12$, $p = .91$. For the two groups, summary statistics for the other Y1 study variables are presented in Table 1.

In addition to their previously reported impaired conversation skill, $t(58) = 6.72$, $p < .001$, partial-$\eta^2 = .44$ (Farrant, Maybery, et al., submitted-b), and sentential complements understanding, $t(58) = 2.50$, $p = .015$, partial-$\eta^2 = .10$ (Farrant, Maybery, et al., submitted-a), and significantly lower maternal socio-emotional engagement, $t(58) = 2.25$, $p = .028$, partial-$\eta^2 = .08$ (Farrant, Maybery, et al., submitted-b), this group of children with SLI were also found to have significantly lower ToM, $t(58) = 4.03$, $p <$

.001, partial-η^2 = .22, emotional PT, $t(58) = 2.67$, $p = .010$, partial-η^2 = .11, and VPT, $t(58) = 3.88$, $p < .001$, partial-η^2 = .21, relative to the typically developing children. They also engaged in significantly less book reading with their mothers, $t(58) = 2.57$, $p = .013$, partial-η^2 = .10. However, the two groups did not differ in terms of maternal language input, $t(56) = 1.16$, $p = .251$ (Farrant, Maybery, et al., submitted-a), or current child socio-emotional engagement $t(58) = 0.26$, $p = .793$. Thus, although these children with SLI had impaired socio-emotional engagement earlier in childhood (see, Farrant, Maybery, et al., submitted-b, for the earlier retrospective measure) this was no longer evident in their current socio-emotional engagement, although their earlier and concurrent levels of socio-emotional engagement were significantly correlated $r(30) = .66$, $p < .001$.

Task Scaling

Memory for False Complements, VPT, and ToM Tasks

The hypothesized relationships between the sentential complements, VPT, and ToM tasks were analyzed next. For the present analyses, to equate the number of questions that had to be responded to correctly to be considered to have mastered each task, children were considered to have passed the sentential complements, level 1 and level 2 VPT, and contents false belief tasks if they answered both target questions correctly, and the diverse desires and diverse beliefs tasks if they answered the target and control questions correctly. For each group of children, Y1 performance on each version of the sentential complements, level 1 and level 2 VPT, diverse desires, diverse beliefs, and contents false belief tasks was compared with performance on the analogue versions using Mann-Whitney U tests. Performance on each of the tasks was not significantly different between the two versions for both typically developing children (all *p*s > .30) and the children with SLI (all *p*s > .39). Therefore, the results were collapsed across the two versions of the tasks. The percentages of children passing each of these tasks are displayed for the matched groups and for the whole sample of typically developing children in Table 9.

The hypothesis, based on de Villiers and de Villiers' (2000; de Villiers, 2005) argument, that the mastery of sentential complement structures associated with communication verbs would precede the mastery of sentential complement structures associated with mental state verbs was tested first. Contrary to this hypothesis, most children mastered thought sentential complements before they mastered said sentential complements with the results of Wilcoxon signed ranks tests supporting this for typically developing children ($p < .001$, one-tailed) (of the 26 children who passed only

one of these tasks 23 passed thought sentential complements) and children with SLI (p = .01, one-tailed) (of the 5 children who passed only one of these tasks all 5 passed thought sentential complements).

The next set of analyses examined the hypothesis that children master sentential complement structures associated with mental state verbs before they master diverse beliefs. Consistent with the hypothesis, most children mastered thought sentential complements before they mastered diverse beliefs with the results of Wilcoxon signed ranks tests supporting this for typically developing children ($p < .001$, one-tailed) (of the 41 children who passed only one of these tasks 31 passed thought sentential complements) and children with SLI (p = .04, one-tailed) (of the 12 children who passed only one of these tasks 9 passed thought sentential complements).

Table 9

Percentage of Children Passing the Year 1 Tasks

Task	Typically Developing (n = 105) % Pass	SLI (n = 30) % Pass	Matched Typically Developing (n = 30) % Pass
Level 1 VPT [a]	92	70	93
Diverse Desires	81	63	87
Thought Complements	74	63	90
Emotional PT [a]	72	50	80
Knowledge Access	68	27	67
Said Complements	55	47	67
Diverse Beliefs	54	43	67
Low Verbal False Belief	54	20	47
Level 2 VPT [a]	48	17	47
Contents False Belief [a]	45	20	37
Level 3 VPT [a]	37	13	40
Array VPT [a]	7	0	10
2nd Order False Belief	1	0	3

[a] two target questions only

The hypothesis that children master sentential complement structures associated with mental state verbs before they master false belief was tested next. Consistent with

the hypothesis, most children mastered thought sentential complements before they mastered contents false belief with the results of Wilcoxon signed ranks tests supporting this for typically developing children ($p < .001$, one-tailed) (of the 33 children who passed only one of these tasks 32 passed thought sentential complements) and children with SLI ($p < .001$, one-tailed) (of the 13 children who passed only one of these tasks all 13 passed thought sentential complements).

The next set of analyses examined the hypothesis, based on Gopnik and Meltzoff's (1997) argument, that the ability to reason with different visual perspectives in the level 1 VPT task would precede the ability to reason with beliefs that conflict with the actual state of affairs in the ToM tasks for typically developing children and children with SLI. Consistent with the hypothesis, most children mastered level 1 VPT before they mastered contents false belief with the results of Wilcoxon signed ranks tests supporting this for typically developing children ($p < .001$, one-tailed) (of the 54 children who passed only one of these tasks 52 passed level 1 VPT) and children with SLI ($p < .001$, one-tailed) (of the 19 children who passed only one of these tasks 17 passed level 1 VPT). Thus, the results for typically developing children and children with SLI are completely consistent with Gopnik and Meltzoff's (1997) argument that the understanding of visual perception is transformed to provide a basis for the child's later understanding of belief.

The hypothesis, based on Gopnik and Wellman's (1992) argument, that children's ability to reason with desires that are different to their own would precede the ability to reason with beliefs that conflict with the actual state of affairs was tested next. Consistent with the hypothesis, most children mastered diverse desires before they mastered contents false belief with the results of Wilcoxon signed ranks tests supporting this for typically developing children ($p < .001$, one-tailed) (of the 40 children who passed only one of these tasks 39 passed diverse desires) and children with SLI ($p = .001$, one-tailed) (of the 17 children who passed only one of these tasks 15 passed diverse desires).

Harris' (1992) argument that the ability to recognize that another person can want or see an object that the child does not, precedes the ability to recognize that another person can think or see something that runs directly counter to what the child currently thinks or sees, was investigated next. As reported above, consistent with this argument, most typically developing children and children with SLI passed level 1 VPT before they passed level 2 VPT, and contents false belief. The patterns of task mastery on the level 1 VPT and diverse beliefs tasks were analyzed next. Consistent with the

hypothesis, most children mastered level 1 VPT before they mastered diverse beliefs with the results of Wilcoxon signed ranks tests supporting this for typically developing children ($p < .001$, one-tailed) (of the 46 children who passed only one of these tasks 43 passed level 1 VPT) and children with SLI ($p = .01$, one-tailed) (of the 12 children who passed only one of these tasks 10 passed level 1 VPT). Thus, the results for typically developing children and children with SLI are completely consistent with Harris' (1992) argument.

The next set of analyses examined the pass-fail contingency between the mastery of diverse desires and level 2 VPT, diverse beliefs, and contents false belief. As reported above, consistent with Harris' argument, most typically developing children and children with SLI mastered diverse desires before they mastered contents false belief, and most typically developing children passed diverse desires before they passed diverse beliefs, but the results for the children with SLI were not as clear cut (of the 11 children with SLI who passed only one of these tasks 7 passed diverse desires). The patterns of task mastery on the diverse desires and level 2 VPT tasks were analyzed next. Consistent with the hypothesis, most children mastered diverse desires before they mastered level 2 VPT with the results of Wilcoxon signed ranks tests supporting this for typically developing children ($p < .001$, one-tailed) (of the 39 children who passed only one of these tasks 37 passed diverse desires) and children with SLI ($p < .001$, one-tailed) (of the 18 children who passed only one of these tasks 16 passed diverse desires). Thus, the present findings for the typically developing children are consistent with Harris' (1992) argument that the ability to recognize that another person can want an object that the child does not, precedes the ability to recognize that another person can think or see something that runs directly counter to what the child currently thinks or sees. The results for the children with SLI demonstrated the same pattern with the exception of a lack of scalable relationships between the mastery of diverse desires and diverse beliefs. As hypothesized, consistent with previous research (Bigelow & Dugas, 2009; Farrant, et al., 2006) and the fourth step in Harris' (1992) theory, the pass/fail scores on the level 2 VPT and contents false belief tasks were significantly correlated , $r_{\phi}(105) = .52$, $p < .001$ (one-tailed), for the typically developing children.

Typical Development versus SLI on the ToM Tasks

Because it was predicted that the typically developing children would perform significantly better on each of the individual ToM tasks, group comparisons were made using one-tailed tests. The percentages of children who passed these tasks are displayed in Table 9. In addition to the previously reported deficit in contents false belief skill

(Farrant, Fletcher, & Maybery, submitted), the present sample of children with SLI also performed significantly worse on the diverse desires, knowledge access, and low verbal false belief tasks compared to the matched group of typically developing children (Mann-Whitney U tests, all *p*s < .03, one-tailed). However, the two groups did not differ significantly on the diverse beliefs task (Mann-Whitney U test, $p = .30$, one-tailed). Thus, consistent with Vygotsky's (1987), Racine and Carpendale's (2007a, 2007b), Hutto's (2008; 2009), de Villiers and de Villiers' (2000; de Villiers, 2005), Harris' (1992; 1996), and Gopnik and Meltzoff's (1997) arguments, the children with SLI were significantly impaired on each of the ToM tasks apart from the diverse beliefs task. Furthermore, contrary to Baron-Cohen's (1995) theory, reasoning involving the volitional mental state of desire was impaired in the children with SLI.

Typical Development versus SLI on the VPT Tasks

As it was predicted that the typically developing children would perform significantly better on each of the individual VPT tasks, group comparisons were made using one-tailed tests. Table 9 displays the percentages of children who passed each of the VPT tasks. The typically developing group performed significantly better than the children with SLI on the level 1, level 2, level 3, and array VPT tasks (Mann-Whitney U tests, all *p*s < .04, one-tailed). Thus, consistent with Vygotsky's (1987), Racine and Carpendale's (2007a, 2007b), Hutto's (2008; 2009), de Villiers and de Villiers' (2000; de Villiers, 2005), Harris' (1992; 1996), and Gopnik and Meltzoff's (1997) arguments, and contrary to Leslie's (German & Leslie, 2001; Leslie & Frith, 1988) and Baron-Cohen's (1995) theories, the children with SLI were significantly impaired on each of the VPT tasks.

Discussion

The current research further investigated the relationships among parenting, socio-emotional engagement, shared practices, language, and perspective taking in human ontogeny. The first aim of the present study was to test the hypothesized relations among parenting, socio-emotional engagement, shared practices, language, and perspective taking (visual, emotional, and cognitive) in typically developing children. The second aim of the study was to test the hypothesized relationships among the sentential complements, VPT, emotional PT, and ToM tasks by analyzing pass-fail contingencies. The third aim was to further test hypotheses regarding the relationship between language and perspective taking by comparing a group of children with SLI with a sub-group of typically developing children matched for age, gender, and NVIQ. These findings are discussed in the following sections.

Factors Involved in the Development of Children's Perspective Taking Skills

Typically developing children's scores on the VPT, emotional PT, and ToM tasks factored together to form a single perspective taking factor. Thus, the present findings indicate that belief-desire reasoning is not an isolated cognitive realm. Furthermore, child conversation skill and sentential complements understanding predicted child perspective taking ability and the results of the longitudinal analyses revealed that conversation skill predicted perspective taking skill (but not vice versa). Thus, the present results provide further support for the roles of language and social interaction in the development of children's perspective taking skills. Further evidence is provided by the finding that child socio-emotional engagement, mother-child book reading, and maternal language input predicted child conversation skill. These latter findings are consistent with previous research that has found a relationship between maternal language use and the development of children's perspective taking skills (e.g., Ruffman, Slade, & Crowe, 2002). The role of socio-emotional engagement in this process is further supported by the current finding that mother and child socio-emotional engagement predicted mother-child book reading.

Delayed Development in Children with SLI

Consistent with previous research demonstrating delayed ToM development in children with SLI (Farrant, et al., 2006; Holmes, 2002; Miller, 2001; Tucker, 2004), and extending the previously reported finding of delayed false belief development in the current sample of children with SLI (Farrant, Maybery, et al., submitted-a), the present results indicate that mastery of diverse desires, knowledge access, and low verbal false belief is delayed in children with SLI. Similarly, consistent with previous research demonstrating delayed development of level 2 VPT understanding in children with SLI (Farrant, et al., 2006) and that language facilitates children's level 2 VPT performance (Ives, 1980), the present results indicate that the mastery of level 1, level 2, level 3, and array VPT are delayed in children with SLI. The results of the present study are also the first to indicate that the development of emotional PT is delayed in children with SLI.

The factors related to this delayed development of perspective taking skills include the previously reported impaired conversation skill (Farrant, Maybery, et al., submitted-b), limited sentential complements understanding (Farrant, Maybery, et al., submitted-a), and significantly lower maternal socio-emotional engagement (Farrant, Maybery, et al., submitted-b). This group of children with SLI also engaged in significantly less book reading with their mothers. However, the two groups did not differ in terms of maternal language input (Farrant, Maybery, et al., submitted-a) or

current child socio-emotional engagement. Thus, while these children with SLI had impaired socio-emotional engagement earlier in childhood (see, Farrant, Maybery, et al., submitted-b, for the earlier retrospective measure) this was no longer evident in their current socio-emotional engagement, although their earlier and concurrent levels of socio-emotional engagement were significantly correlated. A plausible explanation for these latter findings is that children's exposure to professional interventions including attending the Language Development Centre is having a positive impact on their levels of socio-emotional engagement. In the context of the model proposed in the present paper this would also help explain the fact that the Language Development Centre is having success by intervening early in development.

Scaling the Sentential Complements, VPT, Emotional PT, and ToM Tasks

The present results are consistent with previous findings (e.g., de Villiers & Pyers, 2002) and indicate that most typically developing children and children with SLI master sentential complement structures associated with mental state verbs before they master diverse beliefs and false belief. However, contrary to de Villiers and de Villiers' (2000; de Villiers, 2005) argument, most typically developing children and children with SLI master thought sentential complements before they master said sentential complements.

The results of the present pass-fail contingency analyses for typically developing children and children with SLI indicate that the ability to recognize that another person can see an object that the child does not, precedes the ability to recognize that another person can think or see something that runs directly counter to what the child currently thinks or sees. The present findings for the typically developing children also indicate that the ability to recognize that another person can want an object that the child does not precedes the ability to recognize that another person can think or see something that runs directly counter to what the child currently thinks or sees. The results for the children with SLI demonstrated the same pattern with the exception of a lack of scalable relationships between the mastery of diverse desires and diverse beliefs.

Practical Implications

The current findings indicate that children's conversation skill and sentential complements understanding contribute to their perspective taking ability and that mother-child socio-emotional engagement, mother-child book reading, and maternal language input contribute to children's conversation skill. Indeed, the factors related to the delayed development of perspective taking skills in children with SLI include impaired conversation skill and sentential complements understanding, significantly

lower maternal socio-emotional engagement, and significantly less mother-child book reading. Thus, interventions targeting the development of children's perspective taking skills would do well to focus on mother-child book reading such that the emphasis should be on selecting books that are emotionally engaging and language appropriate for the child. Furthermore, as the present findings add to a growing body of literature highlighting the importance of socio-emotional engagement for the development of shared practices including language (e.g., Greenspan & Shanker, 2004; Lewis, 1936; Spitz, 1946; Zeedyk, 2006), there are good grounds to focus on socio-emotional engagement as well. On the relationship between socio-emotional engagement and shared practices see Farrant, Maybery, et al. (submitted-b).

Theoretical Implications

Modular/Nativistic Theories

The present findings do not sit well with Internalist/Nativistic modular theories which by their very nature downplay the role of experience/social interaction to something like triggering. Nativistic claims have served to remove parenting and the child's socio-linguistic environment from center stage in many developmental theories.

Contrary to the prediction drawn from Leslie's modular theory (e.g., German & Leslie, 2001; Leslie, 1994a, 1994b) the present findings add to the existing research demonstrating that VPT development is delayed in children with SLI (e.g., Farrant, et al., 2006). The present findings also add to the burgeoning literature highlighting the role of language in perspective taking (ToM) development (see, Milligan, Astington, & Dack, 2007, for a recent meta-analysis) and this is something that a theory of ToM development should be able to explain. Leslie could argue that language development plays a role in ToM development via facilitating the general executive processes behind selection processing (on the relationship between language and cognitive flexibility/executive functions, see, Farrant, Maybery, et al., submitted-a), but the theory as it stands offers little explanation. Leslie's theory also offers no explanation of the relations among socio-emotional engagement, parenting, shared practices, child language, and perspective taking observed in the present study. In fact all of the extant empirical evidence is explainable without the need to postulate an innate theory of mind mechanism (in the case of autism for example, see, Hobson, 2009) which is, in any case, fairly implausible given the limited evolutionary time between humans and a common primate ancestor (e.g., Stenning & van Lambalgen, 2007) (see also, Hutto, 2008).

Contrary to Baron-Cohen's (1988; 1995) proposals, children's conversation skills did significantly predict their ToM development whereas children's ToM did not

significantly predict their conversation skills. These finding indicate that, consistent with Vygotsky's (1987), Racine and Carpendale's (2007a, 2007b), Hutto's (2008, 2009), Harris' (1992, 1996), and Gopnik and Meltzoff's (1997) arguments, children's ability to engage in conversations with others facilitates their ToM development over time such that individual differences in conversation skill play a role in the development of reflective understanding of psychological concepts. Also, because Baron-Cohen's (1995, 2005) theory posits that VPT, emotional PT, and ToM are processed by separate neurocognitive mechanisms, this theory offers no explanation for the finding that children's scores on the associated tasks factored together to form a single perspective taking factor.

Furthermore, contrary to Baron-Cohen's (1995) argument that the processing of others' behavior in terms of the volitional mental state of desire is the job of an innate module (the intentionality detector), the present results indicate that children with SLI have impaired reasoning involving the volitional mental state of desire. Likewise, contrary to Baron-Cohen's (1995) argument that the perceptual mental state of seeing is processed by an innate module (the eye direction detector), and consistent with previous research (Farrant, et al., 2006), in the present study the children with SLI were significantly impaired on each of the VPT tasks. Thus, the results of the present study indicate that the ability to interpret how another individual sees an object and the volitional mental state of desire are facilitated by language development and therefore are not processed by innate modules.

Baron-Cohen could argue that his theory is neutral with regard to the effect of delayed/disordered language acquisition on VPT ability and the processing of others' desires because he does not consider the intentionality detector, eye direction detector, and shared attention mechanism to be classical Fodorian modules in the sense of being informationally encapsulated. However, as pointed out by Gopnik (1996, p. 182), softened versions of modularity without encapsulation rob the notion of modularity of any epistemological interest because, "if a 'module' just means a functional unit in a cognitive system then all knowledge is modular, and modularity claims are uninteresting". Regardless of whether or not Baron-Cohen's (1995) theory is truly modular in the Fodorian sense, the theory would require revision in order to explain how delayed or disordered language acquisition could have any effect on VPT ability and the processing of other's desires.

Even if Baron-Cohen's (1995) modules are just functional units, his account offers no mechanism or processes whereby language development could facilitate ToM,

emotional PT, or VPT development. Indeed, as the findings of the current study add to the convergent body of evidence indicating that language plays a causal role in ToM development (see, Milligan, et al., 2007, for a recent meta-analysis), there are good grounds to argue that this is something that a theory of ToM development should be able to explain. Also, because Baron-Cohen (1995) argued that epistemic mental states and perceptual mental states are processed by different modules/mechanisms it is not clear how this theory can explain the synchronous emergence of level 2 VPT understanding and false belief understanding found in the present study and in previous research (Bigelow & Dugas, 2009; Farrant, et al., 2006). Furthermore, Baron-Cohen's theory also offers no explanation of the relations among socio-emotional engagement, parenting, shared practices, child language, and perspective taking observed in the present study. In fact all of the extant empirical evidence is explainable without the need to postulate innate emotion detector, intentionality detector, eye direction detector, and shared attention mechanisms (e.g., see, Dube, MacDonald, Mansfield, Holcomb, & Ahearn, 2004, for a behavioral analysis of joint attention behaviors).

Theory-Theory

Gopnik and Meltzoff (1997) argued that adult language is an important source of information that children use in theory construction and that by untangling the structure of language in one domain, the child arrives at solutions that can be applied to solutions in other domains. Consistent with this argument, in the present study the typically developing children's scores on the VPT, emotional PT, and ToM tasks formed a single perspective taking factor and children's conversation and sentential complements skills predicted their perspective taking skills. Gopnik and Meltzoff also argued that cognitive development depends on language development and that children are born into a language community that has already developed a folk ToM which is reflected in its language and semantic structure. The present finding that maternal language input and mother-child book reading predicted typically developing children's conversation skill which in turn predicted their perspective taking skills and the finding that the children with SLI had impaired ToM, emotional PT, and VPT, are consistent with this argument.

The results of the present study are also completely consistent with Gopnik and Wellman's (1992) argument that children's earlier concepts related to perception and desire are re-worked to provide their understanding of belief, and Gopnik and Meltzoff's (1997) argument that the understanding of visual perception is transformed to provide a basis for the child's later understanding of belief. However, Gopnik's (e.g., 1996) theory-theory offers no explanation of the relations among socio-emotional

engagement and shared practices observed in the present study and all the extant empirical evidence is explainable without the need to postulate a starting state nativism such that infants have some highly abstract notions of internal mental states (see, Hutto, 2005, on the paradoxical nature of postulating that infants have innate concepts) and innate theory formation mechanisms.

Simulation Theory

The results of the present study for typically developing children are consistent with Harris' (1992) argument that the ability to recognize that another person can want or see an object that the child does not precedes the ability to recognize that another person can think or see something that runs directly counter to what the child currently thinks or sees. The results for children with SLI were also consistent with this argument except for a lack of scalable relationships between the mastery of diverse desires and diverse beliefs. Consistent with Harris' (1996) emphasis on the role of conversation in the development of children's perspective taking skills, the children with SLI were found to have significantly impaired ToM, emotional PT, and VPT.

The synchronous emergence of level 2 VPT understanding and false belief understanding found in the present study and in previous research (Bigelow & Dugas, 2009; Farrant, et al., 2006) is consistent with the fourth step in Harris' (1992) theory where the child can imagine someone thinking or seeing something that runs directly counter to what the child currently thinks or sees. Furthermore, the present finding that typically developing children's conversation skill predicted their perspective taking skills both concurrently and longitudinally supports Harris' (1996) emphasis on the role of conversation in the development of children's perspective taking skills. However, Harris' theory does not explain the mediating role that children's sentential complements skill plays in this process.

The most plausible explanation of the present findings is that the mastery of sentential complements allows children to reason from conflicting perspectives (de Villiers, 2005; de Villiers & de Villiers, 2000) in the level 2 VPT and contents false belief tasks. However, whether the use of language as a tool in this way represents some kind of simulation process and how the relations between mother-child socio-emotional engagement, shared practices, and children's conversation skill fit into this picture is unclear in Harris' account. Indeed, Harris (2009) has recently argued that it is not exposure to mental state terms (lexical items) or complex syntax (e.g., sentential complements) that facilitates the development of children's perspective taking skills and has instead argued that the pragmatic functions of language use in conversation are what

facilitates this development by repeatedly inviting the child to simulate a different perspective. Thus, it remains unclear whether Harris posits that young children have some kind of innately given direct access to, and knowledge about, their own mental states or whether the understanding of mental states is co-constructed (on the impossibility of a private language of psychological terms, see, Carpendale & Lewis, 2004; Racine, 2004; Wittgenstein, 1958).

Linguistic Determinism

The present findings that most typically developing children and children with SLI mastered sentential complement structures associated with mental state verbs before they mastered diverse beliefs and false belief are consistent with de Villiers and de Villiers' (2000; de Villiers, 2005) linguistic determinism theory. However, contrary to de Villiers and de Villiers' argument that understanding that verbs of communication can take false complements provides a bootstrap for understanding that mental state verbs can take false complements, most typically developing children and children with SLI mastered thought sentential complements before they mastered said sentential complements.

At first blush the present findings may seem to be in conflict with previous research that found that German children performed better on sentential complements tasks with "say" questions than those with "think" questions (Perner, Sprung, Zauner, & Haider, 2003). However, Perner et al. explained this difference as a result of using a procedure where what a puppet said was made more salient by the experimenter impersonating the puppet's voice. Importantly, unlike the present study, in Perner et al.'s "think" condition the children were never explicitly told what the puppet thought and therefore had to infer it from what the puppet said. Therefore, the present findings provide a more valid test of the relationship between the mastery of sentential complement structures associated with communication and mental state verbs. Thus, at least for English speaking children, the results of the present study suggest that de Villiers and de Villiers (2000; de Villiers, 2005) linguistic determinism theory requires revision such that mastery of sentential complement structures associated with mental state verbs precedes the mastery of sentential complement structures associated with communication verbs.

An interesting direction for future research is opened up when the current findings are combined with previous research. Gopnik and Meltzoff (1997) found that verbs of visual perception (e.g., "see") typically emerge in the spontaneous speech of children between the ages of 18 months and 2½ years, before the emergence of mental

state verbs (e.g., "think") around the end of the third year (Bartsch & Wellman, 1995). Bloom et al. (1989) found that sentential complements occurred more frequently with the verb of visual perception "see" than with the mental state verb "think" in the spontaneous speech of children aged between two and three. These findings suggest that the mastery of sentential complement structures with verbs of visual perception may bootstrap the mastery of sentential complement structures with mental state verbs. This hypothesis is consistent with Gopnik and Meltzoff's (1997, p. 117) argument that the "understanding of visual perception is itself further transformed to provide a basis for the child's later understanding of belief" and the finding that both false-belief understanding and level 2 visual perspective taking are delayed in children with SLI (Farrant, et al., 2006).

Narrative Practices Hypothesis

Hutto (2008, 2009) argued that children's unprincipled embodied engagements with others are elaborated and extended in complex ways via exposure to folk psychological narratives to provide the basis for children's understanding of their own and other's intentional actions. The present findings, for typically developing children, that maternal socio-emotional engagement predicted child socio-emotional engagement and these both predicted mother-child book reading which along with maternal language input predicted child conversation skill which in turn predicted their perspective taking skills, are consistent with this argument. Furthermore, the finding that typically developing children's conversation skill predicted their perspective taking skills one year later, after controlling for initial perspective taking skills, and that the reverse prediction was not significant, along with the finding that the children with SLI had impaired ToM, emotional PT, and VPT, are also consistent with the Narrative Practices Hypothesis. However, Hutto's theory does not directly explain the role that mastery of sentential complements plays in the development of children's perspective taking skills. Thus, the present findings suggest that the explanatory power of Hutto's theory would be enhanced by delineating the role that mastering complex syntactic structures plays in children's conceptual development.

Constructivism

Racine and Carpendale (2007a, 2007b) argued that reflective understanding of psychological concepts occurs via the mastery of shared public concepts through shared linguistic practice grounded in shared forms of activity which are naturally embedded in socio-emotional engagement. The present findings, for typically developing children, that maternal socio-emotional engagement predicted child socio-emotional engagement

and these both predicted mother-child book reading which along with maternal language input predicted child conversation skill which in turn predicted their perspective taking skills, are consistent with this argument. Furthermore, the finding that the children with SLI had impaired ToM, emotional PT, and VPT along with the finding that typically developing children's conversation skill predicted their perspective taking skills one year later, and that the reverse prediction was not significant are also consistent with Racine and Carpendale's theory. However, Racine and Carpendale's theory does not directly explain the role that mastery of sentential complements plays in the development of children's perspective taking skills. Thus, although it could be argued that mastering complex syntactic structures is part of the shared practice of being able to talk about and, therefore, reflectively understand psychological concepts, delineating the precise role of complex syntactic structures in this process (perhaps by drawing on Vygotsky's arguments) could further enhance the explanatory power of Racine and Carpendale's theory.

Vygotsky's Developmental Theory

Vygotsky's (1930/1981, 1987, 1997, 1998) developmental theory is consistent with all the present findings because it recognizes the importance of socio-emotional engagement, socio-linguistic interaction, and language development (including the mastery of complex syntactic structures) in the development of hierarchical conceptual structures that facilitate the ability to identify and explicitly reason with conflicting perspectives. That is, important developmental milestones occur when the development of language intersects with the development of cognition: Semantic/conceptual development is only beginning when a new word is learned and the development of the meaningful aspects of speech by engaging in conversations with more competent language users is critical for the child's cognitive development. The ability to identify and explicitly reason with conflicting or contradictory perspectives only becomes possible after the relevant concepts have been connected together in an appropriate hierarchical system. After a child masters a hierarchical structure in a particular domain s/he can use this to restructure/reform other existing conceptual structures. Thus, in terms of Vygotsky's (1930/1981, 1987, 1997, 1998) developmental theory, the sentential complements tasks are measures of the child's conceptual development, the development of hierarchical conceptual structures in particular, and it is the development of appropriate hierarchical conceptual structures that underlies children's performance on each of the explicit perspective taking tasks (ToM, emotional PT, and VPT).

The results of the present study, when combined with the findings of previous research reviewed above indicate that, consistent with Vygotsky's (1930/1981; 1987; 1997; 1998) development theory, contra Piaget, the child does not begin in an egocentric state, in a world of its own. Rather, the infant's emotional experience of the world, the social world in particular, is where the child's first experiences of self and other originate. The child first experiences the self in others and it is via interacting with others that the child becomes able to increasingly differentiate his/her own perspective from the perspective of others. This is a truly developmental process, for which language provides important psychological tools, which continues throughout the lifespan, at least for those who are emotionally motivated to gain an increasingly better understanding of others and, by doing so, themselves.

The extant research is also consistent with the argument (e.g., Mundy & Neal, 2001; Trevarthen & Aitken, 2001) that, like other mammalian species, human infants have "experience expectant" neural systems that rely on and take advantage of regular aspects of the environment and associated stimulus input for their normal development. Human infants' social orienting/socio-emotional engagement and the associated responsive behavior of caregivers play important roles in ensuring that these neural systems receive the social stimuli they require for the development of shared practices including joint attention, language, and perspective taking (see also, Gottlieb, 2002, on the role of probabilistic epigenesis in the development of species typical behaviors).

Vygotsky (1987) pointed out that Piaget's theorizing failed to integrate the structure and function of children's thinking and speech, and that this is why Piaget failed to recognize that the characteristics of young children's thinking are a product of the underdevelopment of their conceptual systems rather than some kind of egocentrism. It also seems likely that, had he still been alive, Vygotsky would have leveled a similar criticism at Chomsky's (1959) argument that was the impetus behind much of the theorizing and research in developmental cognitive psychology that seeks to identify some specialized module(s) or mechanism(s) to explain the socio-cognitive differences between humans and other primates. The development of children's cognitive skills, syntactic skills, word meaning, and conceptual structures cannot be adequately understood if they are artificially divorced from each other and children's thinking, speech, and social learning experiences (Vygotsky, 1987). This does not in any way undervalue any of previous work which focused on any of these in isolation, because this specialization has furthered our understanding, but, as is the case in other sub-disciplines, a complete understanding requires a re-integration (Sokol & Strout,

2007). However, poverty of the stimulus arguments demonstrate nothing more than the poverty of our understanding of the stimulus and the present findings highlight the advantages of constructivist approaches that put parenting and the child's socio-linguistic environment back on center stage.

Conclusions

Thus, while children's first hand experience results in behaviors that reflect the regularities in their environment, the acquisition and internalization of the tools of language enables thought that is not tied to perception (Vygotsky, 1987) using increasingly complex fine grain distinctions about the inner (mental/psychological) workings of themselves and others. The child's path to understanding their own and other's mental life is much the same as the current authors' task: to learn the conceptual structure of the language used by others and use it as a means of satisfying one's emotional drives. The emotional factors that motivate the use of perspective taking skills for pro-social or Machiavellian ends are not well understood and, as the plight of our world suggests, in desperate need of more research.

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Appendix A: Detailed Procedure for ToM Tasks

Diverse Desires

Wellman and Liu's (2004) diverse desires task assesses whether the individual understands that other people can have desires that differ from his/her own. The child is shown a doll and a page depicting a carrot and a cookie. "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." The child is asked the own-desire question: "Which snack would you like best? Would you like a carrot or a cookie best?" If the child chooses the cookie (carrot): "Well, that's a good choice, but Mr. Jones really likes carrots (cookies). He doesn't like cookies (carrots). What he likes best are carrots (cookies)." The child is asked the target question: "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?" The child is asked the control question: "Which snack does Mr Jones like best? Carrots or cookies?" The second (analogue) version of the diverse desires task was identical to the first except that the child was told it was playtime and that "Teddy" the teddy bear wanted a toy to play with and could choose between a doll and a truck.

Diverse Beliefs

Wellman and Liu's (2004) diverse beliefs task assesses whether the individual understands that other people can have beliefs that differ from his/her own. The child is shown a doll and a page depicting bushes and a shed. "Here's Mr. Jones. Mr. Jones wants to find his cat. His cat might be hiding in the bushes or in the shed." The child is asked the own-belief question: " Where do you think the cat is? In the bushes or in the shed?" If the child chooses the bushes (shed): "Well, that's a good idea, but Mr. Jones thinks his cat is in the shed (bushes). He thinks his cat is in the shed (bushes)." The child is asked the target question: "So where will Mr. Jones look for his cat? In the bushes or the shed?" The child is asked the control question: "Where does Mr. Jones thinks his cat is? In the bushes or the shed?" The procedure for the second diverse beliefs task was identical to the first except that the child was told that "Teddy" was looking for the jam which might be in the cupboard or in the fridge.

Knowledge Access

Wellman and Liu's (2004) knowledge access task assesses if the individual understands that whether or not someone knows something depends on whether they have had access to the relevant information. The child is shown a nondescript opaque plastic box with a closed drawer containing a small plastic toy dog inside. "Here's a drawer. What do you think is inside the drawer?" (The child's answer is immaterial.)

The drawer is opened and the child is shown the content of the drawer: "Let's see … it's really a dog inside!" The drawer is closed and the child asked the control question: "Okay, what is in the drawer?" A doll is produced: "Mr. Jones has never seen inside this drawer. Now here comes Mr. Jones." The child is asked the target question: "So, does Mr. Jones know what is in the drawer?"; followed by the memory question: "Did Mr. Jones see inside this drawer?" To be scored correct, the child must answer "dog" to the control question and "no" to both the target and memory questions. The procedure for the second knowledge access task was identical to the first except that the props were the teddy bear and a nondescript case containing a cracker biscuit.

Contents False Belief

Wellman and Liu's (2004) contents false belief task assesses whether the individual understands that people can hold false beliefs about reality. The child is shown a clearly identifiable closed Band-Aid box with a small plastic toy pig inside. "Here's a Band-Aid box. What do you think is inside the Band-Aid box?" "Let's see … it's really a pig inside!" The Band-Aid box is closed and the child is asked the control question: "Okay, what is in the Band-Aid box?" A doll is produced: "Mr. Jones has never seen inside this Band-Aid box. Now here comes Mr. Jones." Then the child is asked the first target question (others false belief): "So what does Mr. Jones think is in the box? Band-Aids or a pig?" Followed by the memory question: "Did Mr. Jones see inside this box?" and the second Target Question (own false belief): "What did you first think was inside the Band-Aids box before we opened it? Band-Aids or a pig?" The procedure for the second contents false belief task was identical to the first except that the props were the teddy bear and a Smarties box with crayons inside.

Low Verbal False Belief

To check the child's understanding of "thought bubbles"**,** the child is shown two pictures, one depicting a girl thinking about a bottle (a girl with an attached thought bubble containing a bottle) and the other depicting a girl holding a bottle and is asked "Which girl is thinking about a bottle?" The child is shown a picture of a boy holding a fishing rod with the line going into the water and a flap (which depicts a plausible obstruction (reeds)) that covers what is on the end of the line (a boot). "See this water? Look. It has fish in it. This is Fred. Fred thinks he has caught a fish on the fishing-line. Can you cover Fred with your hand while we have a look at what is really on the fishing-line?" This emphasises Fred's ignorance of what is on the fishing-line. After the flap is replaced, the child is shown a separate picture of Fred with a blank thought bubble above his head. Next to this picture are four small pictures. Two of these

pictures are of distracter items, one shows the content of Fred's belief (a fish) and the other shows the actual object (a boot). Then the child is asked the target question: "Can you point to what Fred thinks is on the fishing-line?" Followed by the control question: "Can you point to what is really on the fishing-line?" To be scored correct, the child must point to the fish in response to the target question and to the boot in response to the control question. The procedure for the second low verbal false belief task was identical to the first except that the protagonist Charlie thinks there is a fish under the reeds when it is really a mermaid.

Second Order False Belief

The child is shown a picture of a boy and his mum. "This is Andrew, and this is his Mum. Tonight it's Andrew's birthday, and Mum is surprising him with a kitten. Mum wants it to be a secret, so she has hidden the kitten in the garden shed. Andrew says, 'Mum, I really hope you get me a kitten for my birthday.' Remember, Mum wants to surprise Andrew with a kitten. So, instead of telling Andrew she got him a kitten, Mum says, 'Sorry Andrew, I did not get you a kitten for your birthday. I got you a really great toy instead.'" The child is then asked the first order false belief question: "So what does Andrew think his Mum got him for his birthday? A kitten or a toy?" (If correct: That's right, Andrew thinks he's getting a toy; If incorrect: But remember, Andrew thinks he's getting a toy) Followed by the first memory control question: "What did Mum really get Andrew for his birthday? A kitten or a toy?" (If correct: That's right, Mum wants to surprise Andrew with a kitten; If incorrect: But remember, Mum wants to surprise Andrew with a kitten) "Now, Andrew says to Mum, 'I'm going outside to play.' On his way outside, Andrew decides to get his roller-skates from the garden shed. When he opens the door to the garden shed, Andrew finds the birthday kitten! (Child is shown a picture of a kitten in a shed) Andrew says to himself, 'Wow, Mum didn't get me a toy, she really got me a kitten for my birthday.' Now, the important thing is that Mum did not see Andrew go to the garden shed and find the birthday kitten." The child is then asked the second memory control question: "Does Andrew know that his Mum got him a kitten for his birthday?" (If yes: That's right, Andrew saw the kitten in the garden shed; If no: But remember, Andrew saw the kitten in the garden shed) Followed by the third memory control question: "Does Mum know that Andrew saw the birthday kitten in the garden shed?" (If no: That's right, Mum did not see Andrew go to the garden shed and find the kitten; If yes: But remember, Mum did not see Andrew go to the garden shed and find the kitten) "While Andrew is outside, Andrew's grandmother drops in for a chat with Andrew's mum. (Child is shown a picture of mum and

grandma) Grandma asks Mum, ‘Does Andrew know what you really got him for his birthday?’” The child is then asked the second order ignorance question: “What does Mum say to Grandma?” “Now remember, Mum does not know that Andrew saw what she got him for his birthday. Then, Grandma asks Mum, ‘What does Andrew think you got him for his birthday?’” The child is then asked the second order false belief question: “What does Mum say to Grandma?” Followed by the justification question: “Why does Mum say that?” To be scored correct on the first order false belief, the child must answer both the first order false belief question and the first memory control question correctly. To be scored correct on the second order false belief, the child must all of the questions correctly. The procedure for the other second order false belief task was identical to the first except that the child (Molly) wants a bike for her birthday but her dad tells her he got her a really great toy instead.

Appendix B: Detailed Procedure for VPT Tasks

Level 1 VPT

The level 1 VPT task involves the ability to infer what objects another person does and does not see. The child is shown a card (7cm × 10cm) and told: "Here's a card, it has a picture on one side and a different picture on the other side" (a house on one side and a cat on the other). The child is shown one of the pictures and asked: "What is this called?" The process is repeated for the picture on the opposite side of the card. A doll is introduced as Mr. Jones and the child told: "Mr. Jones is going to sit over here" (opposite side of the table from the child). The card is held vertically between the child and Mr. Jones so that the picture of the cat faces the child and the child is asked: "Which picture does Mr. Jones see, the cat or the house?" The orientation of the card is reversed and the question repeated. Then the child is asked the control question, "Which picture do you see, the cat or the house?" The procedure for the second level 1 VPT task was identical to the first except that the props were a teddy bear and a card with picture of a truck on one side and a dog on the other.

Level 2 VPT

The level 2 VPT task involves the ability to recognise that an object that is simultaneously visible to both self and other will nonetheless give rise to different visual impressions if their viewing circumstances differ. The materials for the level 2 task were identical to the level 1 task and the procedures also closely matched. The child is shown a picture on a card (a turtle) and asked to name it. To confirm that the child understands the meanings of the terms 'right-way-up' and 'upside-down' the child is asked "can you turn this card so that you see it right-way-up?" and then "can you turn this card so that you see it upside-down?" As in the level 1 task, Mr. Jones is introduced and placed opposite the child. The card is placed flat on the table so it is right-way-up to the child and upside-down to Mr. Jones and the child is asked: "Which way does Mr. Jones see the turtle, right-way-up or upside-down?" The card is turned so it is upside-down to the child and right-way-up to Mr. Jones and the question repeated. Then the child is asked the control question, "Which way do you see the turtle, right-way-up or upside-down?" The procedure for the second level 2 VPT task was identical to the first except that the props were a teddy bear and a card with picture of a car.

Level 3 VPT

The materials for the level 3 task were similar to the level 2 task and the procedures also closely matched. The child is shown a picture on a card (a dog) and asked to name it. To confirm that the child understands the meanings of the terms 'right-

way-up' and 'upside-down' the child is asked "can you turn this card so that you see it right-way-up?" and then "can you turn this card so that you see it upside-down?" As in the level 2 task, Mr. Jones is introduced and placed opposite the child. "Here is a different card; it has a picture of a dog and a picture of a truck on it, one is right-way-up and the other is upside-down." (on the same side of the card) The card is placed flat on the table between the child and Mr. Jones so that one of the pictures faces the child right-way-up. "Which picture does Mr. Jones see upside-down, the dog or the truck?" "Which picture does Mr. Jones see right-way-up, the dog or the truck?" Then the child is asked the control question, "Which picture do you see right-way-up, the dog or the truck?" The procedure for the second level 3 VPT task was identical to the first except that the props were a teddy bear and a card with a picture of a house and a picture of a cat.

Array VPT

The array VPT task assesses the ability to infer what an array of objects would look like from another spatial location. The child is shown a piece of paper (21cm × 21cm) and told: "Here's a sheet of paper with four colored circles on it (the array), three circles are yellow and one is blue, can you show me which one is blue?" A doll is introduced as Mr. Jones and the child told: "Mr. Jones is going to sit over here" (opposite side of the table from the child). The array is placed on the table between the child and Mr. Jones. A card containing a series of four scaled down (6cm × 6cm) versions of the array shown from 0°, 90°, 180°, and 270° orientations is placed between the child and the array. "Here's a card that has four smaller versions of the piece of paper on it, they are the same, just smaller." Then, pointing to each of the scaled down versions in turn: "Which way does Mr. Jones see the piece of paper: like this, like this, like this, or like this?" This process is repeated with the array in a different orientation. Then the child is asked the control question, "Which way do you see the piece of paper: like this, like this, like this, or like this?" The materials and procedure for the second array VPT task were identical to the first except that the prop was a teddy bear.

Appendix C: Detailed Procedure for Emotional PT Tasks

Initial Emotion Labeling Task

The child is shown a piece of paper with pictures of two faces, one happy, one sad (gender matched to that of the child). The experimenter points to one of the faces and asks, "How does s/he feel?" Then the experimenter points to other face and asks, "How does s/he feel?" (If the child is incorrect, the correct answer is provided and the task repeated until the child agrees that the faces show the correct emotion.) Next the child is shown another piece of paper on which the location of the faces has been switched the experimenter asks the child to "Show me the happy face?" followed by "Show me the sad face? (If the child is incorrect, the correct answer is provided and the task repeated until the child points to the correct face for both emotions.)

Emotional PT Task

The child is then asked, "Who is your best friend?" (If the child does not respond, the child is asked 'who do you like to play with?' If they provide more than one name, the first one they mention is used.) "Now I am going to tell you some short pretend stories about you and _____. After each story, I will ask how you and _____ would feel. I want you to point to the face that shows how you would each feel. If you think that the person would be happy, point to the happy face or say happy. If you think that the person would be sad, point to the sad face or say sad." "Ok, here is the first story, you and _____ are playing with your toys and someone walks by and steps on them. Your favourite toy gets broken, but all of _____ toys are okay. How does _____ feel? How do you feel?" (If the child vocalizes an answer other than happy or sad, the child is asked to point to the face that shows how the person would feel.) "Here is the second story, when you are out on the playground, everyone wants to play with you and no one wants to play with _____. How do you feel? How does _____ feel?"

The procedure for the second set of emotional PT task was identical to the first except that the stories were as follows: "You and _____ both make houses out of blocks and then leave to get some more blocks. When you come back, someone has knocked down your house but _____ house is still there. How does _____ feel? How do you feel?", and "Someone in your class is having a birthday party. You are invited, but _____ is not invited to go. How do you feel? How does _____ feel?"

Appendix D: Memory for False Complements Tasks

Memory for False Complements Task Set 1

Thought

1. (First picture) The woman thought it was a spider.
   (Second picture) But look, it was really hair.
   (Pointing back at first picture) What did the woman think it was?
2. (First picture) The boy thought it was a horse.
   (Second picture) But look, it was really a donkey.
   (Pointing back at first picture) What did the boy think it was?

Said

1. (First picture) The girl said there was a bug in her cereal.
   (Second picture) But look, it was really a raisin.
   (Pointing back at first picture) What did the girl say was in her cereal?
2. (First picture) The woman said she was eating an egg.
   (Second picture) But look, it was really a ball.
   (Pointing back at first picture) What did the woman say she was eating?

Memory for False Complements Task Set 2

Thought

1. (First picture) Teacher thought the girl was reading a book.
   (Second picture) But look, the girl was really playing cards.
   (Pointing back at first picture) What did Teacher think the girl was doing?
2. (First picture) The woman thought it was a ghost.
   (Second picture) But look, it was really a sheet.
   (Pointing back at first picture) What did the woman think it was?

Said

1. (First picture) Teacher said there was a bug in the girl's hair.
   (Second picture) But look, it was really a leaf.
   (Pointing back at first picture) What did Teacher say was in the girl's hair?
2. (First picture) The girl said she drew a face.
   (Second picture) But look, it was really a scribble.
   (Pointing back at first picture) What did the girl say she drew?

Appendix E: Items in the Conversation Skill and Socio-Emotional Engagement scales

Conversation Skill scale

1. My child's answers are connected to what I asked. *
2. My child's responses follow what I am talking about. *
3. When I ask my child a question to check what s/he means, s/he answers me. *
4. If I ask my child to repeat something I haven't understood, s/he does. *
5. My child's sounds/gestures/words match my topic of conversation with him/her. *
6. In a conversation, my child stays on the same topic for two or more turns. *
7. My child's answers are appropriate (e.g. does not give too much or too little information).

* Items from the Conversation Skills Rating Scale (Girolametto, 1997)

Socio-Emotional Engagement scale

1. How often does your child enjoy being hugged and cuddled by familiar people now?
2. How often does your child show affection toward familiar people now?
3. How often does your child show a desire to please you or other significant people?

Appendix F: Example Vignette from Peterson and Slaughter's (2003) Maternal Mental State Input Inventory

(classification of each of the four associated response options is shown in parentheses)

'Lost Keys'

Mum tossed her keys onto the seat of the sofa and then rushed out of the room to answer the phone. While she was gone, the keys slid down a big crack between the cushions and disappeared from view. Emma, age 4, watched at this happening. Now Mum is coming back. She needs the keys and decides to search for them. First she looks all over the sofa and the table beside it. Then she has an idea. Firmly believing she left the keys on the bedside table where the phone is, she heads back to the bedroom to retrieve them. Emma follows her, asking "Why are you going into the bedroom again, Mum?" Mum says:

(a) "To get the keys: I need the keys to unlock the garage. They are probably by the phone." (non-elaborated non-mental state)

(b) "To get the keys: I need them to unlock the garage, and I don't know where they are. I thought I put them on the sofa, but I could not see them there when I looked there just now. Maybe I just imagined putting them on the sofa. Really, I must have left them by the phone when I rushed in to answer it just now." (elaborated mental state)

(c) "To get the keys: I need them to unlock the garage. I'm just going into the bedroom again to get them, because they are probably by the phone. I am glad you are coming with me because we can both comb our hair in front of the big mirror in the bedroom once I get the keys." (elaborated non-mental state)

(d) "To get the keys: I need them to unlock the garage and I don't know where they are, so I'm going to look for them by the phone." (non-elaborated mental state)

Chapter 6

General Discussion

The overarching aim of the current longitudinal research project was to broaden our understanding of the factors involved in the development of children's perspective taking skills. This was achieved by adopting a social constructivist approach to the factors involved in, and the relationships among, the development of ToM, VPT, and emotional perspective taking skills in typically developing children and children with SLI. Predictions were drawn from the constructivist ideas inherent in a number of theories and these were contrasted with predictions based on non-constructivist (usually nativistic) ideas wherever possible. The theoretical and practical implications of the present findings will be discussed shortly, following a brief overview of the key findings from each of the empirical chapters for typically developing children and children with SLI.

Summary of Findings for Typically Developing Children

The first empirical chapter (chapter 2) reported the validation of a parent report measure of children's conversation skill suitable for use in research investigating the developmental relationship between perspective taking (e.g., ToM) and conversation skill. The factor structure of the 7-item conversation skill scale was found to be sound in both groups of typically developing children, with all 7 items loading well onto a single component accounting for over half of the total variance. The reliability of this 7-item scale was good in both groups of typically developing children. Furthermore, as predicted, typically developing children's scores on the conversation skill scale were significantly correlated with their ToM ability even after controlling for age and nonverbal IQ. Thus, the present findings for typically developing children attest to the reliability and construct validity of the conversation skill scale and its suitability for use in research investigating the developmental relationship between perspective taking and conversation skill.

Analyses investigating the precursors of children's conversation skill were reported in the second empirical chapter (chapter 3). The results of the analyses for both groups of typically developing children indicated that joint attention and imitation mediated the relationship between early childhood socio-emotional engagement and children's subsequent conversation skill. The data from the first year of the main longitudinal research project for the typically developing children also indicated that maternal socio-emotional engagement facilitates child socio-emotional engagement and the subsequent development of the shared practices of imitation, joint attention, and conversation skill, and also suggested that there may be a direct relationship between maternal socio-emotional engagement and child imitation**.**

Chapter 4 investigated the relationships among language, executive function (cognitive flexibility), and children's false belief understanding. Analyses of the concurrent and longitudinal (one year later) data for typically developing children from the main longitudinal research project revealed that maternal language input predicts the child's memory for false complements, which in turn predicts cognitive flexibility and explicit false belief understanding, with cognitive flexibility partially mediating the effect of memory for false complements on explicit false belief understanding.

The fourth and final empirical chapter (chapter 5) brought a constructivist perspective to the relationships among parenting, socio-emotional engagement, shared practices, language (sentential complements understanding, conversation skill), and perspective taking (cognitive, visual, emotional). Analysis of the concurrent data from the main longitudinal research project for the typically developing children revealed that children's scores on the VPT, emotional PT, and ToM tasks factored together to form a single perspective taking factor indicating that belief-desire reasoning is not an isolated cognitive realm. Further analyses of the concurrent data found that child conversation skill and sentential complements understanding predicted child perspective taking ability and the results of the longitudinal analyses revealed that conversation skill predicted perspective taking skill (but not vice versa). Analyses also revealed that child socio-emotional engagement, mother-child book reading, and maternal language input predicted child conversation skill. These latter findings are consistent with previous research that has found a relationship between maternal language use and the development of children's perspective taking skills (e.g., Ruffman, Slade, & Crowe, 2002). Thus, the findings of chapter 5 provide further support for the roles of language and social interaction in the development of children's perspective taking skills. The finding that mother and child socio-emotional engagement predicted mother-child book reading provides further support for the role of socio-emotional engagement in this process.

Consistent with previous research (e.g., de Villiers & Pyers, 2002), the results of chapter 5 indicate that most typically developing children master sentential complement structures associated with mental state verbs before they master diverse beliefs and false belief. The results of the pass-fail contingency analyses for typically developing children revealed that the ability to recognize that another person can see an object that the child does not precedes the ability to recognize that another person can think or see something that runs directly counter to what the child currently thinks or sees. These results also indicate that the ability to recognize that another person can want an object

that the child does not precedes the ability to recognize that another person can think or see something that runs directly counter to what the child currently thinks or sees.

Summary of Findings for Children with SLI

The finding, from the first empirical chapter (chapter 2), that the group of children with SLI had significantly lower scores on the conversation skill scale than a sub-group of the typically developing children matched for age, gender, and non-verbal ability (phase three) attests to the validity of the conversation skill scale and its suitability for use in research investigating the factors involved in the development of perspective taking skills in children with SLI. In terms of the factors associated with the impaired conversation skill found in the children with SLI, the findings of chapter 3 indicate that these children had deficits in early childhood socio-emotional engagement, joint attention, and imitation, and that their mothers also had significantly lower socio-emotional engagement. Indeed, the findings suggest that small deficits in parent-child socio-emotional engagement are associated with larger deficits in child imitation, joint attention, and conversation skill.

Consistent with a growing body of research indicating that SLI is associated with delayed ToM development (Farrant, et al., 2006; Holmes, 2002; Miller, 2001; Tucker, 2004), the findings of the third empirical chapter (Chapter 4) revealed that the children with SLI had significantly lower explicit false belief scores. The results also indicate that the delayed ToM development in children with SLI is likely to be underlaid by delays in the acquisition of memory for false complements and cognitive flexibility.

Further evidence of delayed ToM development in children with SLI was provided by the findings reported in chapter 5. These findings indicate that, in addition to delayed false belief understanding, the mastery of diverse desires, knowledge access, and low verbal false belief is also delayed in children with SLI. Similarly, consistent with previous research demonstrating delayed development of level 2 VPT understanding in children with SLI (Farrant, et al., 2006), the results reported in chapter 5 indicate that the mastery of level 1, level 2, level 3, and array VPT are delayed in children with SLI. The results of chapter 5 are also the first to indicate that the development of emotional PT is delayed in children with SLI.

In addition to the impaired conversation skill (reported in chapter 2), cognitive flexibility, and memory for false sentential complements (reported in chapter 4), the factors related to the delayed development of perspective taking skills in children with SLI included significantly less book reading with their mothers. However, the children with SLI did not differ from a matched group of typically developing children in terms

of current child socio-emotional engagement. Thus, while these children with SLI had impaired socio-emotional engagement earlier in childhood (chapter 3) this was no longer evident in their current socio-emotional engagement, although their earlier and concurrent levels of socio-emotional engagement were significantly correlated. Thus, it appears that children's exposure to professional interventions including attending the Language Development Centre is having a positive impact on their levels of socio-emotional engagement.

Consistent with previous research (P. A. de Villiers, Burns, & Pearson, 2003), the results of chapter 5 indicate that most children with SLI master sentential complement structures associated with mental state verbs before they master diverse beliefs and false belief. The results of the pass-fail contingency analyses for the children with SLI revealed that the ability to recognize that another person can see an object that the child does not precedes the ability to recognize that another person can think or see something that runs directly counter to what the child currently thinks or sees. The findings for the children with SLI also indicate that the ability to recognize that another person can want an object that the child does not precedes the ability to recognize that another person can see something that runs directly counter to what the child currently sees.

Theoretical Implications

The results of chapter 3 support Racine and Carpendale's (2007a, 2007b) constructivist argument that shared practices such as joint attention are naturally embedded in socio-emotional engagement and that the acquisition of shared linguistic practice is grounded in the development of competence in shared forms of activity such as joint attention. These results also support a number of constructivist theories that focus on the facilitative role that socio-emotional engagement plays in the development of joint attention skills (Gomez, Sarria, & Tamarit, 1994; Hobson, 2005; Mundy & Acra, 2006; Trevarthen & Aitken, 2001). They also indicate that by paying attention to social partners (by engaging socio-emotionally or being socially motivated; Dawson, et al., 2002) infants take the first step towards achieving joint attention (Hobson, 2005; Pruden, Hirsh-Pasek, & Golinkoff, 2006) by ensuring that the relevant brain systems receive sufficient social input (Mundy & Acra, 2006; Trevarthen & Aitken, 2001). Combining the results of chapters 3 and 5 also suggests that children's level of socio-emotional engagement is responsive to the socio-emotional engagement of those they interact with, which provides further support for the constructivist theories. While this latter finding may appear to be self evident to many of those who have interacted with

infants and young children, its importance is more or less totally overlooked in much of western developmental psychology's theorising about the development of language and perspective taking. Perhaps this is because much of this theorising has sought internalist/nativistic explanations for the cluster of symptoms associated with autism (and this may itself be partially attributable to an overreaction to the "refrigerator mother" hypothesis).

As noted in chapter 5, the idea of a domain specific theory of mind mechanism was promoted as an explanation for a series of findings that were interpreted as demonstrating that children with autism have impaired ToM and intact VPT skills (Langdon, 2003). However, caution is needed here because all of these studies involved children with autism who were much older than the age at which the forms of VPT that were tested typically develop (see Baron-Cohen, 1993, for a review) which means that these earlier studies do not rule out the possibility that autism is associated with delayed development of VPT. Indeed, consistent with the results of chapter 5 and previous research with children with SLI indicating that delayed language acquisition is associated with delayed VPT development (Farrant, et al., 2006), recent research has found that level 2 VPT is delayed in children with autism (Hamilton, Brindley, & Frith, 2009). Therefore, one of the premises that gave rise to innate domain specific ToM theories is false. Similarly, as noted in chapter 4, the interpretation of early ToM research as demonstrating intact ToM in children with SLI (Leslie & Frith, 1988; Perner, Frith, Leslie, & Leekam, 1989; Ziatas, Durkin, & Pratt, 1998) was also used to support theories postulating an innate/genetically determined ToM and its independence from language acquisition. However, these earlier results had also been subject to over-interpretation as the findings of chapters 4 and 5 and other recent research (e.g., Farrant et al., 2006) has demonstrated. Thus, two of the main premises supporting nativistic theories of ToM/perspective taking development have been found to be incorrect.

Furthermore, the findings of chapters 4 and 5 also add to the burgeoning literature highlighting the role of language in perspective taking (ToM) development (see, Milligan, Astington, & Dack, 2007, for a recent meta-analysis) and this is something that a theory of ToM development should be able to explain. As pointed out in chapter 5, Leslie (e.g., Scholl & Leslie, 2001) could argue that language development plays a role in ToM development via facilitating the general executive processes behind selection processing. However, even this is problematic for it would surely add more weight to Doherty's (1999) argument that the selection processor makes the theory of

mind mechanism redundant in Leslie's theory. This is because, in order to select the correct response, the selection processor must be able to perform ToM reasoning itself.

One could be tempted to say that the inclusion of executive (selection) processing in Leslie's model is a step in the right direction as it attempts to explain the relationship between executive functioning and ToM such as that found in chapter 4. However, the nativistic foundation of Leslie's theory prevents it from being able to explain the relationships among language, executive functioning (cognitive flexibility), and ToM. Furthermore, as the theory posits that an impaired ToM underlies the social impairments observed in individuals with autism it also is prevented from explaining the relationships among socio-emotional engagement, shared practices, language, and perspective taking observed in chapters 3 and 5. Indeed, consistent with the findings of chapters 3 and 5 that indicate that typically developing children's level of socio-emotional engagement is responsive to the socio-emotional engagement of those they interact with, recent research with children with autism has found that they too are responsive to the level of socio-emotional engagement of their caregivers (e.g., motherese/infant directed speech; see, Muratori & Maestro, 2007, for a review).

Similarly, one could be tempted to say that Baron-Cohen's (2005) recognition of the importance of emotions and empathising is a step in the right direction. However, Baron-Cohen's commitment to the idea of specific neurocognitive mechanisms, the majority of which he argues are innate, to explain development precludes him from fully confronting the complex and interactive nature of the factors involved in the development of perspective taking skills. Although it is not hard to see how the findings of research can lead one to an overall impression that development follows a universal timetable, and thus is tightly determined, this approach is problematic for a number of reasons. The first, and perhaps the biggest, problem is that by treating some causes (typically genes) as more important than others, the postulation of innate neurocognitive mechanisms leads to an oversimplification of the developmental process that is fundamentally misleading[8] (Bateson, 2001). This is highlighted by the fact that none of the hypotheses drawn from Baron-Cohen's theory were supported by the findings of chapter 5.

The second problem is that research findings often run rough-shod over individual differences and the postulation of innate neurocognitive mechanisms does not allow for the fact that the same genotype can result in different phenotypes in different

[8] The flip side of an overemphasis of the role of genes is demonstrated in Baron-Cohen's (e.g., Auyeung, et al., 2009; Baron-Cohen, 2002) argument regarding the role of prenatal testosterone in his extreme male brain theory of autism.

environments (Bateson, 2001; Segerdahl, Fields, & Savage-Rumbaugh, 2005) or the fact that similar developmental outcomes, or phenotypes, may be produced by a number of different developmental pathways, as the pass/fail contingency analyses in chapter 5 attest. As noted in chapter 1, another problem is that this approach is out of step with the thinking of today's biologists (e.g., Alcock, 1998; Bateson, 2001; Oyama, 2001). Thus, nativistic theories such as Baron-Cohen's (e.g., 2005) and Leslie's (e.g., Scholl & Leslie, 2001) require much more elaboration on the role of the environment and the complex interactions between genes, biology, and social environment in human development.

Similarly, although Gopnik's (e.g., Gopnik & Meltzoff, 1997) theory-theory is less nativistic and the results of chapter 5 supported many of the constructivist ideas contained in this theory, the internalist tendency to see the social environment mainly as a source of information for theory formation and revision by the child's innate theory formation mechanisms is problematic. The postulation of innate mechanisms does not allow for the complex and dynamic interactions that are recognised by today's biologists (e.g., Alcock, 1998; Bateson, 2001; Oyama, 2001). Furthermore, theory-theory would require revision in order to be able to provide an adequate explanation of the relations among socio-emotional engagement, shared practices (including language), and perspective taking observed in the present research.

The findings of chapter 5 also supported a number of the constructivist ideas contained in Harris' (e.g., 1996) simulation theory. However, as alluded to in chapter 5, as it stands it is not entirely clear in Harris' theory whether the ability to simulate another's perspective is a co-constructed skill or whether it relies on some kind of internalist notion that individuals are born with direct access to, and knowledge about, their own mental states. Harris (2009) recently argued that it is not exposure to mental state terms (lexical items) or complex syntax (e.g., sentential complements) that facilitates the development of children's perspective taking skills but rather it is the pragmatic functions of language use in conversation that facilitate this development by repeatedly inviting the child to simulate a different perspective. This suggests that Harris is drawing on some internalist ideas, which would mean that his theory is vulnerable to all the problems associated with nativistic theories delineated above (on the impossibility of a private language of psychological terms, see also, Carpendale & Lewis, 2004; Racine, 2004; Wittgenstein, 1958). Furthermore, even if the ability to simulate another's perspective is a co-constructed skill in Harris' theory, the theory would require revision in order to explain the role of mastery of sentential complements

and the relations among mother-child socio-emotional engagement, shared practices, and children's conversation skill observed in chapters 3, 4, and 5.

The findings of chapters 4 and 5 provided further support for de Villiers and de Villiers' (2000) argument that the mastery of sentential complements plays an important role in the development of children's perspective taking skills. However, the findings of the pass/fail contingency analyses in chapter 5 – in particular, that most children mastered thought sentential complements before they mastered said sentential complements – are contrary to another of de Villiers and de Villiers' claims. They argued that the understanding that verbs of communication can take false complements bootstraps the understanding that mental state verbs can take false complements. Indeed, combining the present findings with those of previous research (e.g., Bloom, Rispoli, Gartner, & Hafitz, 1989) suggests that the mastery of sentential complement structures with verbs of visual perception may bootstrap the mastery of sentential complement structures with mental state verbs. Furthermore, de Villiers and de Villiers' theory would require revision in order to be able to provide an adequate explanation of the relations among socio-emotional engagement, shared practices (including language), and perspective taking observed in the present research.

Similarly, the findings of the current research project are broadly consistent with CCC-r theory's acknowledgement of the role of parent-child interaction and parent's verbal scaffolding in the development of children's cognitive flexibility and perspective taking (Zelazo, Muller, Frye, & Marcovitch, 2003). In particular, the results of chapter 4 support the argument that language facilitates the development of perspective taking skills because linguistic formulations facilitate the ability to flexibly shift between conflicting perspectives (Zelazo, et al., 2003). However, further delineating the precise roles of socio-emotional engagement and complex syntactic structures in this process (perhaps by drawing on Vygotsky's arguments) would enhance the explanatory power of CCC-r theory.

The constructivist ideas contained in Hutto's (2008, 2009) Narrative Practices Hypothesis and Racine and Carpendale's (2007a, 2007b) theory are supported by the findings of chapters 3, 4, and 5. However, neither theory directly explains the role that mastering complex syntactic structures plays in children's conceptual development and the development of perspective taking skills. Thus, although it could be argued that mastering complex syntactic structures is part of the shared practice of being able to talk about and, therefore, reflectively understand psychological concepts (narrative practices), delineating the precise role of complex syntactic structures in this process

(perhaps by drawing on Vygotsky's arguments) could further enhance the explanatory power of both theories.

Because he recognised the importance of socio-emotional engagement, socio-linguistic interaction, language development (including the mastery of complex syntactic structures), and the development of hierarchical conceptual structures that facilitate the ability to identify and explicitly reason with conflicting perspectives, Vygotsky's (1930/1981, 1987, 1997, 1998) developmental theory is consistent with all the findings of the current research project. That the theory was devised decades before the emphasis on ToM, executive function, and sentential complements means that it cannot explicitly predict some of the findings (e.g., the relationships between various individual tasks observed in chapter 5), nevertheless, Vygotsky's insightfulness is demonstrated by the fact that his theory is compatible with the constructivist ideas behind these more fine-grain predictions.

Although the findings of the present research project are most consistent with the constructivist ideas inherent in a number of theories and least consistent with predictions drawn from non-constructivist (usually nativistic) theories, more work is required at the theoretical and empirical levels to deliberate between these different accounts. This would involve teasing out more fine-grain contrasting predictions from the competing theories and should occur not just between the different frameworks (e.g., theory-theory versus constructivism) but also between competing theories within each framework (e.g., Hutto's (2008, 2009) Narrative Practices Hypothesis versus Racine and Carpendale's (2007a, 2007b) constructivist theory).

Practical Implications

The findings of chapter 3 indicate that both joint attention and imitation mediate the relationship between socio-emotional engagement and conversation skill and that SLI is characterised by deficits in joint attention and imitation. These findings therefore open the possibility of reducing later deficits in children with SLI via early identification of deficits in joint attention and imitation and appropriate intervention targeting both. The feasibility of such an approach is highlighted by previous research that has shown that interventions that focus on either joint attention, imitation, or socio-emotional engagement have beneficial effects on language/communication skills (Greenspan & Shanker, 2004; Ingersoll & Schreibman, 2006; Whalen, 2001).

Combining the findings of chapters 4 and 5 with those of previous research which found that training with sentential complement syntax improves explicit false belief understanding in typically developing children (Lohmann & Tomasello, 2003)

opens up the possibility that sentential complements and/or cognitive flexibility training may facilitate the development of perspective taking skills of children with SLI. Furthermore, as noted in chapter 5, interventions targeting the development of children's perspective taking skills would do well to focus on mother-child book reading such that the emphasis should be on selecting books that are emotionally engaging and have language appropriate for the child.

At a more general level, the findings of the current research project should serve to bolster calls to put parenting, socio-emotional engagement, shared practices, and the child's socio-linguistic environment back on centre stage. The present findings also support the growing awareness of the importance of socio-emotional engagement in the etiology of other developmental disorders such as autism (Hobson, 1999, 2009; Muratori & Maestro, 2007). Parents and practitioners alike would be well served by paying more attention to the emphasis that today's biologists place on the complex interaction between the environment and the individual's genetic information (e.g., Alcock, 1998; Bateson, 2001; Oyama, 2001).[9] Indeed, in this light many of the behavioural, cognitive, and/or brain differences that nativistic theorists use to support their arguments are correctly seen as downstream effects of atypical patterns of socio-emotional engagement in infancy and early childhood (Muratori & Maestro, 2007). Furthermore, such an approach is both liberating and full of promise as recent research indicates that these early patterns of atypical socio-emotional engagement are dynamic rather than fixed/predetermined and that even the most socio-emotionally withdrawn infants will engage when the caregivers approach is exaggerated and rich in nonverbal behaviours such as those found in motherese (Muratori & Maestro, 2007).

Methodological Strengths, Limitations, and Directions for Future Research

The major strength of the current research project was the inclusion of a wide array of theoretically based measures of parental and child behaviour and social cognition in a longitudinal design including both typically developing children and children with SLI. This enabled a glimpse at the complex interactional nature of the development of children's perspective taking skills by testing a large number of hypotheses, including many contrasting predictions, drawn from a diverse range of constructivist and more nativistic theories. Another strength of the current research project was the use of closely matched groups of typically developing children and children with SLI. Consistent with Mervis and Robinson's (1999) argument that *p* levels

[9] For an excellent example of this approach applied at both the evolutionary and developmental levels of analysis, see Falk (2009).

should be at least .50 to avoid incorrectly accepting the null hypothesis and thereby ensure that groups are matched on control variables, the groups used in the current research project had the same gender distribution and were well matched in terms of chronological age and nonverbal ability (both *p* levels greater than .90).

The use of parent reports of children's behaviour is a possible limitation of the current research project. However, as noted in chapter 3, although parent reports of child characteristics have some limitations, there are a number of reasons why they were well suited to the aims of the present research project. Nevertheless, future research should investigate the validity of parent reports of children's socio-emotional engagement and imitative behaviour and further investigate the reliability of retrospective parent reports. Such research could also attempt to confirm the mediated pathways identified in the current research project by using experimental measures of socio-emotional engagement, joint attention, and imitation either in isolation or in combination with parental reports.

Future research should also investigate the role that primary caregivers play in the development of conversation skill by further assessing how parental characteristics such as maternal socio-emotional engagement influence the mediated pathways identified in the present research. Our understanding of the development of children's language and perspective taking skills would also profit from research that simultaneously investigates the roles played by a broad range of shared practices. Such research should also include practices that are shared with people other than the child's mother (e.g., fathers, siblings, teachers, peers).

Although the size of the samples used in the current study are fairly large for research of this type, they were not large enough to address the "differential susceptibility hypothesis" where analyses investigate how particular parenting styles and behaviours affect different children differently (Belsky, 2005). Thus, it may be that the effect sizes observed in the current research project overestimate the effect of parenting and shared practices on some children and underestimate their effects on other children (Belsky, 2005). Further research with larger samples is required to address this issue and to investigate how parent and child individual differences mutually influence and interact with each other with respect to the development of children's perspective taking skills. Such an approach can also be profitably included in research with an experimental/intervention focus (e.g., Blair, 2002). Future research should also further investigate the emotional factors that motivate the use of perspective taking skills for pro-social or Machiavellian ends.

Overall Conclusions

The findings of the current research project indicate that constructivist approaches provide a powerful way to investigate the development of children's social cognition and that maternal factors and mother-child shared practices facilitate children's mastery of sentential complements, cognitive flexibility, conversation skill, and perspective taking skills. The results also indicate that both joint attention and imitation mediate the relationship between early childhood socio-emotional engagement and children's subsequent conversation skill, and that language acquisition facilitates the development of cognitive flexibility and perspective taking skills. These findings are also consistent with the argument that shared practices are naturally embedded in socio-emotional engagement.

Although the findings are most consistent with constructivist theories (e.g., Racine & Carpendale, 2007a, 2007b; Vygotsky, 1930/1981) and least consistent with the more nativistic theories (e.g., Baron-Cohen, 1995) it would be a bit fanciful to think that the present thesis provides a knock down blow to nativistic theories of the development of children's perspective taking skills. Such theories remain popular in spite of the fact that they are out of step with the thinking of today's biologists (e.g., Alcock, 1998; Bateson, 2001; Oyama, 2001) and that dichotomies such as nature/nurture are ethically (Hagtvet & Wold, 2003; Linell, 2009) and scientifically (Hagtvet & Wold, 2003) inadequate for explaining the complex and multifaceted nature of development. Indeed, some theorists have even gone as far as to say that philosophical/logical arguments are not enough in themselves to decide among competing theories (Moore, 2007), which suggests that even if a particular theory is logically implausible it would still need to be empirically falsified before its proponents would abandon it. Thus, perhaps a more realistic outcome is that the present thesis adds to the burgeoning literature and empirical evidence supporting constructivist ideas/theories regarding the development of children's perspective taking skills and prompts further theoretical elaboration of the role of co-regulated socio-linguistic interaction in this process.

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