Case Studies of Sentence Complement Training and False Belief Performance

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Speech-language pathologists are aware that their preschool-age clients are in the process of rapid and profound developmental change in language, cognition, and social development. Among the important developmental transitions that take place during the preschool years are fundamental changes in the understanding of mental states and their relationships to behavior. This understanding is referred to as the child’s “theory of mind.” To have a theory of mind is to know that people have mental states, such as beliefs, desires, feelings, intentions, and so on. A mature theory of mind also includes the understanding that people may hold beliefs that are different from reality, or false beliefs. A large and growing body of research exists to document how children become able to interpret and predict others’ behavior due to a developing understanding of false belief.

A task that is widely used to assess false belief understanding is the change-in-location task, first described by Wimmer and Perner (1983). In this task, a story is told or acted out (using dolls or props) in which a character comes to hold a belief that the child knows is not true. The child is then asked to predict the character’s behavior in the given situation. For example, one such story might be, “Mary has a marble. Mary puts her marble into the basket, and runs off to play. Sally comes along while Mary is away. Sally takes the marble out of the basket and puts it in the box. Mary comes back and wants to play with her marble. Where will Mary look for the marble?” A child who understands that people can have and act on false beliefs will say that Mary will look in the basket, because that is the place where she last knew the marble to be. However, a child who has not developed this understanding will say that Mary will look in the box, because that is where the marble actually is. According to a meta-analysis by Wellman, Cross, and Watson (2001), children usually respond correctly to the change-in-location task at 3 years of age; by age 4, performance varies considerably across children but averages more than 50% correct; and by age 5, children usually respond correctly.

ABSTRACT: It has been hypothesized that sentence complement comprehension is a prerequisite for the development of false belief understanding in young children. Previous research has suggested that training on sentence complements leads to improved false belief performance. This study used a case study design to investigate the effect of sentence complement training on false belief for 2 children. One was a 3-year-old twin girl with typical language development; her twin sister was included, without training, for comparison. The second child was a 3-year-old girl with an expressive language delay. The twins demonstrated sentence complement mastery from the outset of the study, but did not display full competence with false belief. The child with a language delay improved markedly in comprehension of sentence complements but consistently failed false belief tasks. The results suggest that although sentence complement comprehension may play a role in false belief development, the relationship between the two may not be as close as has been suggested.

KEY WORDS: false belief, theory of mind, intervention, language development
LANGUAGE AND THEORY OF MIND

The preschool years are also a time of rapid change in language development. It is well documented in the literature that performance on false belief tasks is correlated with measures of overall language ability (see de Villiers & de Villiers, 2000, for an overview; see also Astington & Jenkins, 1999; de Villiers & Pyers, 2002; Farrar & Maag, 2002). There is debate about the direction of the relationship between language and theory of mind, but it is likely that there is reciprocal influence. In the following sections, we summarize possible relationships between language and theory of mind.

Understanding of Mental States Facilitates Communication

In order to be a competent communicator, one must be able to take into account the mental states of communication partners, including their knowledge, intentions, and beliefs. The characteristic deficits of social communication in children with autism are thought to be due to a lack of theory of mind in these children (Tager-Flusberg, 2000), who consistently perform poorly on a wide range of theory-of-mind measures (Baron-Cohen, 2000). A child who does not recognize that other people have mental states is likely to treat communication partners as little more than request-fulfilling machines; a child with a theory of mind will seek to share ideas and feelings with others.

Talk About Mental States Facilitates Theory-of-Mind Development

Although it is likely that a rudimentary theory of mind is essential for children’s motivation to communicate, once they begin to be able to engage in conversation with others, language may provide information that is needed for a more mature theory of mind. There is considerable evidence that verbal interaction in the family plays a role in theory-of-mind development. Mothers’ talk about mental states has been found to predict their children’s later theory-of-mind performance (e.g., Ruffman, Slade, & Crowe, 2002). Cooperation with siblings and family talk about feelings and causality are associated with theory-of-mind performance (Dunn, Brown, Slomkowski, Tesla, & Youngblade, 1991). Deaf children who learn sign language late, and thus are deprived of early opportunities for discourse about mental states, perform worse on false belief tasks than do native signers of similar signing proficiency (Woolfe, Want, & Siegal, 2002).

Verbal Nature of Theory-of-Mind Tasks

Language may influence theory-of-mind performance by limiting children’s ability to express their true competence. It may be that children fail false belief tasks because of the linguistic processing and pragmatic abilities required for the tasks. False belief tasks usually require the child to follow a verbal narrative that is supported by pictures or is dramatically acted out to facilitate their understanding. The child must listen while the experimenter talks, understand and process this information along with subsequent questions, and formulate a response (Astington & Jenkins, 1999). The language used to assess the child’s reasoning about the mental states of others is usually in the form of multiclause sentences with mental state verbs and embedded complements. The child must have acquired the appropriate language skills to answer these questions correctly (de Villiers & de Villiers, 2000).

Syntax Provides a Means for Understanding False Belief

Although it is clear that considerable linguistic ability is required to even participate in many false belief tasks, performance on nonverbal false belief tasks is no better than performance on verbal false belief tasks (Call & Tomasello, 1999). Using a false belief task with a minimal verbal component, de Villiers and de Villiers (2000) found that orally educated deaf children with language delay performed no better on this less verbal task than on a standard verbal false belief task, suggesting that the verbal nature of many theory-of-mind tasks is not the sole reason for the relationship between language development and theory-of-mind performance. To the extent that language ability limits performance on nonverbal false belief tasks, theory of mind and language may be fundamentally interdependent in their development. Syntactic or semantic abilities may provide the means for understanding of false beliefs. Astington and Jenkins (1999) tested this hypothesis by conducting a longitudinal study that examined the relationship between language and theory of mind. Children with a mean age of 3;4 (years;months) at the first time of testing were administered theory-of-mind tasks and a standardized language measure at three time points. The researchers found that changes in the children’s theory of mind were predicted by their language performance at an earlier time. Language, however, was not predicted by earlier theory-of-mind performance.

Another important finding from Astington and Jenkins (1999) is that syntactic abilities contributed more to the prediction of theory of mind than did semantics. An aspect of syntax that may be critical to the representation of false beliefs is complementation (de Villiers & Pyers, 2002). Embedded complements occur in sentences that use verbs of desire (e.g., want and need), verbs of mental state (e.g., think, forget, and know), and verbs of communication (e.g., say, tell, and ask) (Perner, Sprung, Zauner, & Haider, 2003). For example, in the sentence, “Sandy thought the meeting was on Friday,” the embedded proposition the meeting was on Friday is a complement of the verb thought. In other words, this embedded proposition represents the contents of what Sandy thought. The truth value of sentences with embedded complements is not evaluated in terms of reality; if the meeting was on Thursday, it is still true that Sandy thought the meeting was on Friday (de Villiers & Pyers, 2002). de Villiers and Pyers argue that a child who does not understand this type of syntax will...
evaluate the truth of the sentence in terms of the child’s own reality (i.e., what the child knows to be true). This child will not be in a position to understand or talk about false beliefs. The authors also “wish to argue that the child needs the full syntax of mental verbs plus sentential complements in order to represent in his own mind the belief states of other people, not simply to encode them for reporting about them in speech” (de Villiers & Pyers, 2002, p. 1056).

If a child does not understand false beliefs, he or she would still be able to use syntax complementation with communication verbs because these verbs allow for the same embedded structures. For example, “John said he had a sandwich for lunch” can be a true statement whether he actually ate a sandwich or not. A child may use environmental cues to evaluate the truth of this type of statement, such as bread crumbs on the table where John was sitting, whereas evaluation of mental states is more difficult. The use of complementation syntax with communication verbs may provide a first step to understanding that language structures exist that allow false complements (de Villiers & Pyers, 2002).

de Villiers and Pyers (2002) conducted a longitudinal study that examined the direct relationship between children’s understanding of the specific syntax of complementation and their performance on false belief reasoning tasks. The authors hypothesized that the emergence of false belief understanding is dependent on the child’s mastery of complementation. The children were an average of 3;5 at the start of the study, and data were collected four times over the course of a year. Several false belief tasks were administered, as well as a language task measuring the child’s memory for complements. In this task, pictures were used to illustrate a brief story in which a character made a mistake, told a lie, or had a false belief, and the child was asked to state the content of that incident. This task did not require the child to interpret the character’s mental state, but only to represent it by keeping it in mind and saying the relevant (i.e., embedded proposition) part back. For example, the child would hear a story about a boy who thought he found a ring, but it turned out to be a bottle cap. The child was asked, “What did he think?” A correct answer would refer to a ring, not a bottle cap (de Villiers & Pyers, 2002). The results of the study showed that mastery of complement structure was the best predictor of performance on false belief tasks. Further, false belief performance was not simply a function of greater overall language abilities, such as mean length of utterance (MLU) or other complex language structures.

Further evidence supporting the role of sentence complements in false belief understanding comes from training studies (Hale & Tager-Flusberg, 2003; Lohmann & Tomasello, 2003). Hale and Tager-Flusberg asked if training on complements would lead to changes in performance on false belief tasks. Three- and four-year-olds who failed pretests of false belief and sentence complements were randomly assigned to training for false beliefs, sentence complements, or relative clauses (control group). Two training sessions, held during a 1-week period, consisted of acting out situations in which false belief tasks, complement structures, or relative clauses could be discussed. For example, in the false belief training, a change-in-location task was acted out, and the child was asked questions that did not use mental state verbs, such as think or know. If the child answered correctly, this response would be confirmed. If the child answered incorrectly, he or she would be led to the correct answer by discussing the situation.

Several days following training, the children were tested on false beliefs, sentence complements, and relative clauses, using different materials. The children who were trained on sentence complements acquired linguistic knowledge and also increased their scores on the theory-of-mind tasks. The children who were trained on false belief tasks improved on these tasks, but there was no influence on their language abilities. The control group, who were trained on relative clauses, increased their production of relative clauses but demonstrated no other improvements in the other posttests. The data from Hale and Tager-Flusberg (2003) indicate that the acquisition of complements can lead to changes in theory of mind. However, because the group that was trained in false beliefs also performed more successfully on theory-of-mind tasks, training on complements may not be absolutely necessary in the development of theory of mind.

The present study further explored the relationship between sentence complements and the development of theory of mind by implementing training for two case studies to determine if performance on false belief tasks would improve after training in the comprehension of sentence complements. A secondary interest was to explore the effects of varying language ability on sentence complement and false belief tasks by including the participation of a child with a history of expressive language delay as well as typically developing twins.

**METHOD**

**Participants**

There were 3 female participants in this study. Two of the children were typically developing fraternal twins, age 3:3. One twin was the “experimental twin,” or the twin receiving the intervention (Twin-X), and the other twin was the “comparison twin” who did not receive the intervention (Twin-C). Their mother reported that they typically spoke in complex sentences and were understood by all communication partners 100% of the time. One of the children was noted to use the phonological error of gliding (e.g., “little” produced as “yittle”), but this was developmentally appropriate for her age.

The third participant, Child-A, was a child with a moderate expressive language delay, age 2:11; however, she had been receiving speech and language services for 5 months before the start of the study. Her mother reported that at 2 years of age, her language development seemed delayed, but had noted improvement at the start of the study. It was estimated that the child was understood between 85% and 95% of the time by her parents and 70%
of the time by playmates and strangers. Her mother also indicated that her daughter primarily communicated with the use of phrases and demonstrated some grammatical errors and phonological errors such as consonant deletions and substitutions.

A case history was completed by the parents of the participants. This questionnaire included questions about the child’s health and overall development, including mother’s health during pregnancy, childhood illnesses, and language development. The medical history of all participants was unremarkable. Participants passed a pure-tone hearing screening with a threshold of 25 dB at 500 Hz, 1000 Hz, 2000 Hz, and 4000 Hz. The criteria for inclusion in this study were that English was the child’s primary language and that the child had no history of autism or a hearing impairment. The child was also required to not be passing false belief tasks at the time of initial testing.

Language abilities. The Preschool Language Scale—Third Edition (PLS–3; Zimmerman, Steiner, & Pond, 1992) was administered to determine the child’s language abilities. Standard scores of 100 ± a standard deviation of 15 (i.e., scores between 85 and 115) on both the Auditory Comprehension subscale and the Expressive Communication subscale were considered to be within normal limits for the child’s age. The participants’ results are summarized in Table 1.

At the time of Child-A’s initial speech and language evaluation 6 months before the start of the study, she primarily communicated via vocalizations, word approximations (e.g., CV syllables), gestures, and facial expressions. She produced several intelligible words, but these were not combined into two-word utterances. Child-A had progressed through therapy, producing two- and three-word utterances, present progressive verbs (e.g., cooking), prepositional phrases (e.g., on the table), plurals, and irregular past tense verbs. However, clinic records and clinical judgment based on observations and interactions with Child-A indicated an expressive language delay at the time she entered the study. For example, she often produced word approximations (e.g., “et” for “not yet”), and her utterances were still telegraphic in nature.

The PLS–3 did not identify Child-A’s expressive language skills as delayed; however, this test is not as sensitive for younger children as it is for older children. The authors of the test provide information indicating that the PLS–3 correctly classified 3-year-old children as language disordered or non-language disordered 66% of the time. The majority of classification mistakes were failures to identify language disorders in children who had received that diagnosis. Child-A made progress in 5 months of speech and language therapy, but clinic records as well as observations and interactions with Child-A showed that she required frequent models of targeted forms, produced word approximations, and often omitted articles (e.g., a, the). Clinical judgment in this case indicated that an expressive language delay was present although her PLS–3 scores were within normal limits. In contrast, parent report and examiner observation supported the assumption that the language development of Twin-X and Twin-C was not delayed. They were highly intelligible and voluble, using complex sentences and rarely committing grammatical errors.

### Design

In this pair of descriptive case studies, the dependent variable was performance on false belief tasks, and the independent variable was training on sentence complements. There were repeated measurements of the dependent variable over a period of time. Two parallel but separate case studies were conducted: (a) false belief performance of twins, with only 1 twin receiving the training; and (2) false belief performance of a child with an expressive language delay. Inclusion of the second twin allowed us to compare false belief performance in the presence and absence of sentence complement training.

False belief performance was measured during three phases of the study: the baseline phase, intervention phase (sentence complement training), and a follow-up session. The baseline phase determined the participants’ initial level of performance on false belief tasks as well as their knowledge and use of sentence complements. Baseline information was collected by examining the participants’ performance on repeated trials of each task (5 trials of the change-in-location task, 2 trials of the unexpected contents task, and 5 trials of the sentence complement task). The intervention phase was then introduced, and a follow-up session was conducted several weeks after the final training session. The case studies fit the description of an A–B design (McReynolds & Kears, 1983) because they compared baseline performance with performance following

<table>
<thead>
<tr>
<th>Age</th>
<th>Standard score</th>
<th>Age equivalent</th>
<th>Standard score</th>
<th>Age equivalent</th>
<th>Standard score</th>
<th>Age equivalent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Child-A</td>
<td>2;11</td>
<td>130</td>
<td>3;8</td>
<td>111</td>
<td>3;0</td>
<td>123</td>
</tr>
<tr>
<td>Twin-X</td>
<td>3;3</td>
<td>100</td>
<td>3;3</td>
<td>120</td>
<td>3;11</td>
<td>111</td>
</tr>
<tr>
<td>Twin-C</td>
<td>3;3</td>
<td>127</td>
<td>4;6</td>
<td>126</td>
<td>4;2</td>
<td>130</td>
</tr>
</tbody>
</table>

**Note.** Age is in years;months.
treatment. Such designs are appropriate for exploring phenomena of interest in individuals as a preliminary to a controlled study.

Materials and Procedure

Tasks. To determine the children’s understanding of sentence complements, play scenarios were used that involved a character performing one action and saying that she did another. These scenarios were based on those used in previous studies (particularly those described in Hale & Tager-Flusberg, 2003; de Villiers, 2000; de Villiers & de Villiers, 2000; de Villiers & Pyers 2002); examples are provided in Appendix A. The materials consisted of toys, such as a variety of puppet and doll characters, crayons, plastic play food, trucks, and cars. For example, a puppet was shown eating a cookie and then said, “I ate broccoli!” Immediately after witnessing this scenario, the child was asked two questions, “What did he say?” and “What did he do?” The child was considered to understand sentence complements if she responded correctly to both of the questions. A typical incorrect response occurred when the child replied that the puppet said he ate broccoli and that he really did eat broccoli. This response indicated that the child did not understand sentence complements because she was unable to report on what actually happened independently of what was said. These tasks were scored on a pass/fail basis. The number of trials per session varied according to the child’s attention and cooperation.

Two types of false belief tasks were used: change-in-location and unexpected contents. The change-in-location tasks involved scenarios acted out by characters in which one character moved an object while the other character was away from the setting. The child was asked several questions during this task. In an example involving Mommy and Jane making cookies (see Appendix B), the questions were: (1) Where did Jane put the cookies before going to her room to play? (correct answer: the plate); (2) Where are the cookies now? (correct answer: in the box); (3) Jane is coming back from playing and wants a cookie. She has not come in the kitchen yet. Does she know where the cookies are? (correct answer: no); (4) Where will she look for the cookies? (correct answer: the plate); and (5) Why? The first two questions were asked to check for memory of the components of the story (de Villiers & de Villiers, 2000). The fifth question was asked to give the child an opportunity to demonstrate understanding that might not be captured by the other questions. In fact, no additional information was obtained from asking “Why?” Typical responses were “Because” or “Because she’s hungry.” Child-A rarely responded to this question. Various small containers and bags were used to hide objects and toys for change-of-location tasks. Additionally, a separator was used to distinguish between different “rooms” for the scenarios (e.g., one side of the separator wall was the kitchen, and the other side was the bedroom).

For the unexpected contents tasks, easily recognizable boxes with different contents were used, such as a crayon box filled with paper clips or a cookie container filled with cotton. The child was asked three questions: (1) What is in the box?; (2) Take a look inside. What did you think was in there before you looked inside?; and (3) What would mommy (or someone else who is not present, such as a sibling) think was in the box before they looked inside? Correct answers to the second and third questions were that the child thought, for example, that the crayon box held crayons, and another person would think it held crayons.

All of the tasks required the child to understand and remember a brief series of events. The events were enacted with toys by the experimenter and were also described verbally. The false belief tasks included “control” questions to check that the child understood and remembered what happened and what was said; in almost every case, these questions were answered correctly.

Baseline phase. Baseline data for sentence complements and false belief were collected over the course of four sessions within a 2-week period.

Intervention phase. Sentence complement training was introduced to two of the participants, Child-A and Twin-X. Twin-C, the child not receiving training on sentence complements, participated in free play (e.g., coloring, playing with puppets and dolls) with the experimenter during this phase of the study. Four training sessions were held over the course of 2½ weeks. The intervention segment consisted of scenarios that were similar to the baseline scenarios, except that feedback was provided after the child’s responses. For instance, if the child responded incorrectly to the questions “What did he say?” or “What did he do?”, then the experimenter reenacted the scenario and said, “Remember, he said he ate broccoli but he really ate a cookie!” at which point the questions were repeated several times. If and when the child responded correctly to the questions, the experimenter provided positive reinforcement and verbally repeated the story, “That’s right! He said he ate broccoli but he was really eating a cookie. Good job!” Feedback, story repetition, and questions were provided on each trial several times or until the child demonstrated understanding of what happened by responding appropriately to the questions.

In addition to the sentence complement training, false belief probes were also administered approximately every other session during this phase. The probes were similar in structure and content to those described in the baseline phase (with variation in the specific materials and characters), and were used to measure any change that might have occurred during the training period. The unexpected contents task was administered less often than the change-in-location task in case the children began to suspect that the contents of containers presented by the experimenter never matched their appearance.

Follow-up session. A follow-up session was completed 9 weeks after completion of the training. The purpose of this session was to determine if changes occurred after intervention was completed. Two sentence complement tasks were conducted, as well as two change-in-location tasks and one unexpected contents task.
RESULTS

Baseline Phase

Sentence complements. For the sentence complement tasks, the performance of Child-A and that of the twins was initially very different. Child-A’s responses consistently indicated that she had not yet acquired this linguistic structure, meaning that she could not yet express the difference between what the character said he did versus what the character actually did. It should be noted that she understood that there was a difference, as frequently demonstrated by her reactions to the scenario. For example, when the puppet was shown eating some corn and then said, “I ate a cookie!”, the child said, “No” and made a face as if to express “that’s not what happened!” However, when asked, “What did he say?” and “What did he do?” she consistently responded with the same answer for both questions (e.g., “ate corn”). In contrast, the twins had already acquired the ability to express this linguistic structure, as demonstrated by their 100% accuracy with this task.

False belief tasks. A summary of baseline false belief performance is provided in Table 2. All participants were failing both false belief tasks with one exception: Twin-C passed one trial of the unexpected contents task and did not pass the second trial, suggesting that this ability was just beginning to emerge.

Intervention Phase

Sentence complement training. Four sessions were held with each child during this phase in which they received training and reinforcement on sentence complements. Performance during the training segment is summarized in Table 3. Percentages are provided for each session because the number of trials (or opportunities for success) varied. Child-A’s performance steadily improved over the course of training, ranging from 0% to 86%. Although Twin-X was already proficient with sentence complements, she was not yet passing false belief tasks. Her competency with sentence complements was further emphasized during the training segment, when she was observed to reenact the scenarios on her own. For example, while playing with the puppets with the experimenter, she made the Winnie-the-Pooh puppet kiss the cow puppet and said, “I kissed Bugs Bunny!” As expected, her performance was consistently high for this task.

False belief probes. Three false belief probes were administered to Child-A and Twin-X during the training segment. Their performance is summarized in Table 4. Child-A did not pass either false belief task during this phase of the study. Twin-X passed the change-in-location probe one out of three times, and passed the unexpected contents probe on the one trial that was administered.

Follow-up Phase

During the follow-up session 9 weeks after conclusion of the intervention phase, the participants’ performance with

<table>
<thead>
<tr>
<th>Twin-C</th>
<th>Twin-X</th>
<th>Child-A</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Number of times correct out of 5 trials</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Change-in-location</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 Where did the character put the object?</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>2 Where is the object now?</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>3 Does the character know where the object is?</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4 Where will the character look for the object?</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

| **Number of times correct out of 2 trials** | | |
| Unexpected contents | | |
| 1 What is in the box? | 2 | 2 | 2 |
| 2 What did you think was in there before you looked inside? | 2 | 1 | 0 |
| 3 What would someone else think was in the box before they looked inside? | 1 | 0 | 0 |

*This question was considered the most important question in passing or failing the task (de Villiers & de Villiers, 2000).

| Table 3. Performance during sentence complement training. |
|-------------|-------------|-------------|-------------|-------------|
| | Session 1 | Session 2 | Session 3 | Session 4 |
| Child | # Correct | % | # Correct | % | # Correct | % | # Correct | % |
| Child-A | 0/3 | 0 | 3/4 | 75 | 6/7 | 86 | 5/6 | 83 |
| Twin-X | 5/6 | 83 | 6/6 | 100 | 4/4 | 100 | 4/4 | 100 |
sentence complements and false belief tasks was reassessed. Four trials of sentence complements, one trial of unexpected contents, and two trials of false belief tasks were administered. For the sentence complement tasks, each twin remained consistent, with 100% accuracy. Child-A, however, did not answer the questions correctly during the first two trials, but did answer them correctly during the second two trials (i.e., 50% accuracy). This suggested that even though she was beginning to acquire sentence complements by the end of the training sessions, it was not a fully mastered skill at the time of follow-up. It took two trials for her to recall the training and use the sentence complements to express the difference between “What did he say?” and “What did he do?” The participants’ performance on the false belief tasks during the follow-up session was very similar to previous performance during the baseline and intervention segments; these are summarized in Table 5. Twin-X answered the unexpected contents probe correctly, but when questioned further, demonstrated uncertainty about her answer.

**DISCUSSION**

The purpose of this study was to examine the relationship between theory of mind and language development, specifically false belief tasks and sentence complements, using a case study design, which allows for a rich description of the performance of individual children. Based on prior research

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**Table 4. Performance on false belief probes during the intervention phase.**

<table>
<thead>
<tr>
<th></th>
<th>Twin-X</th>
<th>Child-A</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Number of times correct out of 3 trials</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Change-in-location</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 Where did the character put the object?</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>2 Where is the object now?</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3 Does the character know where the object is?</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>4 Where will the character look for the object?</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td><strong>Number of times correct out of 1 trial</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unexpected contents</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 What is in the box?</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2 What did you think was in the box before you looked inside?</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>3 What would someone else think was in the box before they looked inside?</td>
<td>1</td>
<td>0</td>
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</table>

*a This question was considered the most important question in passing or failing the task (de Villiers & de Villiers, 2000).*

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**Table 5. False belief performance at follow-up.**

<table>
<thead>
<tr>
<th></th>
<th>Twin-C</th>
<th>Twin-X</th>
<th>Child-A</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Number of times correct out of 2 trials</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Change-in-location</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 Where did the character put the object?</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>2 Where is the object now?</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>3 Does the character know where the object is?</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4 Where will the character look for the object?</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Number of times correct out of 1 trial</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unexpected contents</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 What is in the box?</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2 What did you think was in the box before you looked inside?</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>3 What would someone else think was in the box before they looked inside?</td>
<td>0</td>
<td>1*</td>
<td>0</td>
</tr>
</tbody>
</table>

*a This question was considered the most important question in passing or failing the task (de Villiers & de Villiers, 2000); *b Twin-X answered this question correctly, but further questioning revealed that she lacked understanding of the task, saying that someone else would know the true contents of the box before opening it.*
(e.g., de Villiers & Pyers, 2002; Hale & Tager-Flusberg, 2003), it was predicted that sentence complement training would result in improved false belief performance.

Child-A, with a history of expressive language delay, was not yet passing false belief tasks and was not demonstrating the ability to understand sentence complements at the start of the study. After four sessions of training, her accuracy levels with sentence complements (i.e., expressing the difference between what a character said and what he or she did) increased from 0% initially to 86%. False belief probes administered during training and at follow-up showed that she was not yet passing the false belief tasks even though her understanding of sentence complements had increased.

Neither of the twins was passing false belief tasks at the start of the study, with one exception: Twin-C initially passed one trial of the unexpected contents tasks. Both children were proficient with sentence complements. Twin-X received training on sentence complements while Twin-C participated in free play activities with the experimenter. It was hypothesized that, even though Twin-X already understood sentence complements, extra training and language stimulation involving this specific form of grammar would improve her performance on false belief tasks. Twin-X passed one change-in-location probe and one unexpected contents probe during the intervention phase. However, she did not pass the change-in-location probes at follow-up, and her correct response to the unexpected contents probe was questionable. Any effect of the intervention on false belief was not robust.

Although Child-A had begun to acquire the sentence complements during training, her variable performance at follow-up suggested that the effect of sentence complement training did not remain consistent, as expected. Perhaps language training for a child with expressive language delay needs to be altered in some way so that he or she acquires the language structure with more consistency. This may include, for example, more time, different structure in the tasks, more feedback and reinforcement, or different types of feedback and reinforcement. It is worth noting that though her accuracy levels varied, Child-A still displayed some understanding or acquisition of sentence complement—a subtlety that would likely go unnoticed, or at least unrecorded, in a group study.

Understanding of sentence complements may not be enough to promote false belief development. Child-A improved markedly on sentence complements (see Table 3) but demonstrated no understanding of false belief. Twin-X was proficient with sentence complements at the outset of the study, and received training and practice with the structure, yet correctly answered the question about false belief in the change-in-location task only once out of 10 opportunities. On the one trial when she answered correctly, she also correctly said that the character did not know where the object was. However, on three baseline trials, she said that the character did not know where the object was, then said that the character would look for the object in its current location. In the unexpected contents task, she correctly answered a question about her own prior false belief on three out of four trials, and about someone else’s false belief one out of four times. Overall, her performance was similar to that of her sister, who did not receive sentence complement training. Twin-C never answered the change-in-location false belief question correctly, despite correctly reporting that the character did not know where the object was on five trials. She consistently reported her own prior false belief in the unexpected contents task correctly, but predicted someone else’s false belief correctly on only one out of three trials. Sentence complement performance, then, did not appear to facilitate false belief understanding for either Child-A or Twin-X.

One potential explanation for our failure to observe changes in false belief is that it takes time for sentence complement proficiency to influence false belief, yet at follow-up, 9 weeks after training, neither Twin-X nor Child-A performed better on false belief than they had previously. Another potential explanation is that our false belief tasks were not sensitive enough. However, the tasks were ones that are widely used in the literature on theory of mind, and were very similar to those used by de Villiers and Pyers (2002) and Hale and Tager-Flusberg (2003).

Hale and Tager-Flusberg (2003) and Lohmann and Tomasello (2003) argued that although sentence complement proficiency may be sufficient to promote false belief understanding, it is not necessary. Children can achieve false belief understanding via other pathways. Our results are consistent with these arguments, but add a somewhat different piece to the puzzle. We found that false belief understanding did not necessarily follow sentence complement understanding. Group designs typically ignore such variation, but Lohmann and Tomasello (2003) provide one piece of evidence to corroborate our results. In their study, the children who were trained on sentence complements improved on false belief as a group, but 47% of the children failed an unexpected contents task following training. In comparison, only 8.3% of the children who received “full” training on complements, mental or communication verbs, and deceptive objects failed the unexpected contents task at posttest.

Although the literature clearly supports the hypothesis that there is a relationship between language development and theory of mind, the nature of the relationship needs to be explored further. In many studies, the research design has not made it possible to exclude the hypothesis that the verbal demands of the theory-of-mind tasks led to the observed relationship between language and theory of mind. Group training studies such as those of Hale and Tager-Flusberg (2003) and Lohmann and Tomasello (2003) suggest that there is not an inevitable relationship between sentence complement mastery and understanding of false belief. Our results support this conclusion. For many children, improving sentence complement understanding will spill over into false belief, but this strategy may not work for every child.

LIMITATIONS, IMPLICATIONS, AND FUTURE RESEARCH

Interpretation of our findings is somewhat complicated by the fact that one of the participants had a language delay. It
is possible that the relationship between language and theory of mind is different for children with language delays than for typically developing children. That very possibility, however, makes investigation of false belief development in children with language delays crucial. Understanding of individual variation in how theory of mind develops is necessary for a complete theoretical account of theory of mind, as well as for designing intervention.

The question of the relationship between sentence complements and false belief has important implications for speech-language pathologists. First, speech-language pathologists should be aware that adequate theory-of-mind development is crucial for social and communicative competence (Astington, 1993). The negative effects of an immature theory of mind may be most dramatic in children with autism, but are an important consideration for other children with communication disorders. Second, due to the complex relationship between language and theory of mind, language delay may put children at risk for deficits in theory of mind. Speech-language pathologists need to be prepared to assess theory of mind as well as related language skills such as sentence complement proficiency. Intervention for both language and theory of mind may be needed if children with language disorders are to maximize their communicative competence.

The research literature on connections between language and theory of mind is growing, but consists of group studies, many of which are correlational rather than experimental. This work should be complemented by studies of individual differences. A logical next step would be to conduct single-subject experimental research in which individual children receive different treatments, such as those used by Hale and Tager-Flusberg (2003), while change in their language and theory-of-mind performance is closely monitored, using multiple dependent measures. The clinical setting is an ideal context for valuable research of this type.

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APPENDIX A. EXAMPLE SCRIPTS FOR SENTENCE COMPLEMENT TEST ITEMS

Jane’s dad said, “Jane, get ready for bed.” So Jane went to her room but she started coloring with crayons. Jane’s dad called out, “What are you doing?” Jane said, “I’m getting ready for bed!”

• What did Jane say she was doing?
• What was she doing?

Cow and Pig were drawing pictures. Cow said, “Don’t draw on my paper.” Then he went in the other room. Pig drew on Cow’s paper. Cow called out, “What are you doing?” Pig said, “I’m just looking at your picture.”

• What did Pig say he was doing?
• What was he doing?

APPENDIX B. EXAMPLE SCRIPTS FOR CHANGE-IN-LOCATION TASK

Jane and her Mom are making cookies. They put the cookies on this plate. Then Jane goes to her room to play. Mom says, “I better put the cookies in this box.” Then Mom goes outside.

• Where did Jane put the cookies before going to her room to play?
• Where are the cookies now?

Jane is coming back from playing and wants a cookie. She has not come in the kitchen yet.

• Does Jane know where the cookies are?
• Where will Jane look for the cookies?
• Why?

Bobby and his Mom are cleaning the living room. They put the toy truck in this bag. Bobby goes to school. Mom says, “I’ll put the truck in Bobby’s toy box.” Then Mom goes to the store.

• Where did Bobby and Mom put the truck before Bobby went to school?
• Where is the truck now?

Now Bobby comes home from school, but he has not gone in the living room yet.

• Does Bobby know where the truck is?
• Where will Bobby look for the truck?
• Why?