Recent research has found that the acquisition of theory of mind (ToM) is delayed in children with specific language impairment (SLI). The present study used a battery of ToM and visual perspective taking (VPT) tasks to investigate whether the delayed acquisition of ToM in children with SLI is associated with delayed VPT development. Harris’ (1992, 1996) simulation theory predicts that the development of VPT will be delayed. Participants were 20 children with SLI ($M = 62.9$ months) and 20 typically developing children ($M = 61.2$ months) who were matched for nonverbal ability, gender, and age. The results supported Harris’ theory and a role for language in ToM and VPT development.

The socio-cognitive abilities that separate humans from chimpanzees include the use of complex language, the ability to “read the minds” of other individuals, and the ability to “see” things from someone else’s perspective. Although researchers continue to delineate the subtleties of chimpanzee communication (e.g., Crockford & Boesch, 2003), it is clear that it does not have the complexity and flexibility of human language (Arbib, 2005). Similarly, while the precise nature of chimpanzee social cognition remains controversial, they clearly cannot “read the minds” of other individuals or “see” things from someone else’s perspective with the same facility as the typical adult human (Povinelli & Vonk, 2003; Tomasello, Call, & Hare, 2003). The present study investigated whether developmental relationships exist between each of these important socio-cognitive abilities in human ontogeny.

The cognitive capacity to impute causal mental states in order to explain and predict behavior was named “theory of mind” (ToM) by Premack and Woodruff (1978). Like other areas of cognitive development, much of the earliest research into the development of children’s knowledge about the mind was a direct or indirect product of Piaget’s work (Flavell, 1999). Piaget (1926/1959) argued that language plays a causal role in the development of intelligent/logical thought because it establishes a bond between thoughts and words, and that before the development of adult-like logical thought, much of early childhood is characterized by cognitive egocentrism. According to Piaget, cognitive egocentrism is where the child is unable to differentiate his/her own perspective from other possible points of view because of an inability to decenter, or shift cognitively, from his/her own perspective.

Piaget used the well-known three mountains task that assesses an individual’s visual perspective-taking (VPT) ability (the ability to appreciate the visual experience associated with another viewpoint) as a measure of the individual’s cognitive egocentrism (Flavell, 2004; Masangkay et al., 1974). More recently, a distinction has been made between the ability to infer what objects another person does and does not see (level 1 VPT) and 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; Masangkay et al., 1974).

Following Premack and Woodruff’s (1978) paper and the associated commentaries regarding ToM in animals (Bennett, 1978; Dennett, 1978; Harman, 1978), ToM has been the subject of extensive research and theorizing (Astington, 1998). Much of this research has focussed on children’s understanding of false belief (Wellman & Liu, 2004). False belief tasks assess whether children recognize that people can
have mistaken beliefs about reality and whether children can predict what an individual who has a false belief will do, say, or think (Peterson, 2003). Research has demonstrated that aspects of ToM, including false belief, are mastered by typically developing children during the preschool years (e.g., Wellman & Liu, 2004).

In addition to the typical development of false belief understanding, a large amount of research has focussed on the deficits in ToM associated with autism (Baron-Cohen, 2001). However, researchers have also investigated ToM development in other populations including those with schizophrenia (e.g., Langdon & Coltheart, 2001), impaired hearing (e.g., Peterson, 2003), impaired vision (Peterson, Peterson, & Webb, 2000), and specific language impairment (SLI) (e.g., Miller, 2001).

Evidence for a Developmental Relationship Between Language and ToM

Research has found that those profoundly deaf children who suffer delayed language acquisition (late-signing) because of a lack of a native speaker of sign language in their household have substantially delayed ToM development (Peterson, 2003). A relationship between language and ToM is also supported by the consistent finding that profoundly deaf children who have a native speaker of sign language in their household (native-signers) perform significantly better on ToM tasks than late-signers and at least as well as typically developing children (Peterson, 2003).

Correlational research with typically developing children also supports the existence of a relationship between language and ToM (e.g., Hughes & Dunn, 1997; Jenkins & Astington, 1996). However, as these data are equally consistent with causality in either direction, they do not provide definitive support for the hypothesis that language plays a causal role in ToM development. More convincing support for this hypothesis is provided by the findings of longitudinal research into the relationship between language and ToM. For instance, Astington and Jenkins (1999) found that 3-year-olds’ language ability (semantic and syntactic) significantly predicted their ToM ability 7 months later (after controlling for age and initial ToM ability), whereas ToM ability at 3 did not predict language ability 7 months later (after controlling for age and initial language ability). For other longitudinal evidence of language contributing to ToM development, see Watson, Painter, and Bornstein (2001) and Farrar and Maag (2002).

The results of a training study by Lohmann and Tomasello (2003) also support the hypothesis that language plays a causal role in ToM development. In this study, after pre-testing, 3-year-old children participated in one of four training conditions. The first training condition involved perspective-shifting discourse about deceptive objects (e.g., an object that looked like a flower but was actually a writing pen). The second involved the use of mental state terms and associated sentential complement syntax (in which a sentence takes a full clause as its object complement: e.g., “Peter thinks Mummy’s home”). The third “full” training condition involved both perspective-shifting discourse about deceptive objects and the use of sentential complement syntax. The fourth “no language” training condition combined exposure to deceptive objects with the use of only a few attention-directing words (e.g., “look”).

Lohmann and Tomasello (2003) found significant improvements in the false belief performance of each group of children, except those who participated in the “no language” training condition. In addition, post-training false belief performance was superior for the children who participated in the “full” training condition compared with those who received either perspective-shifting discourse about deceptive objects or the use of mental state terms and associated sentential complement syntax in isolation. Lohmann and Tomasello argued that their results provided strong support for the hypothesis that language plays a causal role in the development of false belief understanding. As the “full” training condition resulted in the greatest improvement, Lohmann and Tomasello argued that participation in perspective-shifting discourse and experience with sentential complement syntax play important independent roles in ToM development. The finding that training involving perspective-shifting discourse facilitated false belief understanding also suggests that the ability to recognize and adopt different cognitive perspectives plays a role in ToM development, and that language may facilitate the ability to recognize and adopt different cognitive perspectives.

Thus, the findings of research with profoundly deaf children, and of longitudinal and training studies with typically developing children, converge in supporting the hypothesis that language plays a causal role in ToM development. Further support for this hypothesis is provided by recent research that has found that ToM development is delayed in children with SLI (Holmes, 2002; Tucker, 2004).

SLI involves delayed or disordered language acquisition and development in the context of normal hearing and nonverbal ability and in the absence of
neurological impairment (Bishop, 1997). This pattern of intact nonverbal ability in the face of delayed or disordered language development means that investigating ToM development in children with SLI offers an important way to gain insight into the relationship between language and ToM (Miller, 2004).

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. Using a battery of ToM tasks, Holmes (2002) also found a significant delay in ToM acquisition for children with SLI aged 4–7 years. At first blush, these findings may seem to be in conflict with earlier results that 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, this earlier research used false belief tasks and yet involved children with SLI who were much older than the age at which false belief understanding typically develops (3–5 years). Therefore, the results of the earlier studies are consistent with the later finding of a 12–18-month delay in false belief understanding in children with SLI (Tucker, 2004).

The results of research by 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 with a mean age of 66 months performed significantly worse than chronologically age-matched typically developing children aged between 5 and 6.5 years. While there was no significant difference in any of the four conditions between a group of 15 children with SLI (mean age of 59 months) and a group of chronological age-matched typically developing children. Issues of limited power to detect group differences and a focus on false belief tasks mean that the results of Miller (2001; 2004) should be interpreted with care. 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 that ToM development is delayed in children with SLI (Holmes, 2002; Tucker, 2004).

**Simulation Theory and the Relationships Between Language, ToM, and VPT**

A number of different types of theories have been proposed as explanations for the development of ToM (Flavell, 2004). A theory that allows a causal role for language in ToM development and hypothesizes relationships between language, ToM, and VPT is Harris’ (1992, 1996) 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). Thus, according to simulation theory, ToM and VPT involve “a process of imaginatively stepping into the shoes of another person” (Langdon & Coltheart, 2001, p. 22).

According to Harris (1992), the first step in development of this ability is when children can only echo another person’s intentional stance toward a target (object, person, etc.). The child does this by feeding the other person’s visual target and/or the other person’s emotional stance toward that target into his/her own perceptual and/or emotional system. 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’ (1992) 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 relationships between language, VPT, and ToM, 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 adopt another person’s perspective imaginatively (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 imagine accurately what other people perceive, desire, believe, etc. (Harris, 1996). Thus, Harris’ version of simulation theory predicts that delayed or disordered language acquisition will be associated with delayed/impaired ToM and VPT ability.

The Present Study

To further explore the relationships between language, ToM, and VPT, the current study sought to confirm the delayed development of ToM in children with SLI and to investigate whether any such delay is associated with delayed development of VPT. As the above review suggests, the major limitations of much of the previous research in this area involve an over-reliance on false belief tasks in measuring ToM and a failure to use age-appropriate tasks. To avoid these problems, the present study investigated the development of ToM and VPT in a group of pre-primary children with SLI and a group of typically developing pre-primary children using a range of age-appropriate tasks. These tasks included Wellman and Liu’s (2004) scale of ToM tasks, and a “scale” of VPT tasks comprised of the level 1 and level 2 VPT tasks used by Masangkay et al. (1974) and a modified version of the array VPT task used by Langdon and Coltheart (2001).

The current study addressed three related hypotheses concerning the relationships between language, ToM, and VPT development. Consistent with previous research (Holmes, 2002; Tucker, 2004), it was predicted that ToM development would be delayed in children with SLI. Harris’ (1992, 1996) simulation theory predicts that children with SLI will display delayed/impaired development of VPT ability. Regarding the relationship between VPT and ToM, Harris’ theory predicts that level 2 VPT understanding will emerge around the same time as false belief understanding. This is because the ability to imagine someone thinking or seeing something that runs directly counter to what the child currently thinks or sees is the fourth step in Harris’ theory.

Method

Participants

All 40 Australian children who participated in this study were Caucasian and spoke English as their first language. Twenty children with SLI (13 males) aged between 58 and 68 months ($M = 62.9$ months, $SD = 3.2$ 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 nonverbal 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 nonverbal intelligence via the performance scale of the Wechsler Preschool and Primary Scale of Intelligence – Revised (Wechsler, 1989). Twenty typically developing children (12 males) aged between 51 and 70 months ($M = 61.2$ months, $SD = 5.9$ months) were recruited from a preschool center.

Measures

Nonverbal ability. The Fluid Reasoning composite score from the Leiter International Performance Scale – Revised (Leiter – R; Roid & Miller, 1997) was used as a measure of nonverbal ability as 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.

ToM. ToM ability was assessed using 10 tasks. The five tasks that comprise Wellman and Liu’s (2004) ToM scale were used along with an analogue of each of these tasks created specifically for the present study (see Appendix for details of these tasks). 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 real–apparent emotion task that assesses whether the individual understands that a person can feel one thing but display a different emotion. 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). Children typically pass the diverse desires task first, followed by the diverse beliefs, knowledge access, contents false belief, and real–apparent emotion tasks in that order.

Visual perspective taking. VPT ability was assessed with the level 1 and level 2 VPT tasks used by
Masangkay et al. (1974) and a modified version of Langdon and Coltheart’s (2001) array VPT task (see Appendix for details of these tasks). Previous research has found that typically developing children pass level 1 VPT tasks before they pass level 2 VPT tasks (Flavell, Everett, Croft, & Flavell, 1981; Masangkay et al., 1974).

Procedure
Consent forms and information sheets were sent to parents/guardians of all typically developing children attending the preschool center and all preprimary children in the LDC. Participants were selected from among those for whom consent was received so as to match the two groups as closely as possible in terms of gender and chronological age.

Participants were individually tested over three sessions in a quiet room at the child’s regular center. Each session lasted approximately 15 min, and the maximum period between the first and final session for each participant was 3 weeks. The nonverbal ability test was completed in the first session, with the ToM and VPT tasks presented in the following two sessions in counterbalanced order for each group. The within-session order of presentation of the individual ToM or VPT tasks was also counterbalanced.

Results
Consistent with previous research (Peterson et al., 2005; Wellman & Liu, 2004), to be scored as correct on the knowledge access, contents false belief, and real–apparent emotion tasks, children had to answer the memory and control questions as well as the target question correctly. However, analyses conducted using scores based solely on the responses to target questions yielded the same pattern of results as analyses conducted using scores based on the responses to the memory, control, and target questions. Therefore, only the results of analyses using scores based on the latter are reported. The alpha level was set at .05 for all analyses.

Group Comparisons on Matching Variables
The two groups did not differ significantly in chronological age, nonverbal IQ, or raw scores on the Leiter–R subtests, all ts(38) < 1.21, all ps > .23, and were well matched in gender distribution, $\chi^2$ (1, 20) = 1.1, p = .29. Summary statistics for the matching variables are presented in Table 1.

<table>
<thead>
<tr>
<th>Variable</th>
<th>SLI (n = 20)</th>
<th>Typically developing (n = 20)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CA (months)</td>
<td>62.9</td>
<td>61.2</td>
</tr>
<tr>
<td>Nonverbal ability</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nonverbal IQ</td>
<td>97.00</td>
<td>101.10</td>
</tr>
<tr>
<td>Sequential order (raw score)</td>
<td>9.20</td>
<td>9.50</td>
</tr>
<tr>
<td>Repeated patterns (raw score)</td>
<td>9.65</td>
<td>10.35</td>
</tr>
<tr>
<td>Gender (males:females)</td>
<td>13:7</td>
<td>12:8</td>
</tr>
</tbody>
</table>

CA = chronological age; SLI = specific language impairment.

$N = 40$, $r = .74$. Summary statistics for the matching variables are presented in Table 1.

ToM Subscales, and Memory and Control Questions
Across both groups, performance on the Wellman and Liu (2004) ToM tasks (Wellman and Liu ToM subscale) was compared with performance on the analogue ToM tasks (analogue ToM subscale) using the total score for each subscale. Performance on the Wellman and Liu ToM subscale ($M = 2.42$, $SD = 1.06$) was not significantly different, $t(39) = .68$, $p = .50$, from performance on the analogue ToM subscale ($M = 2.53$, $SD = 1.26$), and scores on the two subscales were significantly correlated, $r(38) = .69$, $p < .001$. Therefore, to simplify subsequent analyses, the scores for the two ToM subscales were summed to give total scores for each type of ToM task (e.g., diverse desires).

To help ensure that any group differences on the experimental tasks were not the result of the linguistic or working memory demands of the tasks, comparisons were made of the two groups’ performance on the control and memory questions of the experimental tasks. All children in both groups were able to identify successfully the pictures used in the level 1 and 2 VPT tasks along with the blue circle in the array VPT task. On the level 2 VPT task, 3 children in the SLI group and 2 children in the typically developing group initially tried to turn the card over to the other side when asked to turn it so that they saw it upside-down. However, all these children successfully rotated the card after it had been demonstrated to them. Thus, both groups performed at ceiling on the control questions for the VPT tasks.
The performance of the SLI group on the four memory and control questions from the knowledge access tasks ($M = 3.65, SD = .74$) was not significantly different, $t(38) = 1.29, p = .21$, from the performance of the typically developing group ($M = 3.90, SD = .45$). Similarly, the performance of the SLI group on the four memory and control questions from the contents false belief tasks ($M = 3.75, SD = .55$) did not differ significantly, $t(38) = .61, p = .55$, from the performance of the typically developing group ($M = 3.85, SD = .49$). However, the performance of the SLI group on the four memory questions from the real–apparent emotion tasks ($M = 1.45, SD = .89$) was significantly different, $t(38) = 3.17, p = .003$, from the performance of the typically developing group ($M = 2.45, SD = 1.01$). This last result suggests that either the linguistic complexity or the sheer amount of narrative involved in the real–apparent emotion tasks affected the performance of the SLI group more than the performance of the typically developing group. Because of this, the scores on the real–apparent emotion tasks were excluded from subsequent analyses.

**Group Comparisons on Total ToM and VPT Scores**

Scores on each of the ToM tasks (excluding the real-apparent emotion tasks—for the reasons described above) were summed to give a total ToM score for each participant, with a maximum score of 8. Similarly, scores on the level 1, level 2, and array VPT tasks were summed to give a total VPT score, with a maximum of 18. The distributions for the total ToM and total VPT scores for each group did not contain outliers and were approximately normal. As hypothesized, the total ToM scores were significantly lower, $t(38) = 4.69, p < .001$, for the SLI group ($M = 3.60, SD = 1.23$) compared with the typically developing group ($M = 5.85, SD = 1.75$). Consistent with the prediction made by Harris’ (1992, 1996) simulation theory, the total VPT scores were significantly lower, $t(38) = 2.72, p = .01$, for the SLI group ($M = 9.10, SD = 2.10$) compared with the typically developing group ($M = 11.10, SD = 2.53$).

**Identifying the Particular Tasks that Differentiated the ToM and VPT Abilities of the Two Groups**

The means and standard deviations of scores on each type of VPT and ToM task are displayed in Table 2. The scores of the two groups on the level 1 and array VPT tasks, as well as the diverse desires and diverse beliefs tasks, were not significantly different, all $t(s)(38) < 1.40$, all $p > .16$. However, the SLI group scored significantly lower than the typically developing group on the level 2 VPT task, as well as the knowledge access and contents false belief tasks, all $t(s)(38) > 2.16$, all $p < .04$.

**Relationship between VPT and ToM**

To enable patterns of task mastery on the level 2 VPT and contents false belief tasks to be assessed across individuals and groups, children were coded as having passed or failed each type of task. Children were deemed to have passed the contents false belief tasks if they answered both tasks correctly. Following Masangkay et al. (1974), children were deemed to have passed the level 2 VPT task if they scored 5 or 6 out of 6. The patterns of task mastery on the level 2 VPT and contents false belief tasks as well as the number of children in each group whose responses fit those patterns are displayed in Table 3. Consistent with the prediction based on Harris’ (1992, 1996) simulation theory, that level 2 VPT understanding emerges around the same time as false belief understanding, most children either failed both tasks or passed them both (see Table 3). Indeed, across both groups, the pass/fail scores on the level 2 VPT and contents false belief tasks were significantly correlated, $r_{s}(38) = .44, p = .005$. Finally, notice the contrasting performances of the two groups: Whereas none of the SLI children passed both tasks and 70% failed the two, 55% of the typically developing children passed both tasks and only 20% failed the two.

---

**Table 2**

<table>
<thead>
<tr>
<th>Task</th>
<th>SLI ($n = 20$)</th>
<th>Typically developing ($n = 20$)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$M$</td>
<td>$SD$</td>
</tr>
<tr>
<td>VPT tasks (all scores out of a maximum possible of 6)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level 1</td>
<td>5.85</td>
<td>0.49</td>
</tr>
<tr>
<td>Level 2</td>
<td>2.65</td>
<td>1.95</td>
</tr>
<tr>
<td>Array</td>
<td>0.60</td>
<td>0.75</td>
</tr>
<tr>
<td>ToM tasks (all scores out of a maximum possible of 2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diverse desires</td>
<td>1.50</td>
<td>0.76</td>
</tr>
<tr>
<td>Diverse beliefs</td>
<td>1.20</td>
<td>0.89</td>
</tr>
<tr>
<td>Knowledge access</td>
<td>0.55</td>
<td>0.76</td>
</tr>
<tr>
<td>Contents false belief</td>
<td>0.35</td>
<td>0.67</td>
</tr>
</tbody>
</table>

VPT = visual perspective taking; ToM = theory of mind.
The findings of the current study address three related hypotheses regarding the relationships between language, ToM, and VPT development.

Relationships Between Language, ToM, and VPT

Regarding the relationship between language and ToM, as predicted, the children with SLI displayed delayed ToM development. This finding is consistent with recent research (Holmes, 2002, Tucker, 2004) and adds further support to the argument that language plays a causal role in ToM development. Extending on Tucker’s (2004) finding of a 12–18-month delay in false belief understanding in children with SLI, the current results are the first to indicate that the understanding of knowledge access is also delayed in children with SLI. Regarding the relationship between language and VPT, as predicted by Harris’ (1992, 1996) simulation theory, the children with SLI displayed delayed VPT (level 2 in particular).

It could be argued that these results represent a decrement in the performance (as opposed to competence) of the children with SLI due to the linguistic demands of the ToM and VPT tasks. However, closer examination of the tasks and results argues against such an interpretation. In relation to the VPT tasks, the level 2 task on which the children with SLI performed significantly worse than the typically developing children is almost identical in linguistic and other general demands to the level 1 task on which their performance was not significantly different. These tasks used the same stimuli and both asked the child to infer the visual experience associated with another viewpoint. The target question in the level 1 task (“Which picture does Mr. Jones see? Does he see the picture of the [turtle] or the picture of the [car]?”) is similar in terms of linguistic complexity to the target question in the level 2 task (“How does Mr. Jones see the [turtle]? Does he see the [turtle] the right-way-up or does he see the [turtle] upside-down?”). Furthermore, all children were able to demonstrate that they understood the meanings of the terms “upside-down” and “right-way-up.” Therefore, it is unlikely that the impaired performance of the children with SLI on the level 2 VPT task was due to the linguistic demands of the task.

Similarly, it would be difficult to argue that the impaired performance of the children with SLI on the knowledge access and contents false belief tasks is due to the linguistic demands of the tasks. For a start, the performance of the children with SLI on the memory and control questions for these tasks was not significantly different from that of the typically developing children, suggesting that neither linguistic complexity nor the memory demands of the tasks were the source of the group differences. Also, the performance of the children with SLI was not significantly different from that of the typically developing children on the diverse beliefs task that used the mental state verb “think” several times. Therefore, it is unlikely that the impaired performance of the children with SLI on the contents false belief task was due to some special difficulty with the mental state verb “think”. (However, as pointed out by an anonymous reviewer, it may be the processing of sentential complements that is the cause of the impaired performance demonstrated by children with SLI. This point is explored further in the Theoretical Implications section. We thank the anonymous reviewer for drawing our attention to this point.)

It could also be argued that rather than delayed/impaired language being the cause of delayed/impaired ToM and VPT development, some other variable is responsible for the delays/impairments in all of these areas. For example, it could be argued that the delays/impairments in all three areas are the result of neurological impairment or that they are the result of problems with socialization in general. However, the definition of SLI excludes children with such problems and in the present study children with SLI were matched to typically developing children for nonverbal ability. Also, the results of previous research, including the longitudinal research by Astington and Jenkins (1999) and the training study by Lohmann and Tomasello (2003) reviewed above, argue against such interpretations. These studies indicate that language facilitates the development of ToM and the ability to recognize and understand

<table>
<thead>
<tr>
<th>Pattern</th>
<th>Level 2 VPT</th>
<th>Content false belief</th>
<th>SLI (n = 20)</th>
<th>Typically developing (n = 20)</th>
</tr>
</thead>
<tbody>
<tr>
<td>–</td>
<td>–</td>
<td>14</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>+</td>
<td>–</td>
<td>4</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>–</td>
<td>+</td>
<td>2</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>+</td>
<td>+</td>
<td>0</td>
<td>11</td>
<td></td>
</tr>
</tbody>
</table>

VPT = visual perspective taking; SLI = specific language impairment.

Discussion

The findings of the current study address three related hypotheses regarding the relationships between language, ToM, and VPT development.
adopt different cognitive perspectives. Therefore, although it is not possible to rule out completely the existence of other cognitive differences between the two groups in the present study, the findings of previous research strongly suggest that delayed/impaired language acquisition is the primary cause of the delayed/impaired ToM and VPT development found in the present study in children with SLI.

The Relationship Between VPT and ToM

A significant correlation was found between pass/fail scores on the level 2 VPT and contents false belief tasks. This finding is consistent with the prediction, based on Harris’ (1992, 1996) theory, that level 2 VPT understanding will emerge around the same time as false belief understanding. In fact, the current results suggest that the ability to simulate a perspective that is counter to one’s own is facilitated by language development and may develop in step for the perceptual mental state of seeing and the epistemic mental state of thinking. However, longitudinal research is required to extend understanding of the relationship between level 2 VPT and false belief understanding.

Theoretical Implications

Harris’ (1992, 1996) simulation theory correctly predicted that both ToM and VPT development would be delayed/impaired in children with SLI and that level 2 VPT understanding would emerge around the same time as false belief understanding. Thus, the results of the present study lend support to Harris’ theory.

It should be noted that the present findings regarding the relationships between language, ToM, and VPT may be compatible with other theoretical perspectives, even if they were not explicitly predicted by them. For example, consistent with a linguistic determinism position advanced by de Villiers and de Villiers (2000; see Tager-Flusberg & Joseph, 2005 for a related argument), it could be argued that the reason why children with SLI demonstrate delays in the mastery of knowledge access, false belief, and level 2 VPT is that each of these tasks requires mastery of sentential complements.

Similarly, Baron-Cohen’s (1995) minimalist innate modularity theory allows for an interaction between language and ToM. For example, Baron-Cohen, Baldwin, and Crowson (1997) argued that one of the innate neurocognitive mechanisms said to be involved in mindreading, the shared attention mechanism, also facilitates language acquisition via its involvement in joint attention. However, Baron-Cohen’s (1995) theory would require revision in order to explain the synchronous emergence of level 2 VPT understanding and false belief understanding. This is because Baron-Cohen (1995) argued that the interpretation of eye gaze in terms of the perceptual mental state of seeing (e.g., Mr. Jones sees the turtle right-way-up) is performed by the eye direction detector whereas the representation of epistemic mental states (e.g., false belief) is enabled by the ToM mechanism. Indeed, Baron-Cohen (1995, 1999) presented a range of evidence in support of a neurocognitive eye direction detector and argued that this mechanism is an innate brain module available to the infant from birth.

Baron-Cohen could argue that the shared attention mechanism is involved in level 2 VPT and that, therefore, the delays in language, VPT, and ToM found in children with SLI are a product of a delay in the shared attention mechanism coming on line. However, it is unclear why level 2 VPT would require the involvement of the shared attention mechanism whose key function is to build triadic representations specifying shared attention (Baron-Cohen, 1995). Instead, the synchronous emergence of false belief and level 2 VPT mastery suggests that level 2 VPT requires a mental representation that is similar, if not identical, to that which Baron-Cohen (1995) argued to be necessary for epistemic mental states (M-Representations of the form [Agent-Attitude-''Proposition'']). Baron-Cohen argued that M-Representations (meta-representations) are enabled by the ToM mechanism.

Furthermore, Baron-Cohen’s (1995) M-Representations take the form of a sentential complement and this fits nicely with de Villiers and de Villiers’ (2000) linguistic determinism argument. Thus, it may be that mastery of sentential complements allows children to reason from conflicting perspectives or points of view (de Villiers, 2005) and/or that the ToM mechanism may be more aptly named the perspective-taking mechanism (this would also form a bridge between ToM research and research into perspective/role taking). However, all of this is somewhat speculative because, as noted previously, longitudinal research is required to confirm the relationship between level 2 VPT and false belief understanding.

Directions for Future Research

By using a range of age-appropriate ToM and VPT tasks, the present study avoided the major limitations inherent in much of the previous research in
this area. Nevertheless, the use of one-off measurements of ToM and VPT ability in children with and without delayed language acquisition meant that the findings of the present study had to be considered in conjunction with the results of other research in order for causal inferences to be made. Although there is substantial evidence supporting the causal role of language in ToM development, future research should use longitudinal or training designs as these would allow stronger claims to be made regarding the causal role of language in VPT development and the relationship between VPT and ToM.

In the present study, it was necessary to exclude the real-apparent emotion task from group comparison analyses because of the difficulty that the children with SLI had comprehending this task. Future research should use the very recently developed simplified version of this task (called the hidden emotion task) as deaf children with delayed/impaired language have been found to perform at a similar level to typically developing children on the control questions of this simplified task (Peterson et al., 2005). On a lesser note, because none of the children in the present study passed the array VPT task, future research with pre-primary (or younger) children should consider using a different task with a level of difficulty that is closer to that of the level 2 VPT task. For example, the turntable task used by Horan and Rosser (1983) may have a more appropriate level of difficulty.

By including younger children, future research could also investigate whether the understanding of VPT and ToM concepts that typically appear earlier in development (e.g., level 1 VPT, diverse desires, and diverse beliefs) is delayed in children with SLI. Research of this kind would help to identify the aspects of ToM and VPT for which language plays a causal developmental role and could also manipulate task designs and target question wording in order to further investigate the role of sentential complements in ToM and VPT. Future research should also investigate which aspect(s) of language is/are most important for ToM and VPT development. Such research could investigate whether syntax, and in particular, mastery of sentential complements (de Villiers & de Villiers, 2000) or the pragmatic aspects of language (Harris, 1996) is more important.

Conclusions

The results of this study provide strong evidence for delayed/impaired ToM and VPT development in children with SLI. These findings add further support to the argument that language plays a causal role in ToM development and are the first to suggest a causal role for language in VPT development. The delayed/impaired VPT development found in children with SLI as well as the relationship found between level 2 VPT understanding and false belief understanding were predicted by, and therefore support, Harris’ (1992, 1996) simulation theory. Perhaps most intriguing, though, is that the present results suggest that two of the socio-cognitive abilities that separate humans from chimpanzees, ToM and VPT, are facilitated by what is arguably the most important of these socio-cognitive abilities, the use of complex language.

References


Appendix: Detailed Procedure for ToM and VPT Tasks

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?” To be scored correct, the child must answer the opposite answer 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 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?” To be scored correct, the child must answer the target question 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 it was playtime and that “Teddy” the teddy bear wanted a toy to play with and could choose between a doll and a truck.

Knowledge access. Wellman and Liu’s (2004) knowledge access task assesses whether 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 is 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 non-descript 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 target question: “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?” To be scored correct, the child must answer “pig” to the control question, “Band-Aids” to the target question, and “no” to the memory 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.

Real–apparent emotion. Wellman and Liu’s (2004) real–apparent emotion task assesses whether the individual understands that a person can feel one thing but display a different emotion. The child is shown a page depicting three faces (happy, neutral, sad) and asked to point to each face in turn. “Can you point to the face that looks happy (sad, okay)?” The child is shown a picture of a group of children laughing with a girl shown from the back so that the girl’s facial expression cannot be seen. “This story is about a girl. I’m going to ask you about how the girl really feels inside and how she looks on her face. She might really feel one way inside but look a different
way on her face. Or, she might really feel the same way inside as she looks on her face. I want you to tell me how she really feels inside and how she looks on her face.”

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

Then the child is asked two memory questions: “What did the other children do when Matt told a mean joke about Rosie?” “In the story what would the other children do if they knew how Rosie felt?” Pointing to the three emotion faces, the child is asked the target-feel question: “So, how did Rosie really feel when everyone laughed? Did she feel happy, sad, or okay?”; followed by the target-look question: “How did Rosie try to look on her face when everyone laughed? Did she try to look happy, sad, or okay?” To be scored as correct, the child must answer “laughed” to the first memory question, “call her a baby” to the second memory question, and his/her answer to the target-feel question must be more negative than his/her answer to the target-look question. The procedure for the second real-apparent emotion task was analogous to the first, except that the protagonist received a present that she did not like and it was in her interest to not display this emotion to her aunt who gave her the present.

**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 (7 cm × 10 cm) and told: “Here’s a card, it has a picture on one side and a different picture on the other side” (e.g., 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? Does he see the picture of the cat or the picture of the house?” The orientation of the card is reversed and the questions are repeated. The whole process is repeated with two more cards (with pictures of a car and a turtle, and a truck and a dog). To be scored correct, the child must answer with the name of the picture that is facing Mr. Jones.

**Level 2 VPT.** The level 2 VPT task involves 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. The materials for the level 2 task were identical to the level 1 task and the procedures also matched closely. The child is shown a picture on a card (e.g., picture of 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: “How does Mr. Jones see the turtle? Does he see the turtle the right-way-up or does he see the turtle upside-down?” The card is turned so it is upside-down to the child and right-way-up to Mr. Jones and the questions repeated. The whole process is repeated with two more cards (with pictures of a truck and a house). To be scored correct, the child must answer with the orientation (right-way-up or upside-down) of the picture as seen from Mr. Jones’ perspective.

**Array VPT.** The array VPT task assesses the ability to infer what an array of objects would look like from other spatial locations. The child is shown a piece of paper (21 cm × 21 cm) 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 is 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 (6 cm × 6 cm) 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: “If you were sitting where Mr. Jones is, would the piece of paper look like this, like this, like this, or like this?” This process is repeated twice with the array in different orientations. Then, the location of the doll is changed: “Mr. Jones is moving over here” and the whole process is repeated with Mr. Jones placed at 90° to the child. To be scored correct, the child must select the scaled-down version of the array that matches the orientation of the array as seen from Mr. Jones’ perspective.