Language and false belief in Korean-speaking and English-speaking children

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\textbf{ABSTRACT}

The link between language and false belief (FB) understanding has been the focus of considerable debate regarding which language component (semantics, general language, or complementation) is necessary for FB development. We examined the relative roles of complementation and receptive vocabulary in FB development in Korean-speaking and English-speaking children. FB understanding, memory for complements involving the verbs \textit{think}, \textit{say} and \textit{want}, and receptive vocabulary were measured at three time points in 59 Korean-speaking children and 72 English-speaking children. A multi-level growth model indicated that the development of receptive vocabulary and separately the development of \textit{think} understanding uniquely predicted the development of FB understanding. Neither \textit{say} nor \textit{want} was associated with FB understanding. The same pattern was found for Korean- and English-speaking children. The results provide evidence for the role of general language in FB understanding and against the unique role of sentential complementation.

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1. Introduction

Language plays an important role in theory of mind development, particularly the acquisition of false belief (FB; Astington & Baird, 2005; Milligan, Astington, & Dack, 2007). The aspect of language responsible for this achievement has been the center of considerable debate. A particular focus has been whether the specific grammatical structure of complementation is required for FB understanding (de Villiers & Pyers, 2002) or whether general language abilities are sufficient (Slade & Ruffman, 2005). The research on this topic, however, has produced mixed results. Collecting data at three time points, we investigated the relative role of sentential complementation and general language abilities in FB understanding in a cross-linguistic study of Korean- and English-speaking preschoolers.

1.1. False belief and language

During the preschool years, children make rapid progress in the understanding of minds (Wellman, Cross, & Watson, 2001). FB understanding is considered a key achievement in the development of theory of mind. This understanding reflects children’s knowledge that people can have different beliefs about the same situation. It is often assessed by an unexpected-content task. For example, children are shown a familiar container, such as M & Ms, and asked what they think is in the container. After typically responding “M & Ms”, they are shown that it contains marbles. They are then asked what someone else, who has not seen what is in the container, believes is in the container. Children younger than 4.5 years typically fail the task (replying “marbles”) whereas older children succeed (replying “M & Ms”) even though they know that there are marbles in the container.

Language is fundamentally important to the development of FB. However, there have been a number of different proposals regarding which dimension(s) of language are crucial to its development. These proposals typically fall into one of two categories, those that argue that the specific syntactic structure of complementation is required and those that argue that general language ability, as reflected in semantic and syntactic measures, is needed for FB, but not complementation per se. Although hundreds of studies have examined the relation between various language measures and FB, only a few have directly evaluated the preceding alternatives. To do so adequately, it is necessary to include both complementation and general language measures in the same longitudinal study.

1.2. Complementation and false belief

De Villiers (2005a, 2007) and de Villiers and de Villiers (2000) have argued that the acquisition of sentential complement structures is necessary for the development of FB understanding. Complement structures involving mental state verbs allow the embedding of one proposition in another. For instance in the sentence, The girl thinks that it is raining but it is really the sprinkler, the presence of the mental state verb think makes the truthfulness of the sentence independent of the real state of the world. Thus, sentential tensed complements allow a distinction between what a person thinks and what is actually true, which is the core of FB understanding. In contrast, desire terms, such as want, do not require such sentential complements, but rather infinitival complements, to + infinitival (e.g., She wants to go to the movie). De Villiers proposed that FB understanding requires the child have the full tensed complement structure to represent the belief. de Villiers and Pyers (2002) tested this proposition in a three-wave longitudinal study. Children’s understanding of sentential complements was assessed by ability to correctly recall from a sentential complement sentence the fact that another person’s thinking is different from the true state of reality. They found that children’s understanding of sentential complement at time 2 accounted for the additional variance in FB understanding at time 3 controlling for general language measures at time 2, thus demonstrating the unique role of sentential complementation in FB understanding.

Other evidence supporting the importance of understanding complement structure as a predictor of FB understanding comes from training studies, investigations of special groups of children (e.g., those who are deaf or autistic) and a meta-analysis of relations between language and FB. Hale and Tager-Flusberg (2003) trained children who failed both a FB and sentential complement pretest in either FB understanding, sentential complements, or relative clauses (a control group). Children who
were trained in either FB or sentential complements significantly improved their performance on FB tasks, whereas those trained in relative clauses did not. The results thus suggest that improvement in complementation can facilitate FB understanding.

Studies of FB understanding in deaf children have also demonstrated the importance of complementation (De Villiers, 2005b; Schick, de Villiers, de Villiers, & Hoffmeister, 2007). Schick et al. compared four groups of children regarding the relation between language (receptive vocabulary, general syntax, and complementation) and FB: deaf children who signed American Sign Language (ASL) with deaf parents; deaf children who signed ASL with hearing parents; deaf children educated in oral communication with hearing parents; and a hearing control group. Children's language development was measured using either an ASL version or hearing version that matched their communication method. For both deaf children using ASL with deaf parents and hearing children, both complements and vocabulary made independent contributions to FB understanding after accounting for other variables such as age. In a two-wave longitudinal study of children with autism, Tager-Flusberg and Joseph (2005) also found that complementation understanding at time 1 made a unique contribution to FB understanding at time 2 controlling for a general measure of productive syntax at time 1. Finally, in a meta-analysis of over 100 studies of typically developing children, Milligan et al. (2007) reported that complementation had a stronger association with FB understanding than receptive vocabulary, but not significantly more than other language measures. However, there were only four studies in the meta-analysis that included complementation measures.

### 1.3. General language and false belief

Alternatively, some researchers have argued for the greater importance of general language on FB. Studies vary in defining the scope of general language, ranging from receptive vocabulary to various measures including syntax and semantics. Several studies have shown the importance of receptive vocabulary in FB understanding (Farrar & Maag, 2002; see also Watson, Painter, & Bornstein, 2001). Others have shown the importance of general language abilities assessed by syntax and semantic measures. In a two-wave longitudinal study, Slade and Ruffman (2005) assessed several aspects of general language including receptive vocabulary, comprehension of word order, sentence comprehension, and comprehension of embedded clauses. Time 1 language variables together predicted FB performance at time 2, although there was no unique effect of each language variable on FB. Slade and Ruffman concluded that contributions from several aspects of general language ability, rather than any particular aspect of general language, seem to be necessary for FB development. However, none of these studies included complementation measures, making it difficult to directly evaluate the complementation hypothesis against the general language hypothesis (see also Ruffman, Slade, Rowlandson, Rumsey, & Garnham, 2003).

Several recent studies directly compared the role of general language ability to that of complementation and found that general language, but not complementation, predicts FB understanding. One of the strongest lines of evidence supporting the role of general language over sentential complementation in FB development has come from studies of children who are learning languages other than English. In a cross-sectional study, Cheung et al. (2004) studied children acquiring either English or Cantonese to investigate whether FB understanding was related to comprehension of sentential complements, infinitival complements, or general language. Children's general language ability was assessed using the verbal comprehension subtest of the Reynell Developmental Language Scales (RDSL; Reynell & Huntley, 1985), which assesses both semantic and syntactic knowledge. Among both Cantonese-speaking and English-speaking children neither sentential nor infinitival complement comprehension predicted FB, whereas general language ability did. This pattern of results was replicated among Cantonese-speaking children for other verbs than say and think (e.g., forgets; Cheung, 2006). However, these studies were not longitudinal, and thus initial FB understanding was not controlled.

In a four-wave longitudinal study of preschoolers acquiring Cantonese, Tardif, So, and Kaciroti (2007) further examined the role of general language and complementation, particularly the use of the communication verb say and belief verb think. Without controlling other variables, children's understanding of false complements at time 1 predicted differences across children in the developmental
trajectories of FB at time 2 through 4, and there were no differences in this relationship for communication terms vs. belief terms. However, when controlling for FB, general language, and age at time 1, complement at time 1 did not predict differences across children in the developmental trajectories of FB. Instead, general language measures at time 1 made a unique contribution in predicting differences across children in the developmental trajectories of FB after controlling for FB, complementation and age at time 1. Tardif et al. (2007) argued that these results ruled out the role of sentential complementation in the development of FB understanding.

Additional evidence that complementation is not necessary for FB came from a study by Lohmann and Tomasello (2003) that trained children in detecting the true identity of a deceptive object, such as a candle that resembled an apple. Children who were exposed to the deception using a complement construction performed significantly better on FB assessments than children who did not receive such training. However, they did not perform any better than children who were exposed to discourse that highlighted the deception but did not use a complementation. Thus, this training study suggested that while mastering complementation can facilitate FB reasoning it is not critical for mastery (Hale & Tager-Flusberg, 2003).

Overall, the available evidence systematically evaluating the complementation hypothesis against the general language hypothesis is limited in typically developing children. Only a few studies have included both measures of complementation and general language. The evidence from these studies is mixed with slightly less than half supporting the complementation hypothesis and the others supporting the general language hypothesis. Although several studies (de Villiers & Pyers, 2002; Low, 2010) provided evidence supporting the complementation hypothesis, the majority of these studies did not control for prior FB understanding or other important demographic variables such as age and thus their results are subject to alternative explanations. In contrast, several studies involving Cantonese-speaking children provide consistent evidence. Once general language ability is accounted for, complementation understanding does not account for any or a minimal amount of variance in FB (Cheung, 2006; Tardif et al., 2007). This relationship holds regardless of how complementation is structured in different languages and whether it is assessed with different verbs.

2. Present study

The present study further examined the relative role of sentential complementation and general language in FB understanding. It extends earlier studies in three ways. First, we included both complementation and general language measures in the same study. Second, we examined this relationship in children who speak Korean, a language that has not been frequently considered in past studies, in addition to English-speaking children (Oh & Lewis, 2008). Previous cross-linguistic comparisons have almost exclusively involved Cantonese-speaking and English-speaking children (Cheung et al., 2004; although see Perner, Sprung, Zauner, & Haider, 2003). Investigations of other languages are needed. Furthermore, only a few past studies have directly compared both English-speaking children and non-English-speaking children within the same study to investigate potential differences (e.g., difference in the rate of developmental trajectories) across languages in the role of complementation and general language in FB understanding. Thus, we take the opportunity to further evaluate these two competing hypotheses across two languages. The Korean complement structure is the same as the English one. In both languages, the verbs say and think take a sentential complement, while want takes an infinitival complement. However, in contrast to English, the Korean complement clause is placed before the main verb.

Third, the majority of past studies collected data at two time points (Slade & Ruffman, 2005) or analyzed only two time points even if third data points were available (de Villiers & Pyers, 2002), and applied a sequential regression technique. According to Singer and Willett (2003), two-wave data provide limited information. For example, it would be difficult to discern whether FB development is gradual or FB development is peaked right after the first wave. In addition, a two-wave study cannot fully rule out the possibility that increased FB understanding is partially due to measurement error. Thus, three or more waves of data are needed. As far as we know, only one study by Tardif et al. (2007) collected four-wave data and applied a multi-level model to investigate whether variability in language at time 1 predicts variability in the developmental trajectories across times 2 through 4.
We collected data at three time points. While Tardif et al.’s analysis focused on predictors that accounted for differences across children, we focused on language predictors that account for the FB development of each child. Thus, we applied a multi-level growth model, a slightly different analytic method that allows us to investigate whether each child’s FB development trajectory over three time points is associated with his or her complementation and vocabulary developmental trajectories across the three time points. This approach also allows initial FB understanding to be controlled.

3. **Method**

3.1. **Participants**

Fifty-nine Korean-speaking children residing in South Korea were initially recruited, 53 children from four daycare centers in the Daegu area and six children via private acquaintance. Seventy-two U.S. children were initially recruited from several preschools in a small city in the USA. All U.S. children spoke English as a primary language. Both groups of children were from primarily middle and upper-income families based on the schools they attended. One Korean child and seven U.S. children who had participated only at one time point were excluded. The final sample of 123 children consisted of 58 Korean-speaking children (M age = 42.56 months, SD = 2.77 months) and 65 English-speaking children (M age = 42.88 months, SD = 4.83 months) who had participated at two (n = 20) or three (n = 103) time points. Participants received $10 gift cards at each assessment.

3.2. **Measures**

We employed two measures of language development, a measure of receptive vocabulary and an assessment of complementation understanding. Due to lack of a common measure of general language or syntax appropriate for both Korean and English, receptive vocabulary measure was used as a measure of general language. In addition we assessed FB understanding.

3.2.1. **Vocabulary**

The Peabody Picture Vocabulary Task, Fourth Edition (PPVT; Dunn & Dunn, 2007) was used to measure the English children’s receptive vocabulary. Because the same version of the PPVT was not available in Korean, the Korean children’s receptive vocabulary was measured with the PPVT-R (1981). The PPVT-IV used with English children has a total of 228 items whereas the PPVT-R used with Korean children has a total of 112 items. Thus, raw scores were standardized for analysis.

3.2.2. **Complementation understanding**

Children’s understanding of the complements involving think, say, and want was measured using a picture/story format. Two stories were presented at each time point. As the experimenter read each sentence of a story, the child was shown a picture corresponding to the sentence on a laptop computer. All of the stories had the same format of two characters discussing the actions of an absent character. A sample story was as follows: Tom’s mother and father were discussing what Tom, who was not present, was doing. Tom’s father stated (say) what they desired (want) Tom to do (e.g., “Tom should be doing his homework.”). Tom’s mother stated that Tom was doing the action (e.g., “Yes, he is doing his homework”). The participant was then told what Tom’s mother actually thought (think) Tom was doing (e.g., “However, Tom’s mother thought that Tom was talking to his friend on the phone.”).

Once each story presentation was completed, the child was asked three questions (using a complement involving think, say, and want, respectively) related to the story (e.g., What did Tom’s mother think Tom was doing? What did Tom’s mother say Tom was doing? What did Tom’s father want Tom to do?). A question involving say was used to investigate the role of sentential complements involving a communication verb. A question involving think was used to investigate the role of sentential complements involving a mental verb. A question involving want was used to investigate the role of infinitival complements.

At each time point children were presented two stories and thus two questions using each of the three complement verbs. Thus, scores on each of the three complements ranged from 0 (incorrect
responses to both questions) to 2 (correct responses to both questions) at each time point. Four additional stories with the same format, but different content, were used at time 2 and time 3, two stories each time.

The measure of complements in our study is different from that of studies using memory for complements developed by de Villiers and Pyers (2002). They asked children “What did he think?” after presenting a short story with pictures such as “He thought he found his ring, but it was really a bottle cap.” The answer ‘ring’ was scored as correct. The child was required to verbally produce the correct answer. In the present measure of complementation structure the child was required to show comprehension of the structure through a point (or a verbal response). For example, the question included the complement structure as follows: “What did Tom’s mother think he was doing?” and then “Does Tom’s mother think that he is playing computer games or he is sleeping? The child indicated the correct answer by pointing to the correct picture or providing a verbal response.

3.2.2.3. False belief

Children’s FB understanding was measured using Unexpected Location (UL) and Unexpected Content (UC) tasks. The UL and UC tasks were designed to measure children’s ability to identify the beliefs of a naïve other as well as their own initial beliefs regarding the location of an object and the content of a tangible object. The UL task was modeled after the traditional “Sally-Anne” task. One of two characters hides an object and leaves the room. The remaining character moves the hidden object to a different location. The naïve character who left the room returns. The child is then asked where the naïve character will look for the object.

The UL task was presented to the child using a story format with accompanying pictures on a laptop computer. Then, the child was asked the FB question (e.g., When Tom went into the kitchen, where would he look for the cake?). Thus, ULFB scores ranged from 0 to 2. After the FB questions, the child was also asked two memory control questions relating to the original location of the object (e.g., Where did Tom put the cake?) and the new location of the object (e.g., Where is the cake now?). Virtually all children provided correct answers. Two versions of the FB task were presented at each time point. Thus, ULFB scores ranged from 0 to 2 at each time point.

The UC task involved tangible objects. In this task, the child was shown an M&M bag and asked what he or she thought was in the bag. The child was then shown the true contents of the bag (e.g., paperclips) and asked to identify the contents. The experimenter then placed the contents back into the bag and asked the child about his or her own original belief (e.g., When you first saw this bag all closed up like this, what did you think was inside the bag?). The correct identification of one’s own belief (i.e., M&Ms) received one point. Next a naïve puppet was presented and the child was asked about the puppet’s beliefs (e.g., Big Bird has never looked inside of this bag before; what does Big Bird think is inside the bag?). The correct identification of a naive puppet’s belief (i.e., M&Ms) received one point. Thus, UC FB scores ranged from 0 to 4. The total FB scores, UL and UC combined, ranged from 0 to 6 at each time point. Four additional stories with the same format were used at times 2 and 3, two stories each time. After each FB question, children were tested on whether they remember the actual contents. Children who answered the FB question correctly also correctly answered the memory control questions.

3.3. Procedure

Children were tested individually at three time-points throughout the study: at enrollment, (time 1); 6 months later (time 2); and 6 months after time 2 (time 3). At each time point, children received the PPVT and two batteries. Each battery contained one FB location task, one FB content task, and one complementation task consisting of three questions involving think, say, and want, all described above. The administration of the batteries was counterbalanced across types of complementation verbs, across different tasks, across times within each child, and across children. Specifically, the order of the three complementation questions, involving think, say, and want, was counterbalanced across six batteries. The order of the complementation questions as a set, the FB location task, and the FB content task was also counterbalanced across three time points. All testing at each time point was administered in two separate sessions within a few days of each other. Children received the PPVT during Session 1 and the FB and complementation measures during Session 2. Each testing session
Table 1
Means (standard deviations) for all measures.

<table>
<thead>
<tr>
<th></th>
<th>English-speaking children</th>
<th>Korean-speaking children</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Time 1</td>
<td>Time 2</td>
</tr>
<tr>
<td>Age</td>
<td>42.88</td>
<td>48.16</td>
</tr>
<tr>
<td></td>
<td>(.83)</td>
<td>(.88)</td>
</tr>
<tr>
<td>FB</td>
<td>1.53</td>
<td>2.10</td>
</tr>
<tr>
<td></td>
<td>(.54)</td>
<td>(.83)</td>
</tr>
<tr>
<td>Vocabulary</td>
<td>66.94</td>
<td>80.88</td>
</tr>
<tr>
<td></td>
<td>(24.70)</td>
<td>(18.56)</td>
</tr>
<tr>
<td>Say</td>
<td>.96</td>
<td>.92</td>
</tr>
<tr>
<td></td>
<td>(.75)</td>
<td>(.76)</td>
</tr>
<tr>
<td>Think</td>
<td>1.08</td>
<td>1.02</td>
</tr>
<tr>
<td></td>
<td>(.70)</td>
<td>(.72)</td>
</tr>
<tr>
<td>Want</td>
<td>1.39</td>
<td>1.65</td>
</tr>
<tr>
<td></td>
<td>(.69)</td>
<td>(.60)</td>
</tr>
</tbody>
</table>

Note. FB = False Belief.

lasted from 15 to 30 min. The majority of testing occurred at children’s childcare center. In some cases, children were tested in the experimenter’s laboratory when testing at the center was not possible.

4. Results

4.1. Descriptive data

Table 1 provides descriptive data for all measures and time points for both samples. The FB measure for the English-speaking children seems to increase linearly over time whereas the FB measure for the Korean-speaking children had increased rapidly by time 2 and only slightly more by time 3. Both groups showed increases across time for all other measures with the exception of say development for English-Speaking children, which is fairly flat over time. To gain a better understanding of developmental trajectories, we randomly selected (using a random number generator) 10% of the sample (10 children) who provided data for three time points. Fig. 1 presents ordinary linear regression lines representing developmental trajectories of FB understanding (A), vocabulary (B), say (C), think (D), and want (E) of these 10 children. The numbers next to each growth line are numbers of children who show the same developmental trajectory. Children displayed growth in both FB and receptive vocabulary; however the developmental trajectories for each complement were generally mixed, although there was a trend of growth in children’s complement understanding of think.

4.2. General data analytic strategy

We applied a multi-level growth model to investigate the extent to which each child’s development in FB was associated with his/her spoken language and language development (i.e., vocabulary development and complement understanding of think, say, and want). Multi-level Growth Model (MGM) is particularly useful in studying developmental trajectories when longitudinal data are available. Within a single model, MGM allows for the investigation of factors associated with within-person developmental trajectories and factors associated with between-person differences in developmental trajectories (Singer & Willett, 2003). Employing MGM, in a single model we examined (a) the association between each child’s FB development and his/her language development over time, and (b) the association between children’s spoken language (i.e., English or Korean) and their initial FB understanding and change in FB understanding over time.

All MGMs include a measure of time as well as time-variant and time-invariant predictors. The language variables are all within-person (Level 1) predictors and they are all time-variant predictors, meaning they change over time and were measured at each time point. In contrast, language (English or Korean) is a between-person (Level 2) predictor and is time-invariant. We used age as a metric for time rather than a static coding of time to incorporate slight variation in children’s age at each time point and slight variation in the observation intervals across children (Singer & Willett, 2003). However, in the following presentation of results we occasionally refer to time instead of age for clarity. The analyses were conducted using HLM version 6.04 (Raudenbush & Bryk, 2007), which handles missing data well. Age was centered on the mean age at Time 1 to anchor children’s FB development relative to starting point. All language predictors were grand mean centered except for vocabulary scores, which were standardized separately for English and Korean language groups.

4.3. Linear development of false belief over time

Following the convention of MGM, we first tested the baseline unconditional growth model to investigate (a) the existence of linear growth of FB as a function of age, and (b) the existence of additional variability in FB development that might be explained by other factors besides age. Thus, only age (a Level 1 time variable) was entered in this model.

The Level 1 model was as follows:

\[ FB_{ij} = \beta_{0i} + \beta_{1i} \text{Age}_{ij} + e_{ij} \]

\( FB_{ij} \) represents FB understanding for the child \( i \) at age \( j \). Thus, \( \beta_{0i} \) represents the predicted level of FB understanding for the \( i \)th child at the starting point of the study and \( \beta_{1i} \) represents the predicted rate of change in FB for each child as a function of age. The error, \( e_{ij} \), represents the degree to which each child’s predicted FB score at a given age differs from his or her observed FB at that age.
Fig. 1. Intra-individual growth trajectories of FB development (A), vocabulary development (B), say development (C), think development (D), and want development (E). The numbers next to each growth line represent the number of children who show the same development trajectory.
The Level 2 model was as follows:

\[ \beta_0 = \gamma_00 + U_0 \]
\[ \beta_i = \gamma_{0i} + U_{0i} \]

The Level 2 equations represent variability in FB across children. Thus, \( \beta_0 \) (variability across children in FB understanding at the starting point of study) is represented by the addition of \( \gamma_{00} \) (i.e., the overall mean of FB understanding at the starting point) and \( U_0 \) (unique random effect for the ith child). Also, \( \beta_i \) (variability across children in the rate of FB understanding) is represented by the addition of \( \gamma_{0i} (\text{i.e., the overall rate of FB understanding}) \) and \( U_{0i} \) (unique random effect for the ith child).

The results (Table 2, fixed effects) showed that on average the rate of growth in FB understanding over time was positive and significantly different from zero, \( \gamma = .15, p < .001 \), indicating increased understanding of FB as children aged. Specifically, as children aged one month, their FB understanding increased by .15 on average. The results (Table 2, random effects) also showed that as expected children did not differ in the level of FB understanding at the starting point of the study (intercept); however, they differed in the rate (slope) of change in FB development over time, \( \chi^2 = 161.12, p = .01 \). Korean-speaking children increased more rapidly in FB understanding from Time 1 to Time 2, and then stabilized. English-speaking children’s FB understanding increased linearly.

### 4.4. FB development as a function of language variables and spoken language

Because FB understanding increased over time for each child over and above age increase, the variables (think, say, want, and vocabulary) representing each child’s language development over time were added to age in Level 1, to investigate whether these predictors could explain the child’s FB development over time. Further, because the rate of FB development differed across children, children’s spoken language (coded 0 for English and 1 for Korean) was entered in Level 2 to investigate the difference in the rate of FB development over time across the two languages. The resulting Level 1 and Level 2 models are as follows.

**Level 1:**
\[ \text{FB}_i = \beta_0 + \beta_{1i} \text{Age}_i + \beta_{2i} \text{Vocabulary}_i + \beta_{3i} \text{Say}_i + \beta_{4i} \text{Think}_i + \beta_{5i} \text{Want}_i + \epsilon_i \]

**Level 2:**
\[ \beta_0 = \gamma_{00} + U_0 \]
\[ \beta_i = \gamma_{0i} + U_{0i} \]
\[ \beta_{1i} = \gamma_{10} + \gamma_{11} \text{ (Spoken Language)}_i + U_{1i} \]
\[ \beta_{2i} = \gamma_{20} \]
\[ \beta_{3i} = \gamma_{30} \]
\[ \beta_{4i} = \gamma_{40} \]
\[ \beta_{5i} = \gamma_{50} \]

The results (Table 3, fixed effects) showed that among the Level 1 language predictors, vocabulary and think were significantly associated with FB understanding, whereas want and say were not. That is, controlling for all other predictors, as children developed vocabulary and think understanding with age, their FB understanding also improved with age, \( \gamma = .44, p < .001 \) and \( \gamma = .25, p = .04 \), respectively. The result implies that each child’s development of FB understanding is associated with his or her vocabulary development and the development of mental verb think, but not the development of sentential complementation involving say or the development of infinitival complementation involving want.

The results for fixed effects also showed a significant interaction of spoken language and FB development over time (Fig. 2), with Korean-speaking children’s FB development faster than that of English-speaking children. The results (Table 3, random effects) also showed a significant slope difference across children (\( \chi^2 = 152.12, p = .02 \)) in FB development over time that was not accounted for by spoken language difference.
Table 3
Fixed and random effects for the exploratory model for FB understanding.

<table>
<thead>
<tr>
<th>Fixed effects</th>
<th>Coefficient</th>
<th>SE</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept, $\gamma_{00}$</td>
<td>1.74</td>
<td>.13</td>
<td>13.22</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Age $\gamma_{10}$</td>
<td>.05</td>
<td>.02</td>
<td>2.32</td>
<td>.02</td>
</tr>
<tr>
<td>Spoken language, $\gamma_{11}$</td>
<td>.10</td>
<td>.03</td>
<td>3.62</td>
<td>.001</td>
</tr>
<tr>
<td>Vocabulary, $\gamma_{20}$</td>
<td>.44</td>
<td>.11</td>
<td>3.76</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Say, $\gamma_{30}$</td>
<td>-.05</td>
<td>.12</td>
<td>-.39</td>
<td>.70</td>
</tr>
<tr>
<td>Think, $\gamma_{40}$</td>
<td>.25</td>
<td>.12</td>
<td>2.04</td>
<td>.04</td>
</tr>
<tr>
<td>Want, $\gamma_{50}$</td>
<td>.02</td>
<td>.14</td>
<td>.13</td>
<td>.90</td>
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Random effects (variance)

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<th>Variance component</th>
<th>df</th>
<th>$\chi^2$</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Within-person (Level 1)</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Intercept, (Level 2)</td>
<td>.02</td>
<td>122</td>
<td>126.11</td>
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<tr>
<td>Age, $U_{1i}$, (Level 2)</td>
<td>.01</td>
<td>121</td>
<td>152.12</td>
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</table>

5. Discussion

The present study examined the relative role of sentential complementation and general language in FB understanding using three-wave longitudinal data from Korean-speaking and English-speaking children. While this has been a central debate in the field, it has not often been directly tested since the vast majority of studies have not included both general language and complementation measures in the same longitudinal study. Using a multi-level growth model, we found supporting results for the role of general language over complementation in facilitating FB development. Specifically, we found that controlling for complementation structures, the development of receptive vocabulary over time was related to the development of FB over time. We also found that the development of say over time was not associated with the development of FB over time when receptive vocabulary was controlled, but the development of think was. Finally, the development of want was not associated with FB development.

Taken as a whole, the pattern of results supports the general language view of FB development. Although we found that think was associated with FB understanding, this result cannot be interpreted as evidence for the de Villiers’ complementation hypothesis. This is because the semantics of the mental verb inherent in think, rather than the structure of complementation, played a role in FB understanding. That is, the finding that say was not associated with FB understanding leads to this

![Fig. 2. Rate of false belief development in Korean- and English-speaking children.](image-url)
conclusion. If complementation per se was critical, say should have been related to FB understanding as well.

It might be argued, however, that since say and think were both entered in the equation, it is possible that say was not significant because the majority of say complementation was shared with think. Thus, controlling for think made the unique contribution of say negligible.\(^2\) To examine this possibility we conducted an additional analysis that indicated say was still not a significant predictor of FB even when think was removed from the equation. Thus, this eliminates the possibility that the complement component in think erased the role of say in predicting FB. Conversely, think was still a significant predictor of FB when say was removed from the equation. This interpretation is further supported by the fact that the correlations between think and say were relatively low (.02 at time 1, .12 at time 2, .26 at time 3). Thus, our interpretation that the link between think and FB reflects the semantics of think and not the grammar of complementation is supported.

This finding corroborates other studies (Cheung et al., 2004; De Villiers, 2007) in indicating the importance of communicative verbs rather than mental verbs in investigating the role of sentential complementation on FB understanding. Communication verbs (say) are critical for testing the complementation hypothesis, since it is possible that mental verbs (think) are redundant with FB measures. Our results differ from those of de Villiers and Pyers (2002) regarding the role of complementation for FB. This difference may be attributable to the fact that de Villiers and Pyers analyzed two-wave data and did not control for prior FB understanding. The unique role of receptive vocabulary on FB development found in the present study is consistent with other studies (Milligan et al., 2007) and underscores the important role that vocabulary plays in children’s understanding of beliefs. More broadly, because receptive vocabulary is considered one aspect of general language, our results are in line with past cross-linguistic studies showing the unique role of general language in predicting FB (Cheung, 2006; Tardif et al., 2007).

A number of proposals have been made regarding the role of general language in FB development (Juan & Astington, 2012). For example, Slade and Ruffman (2005) proposed that both semantics and grammar play important roles in FB reasoning by enabling children to “reflect on and refine” on a more implicit FB understanding (p. 138). Taking more of a social constructivist perspective, Nelson (2005) argues that general language measures, including vocabulary, reflect children’s participation in social interactions. From this perspective, language is important to theory of mind because it provides children with access to the social world, with experiences of mental state talk, and with the opportunity to learn about the mental states of others (de Rosny & Hughes, 2006; Dunn, 1988; Nelson, 2003, 2005). The present study was not designed to tease apart these different interpretations of the role of general language, although both perspectives likely capture important aspects of the influence of language on FB reasoning.

The present study applied a unique data analytic approach. While the majority of studies on the relation between language and FB understanding analyzed various aspects of language at two time points (de Villiers & Pyers, 2002; Tager-Flusberg & Joseph, 2005) or at one time point (Cheung, 2006; Cheung et al., 2004), the present study collected data at three time points. Thus, the results provide a more comprehensive picture of the role of language on the developmental trajectory of FB while minimizing potential measurement errors (Singer & Willett, 2003). In addition, our analytic approach is different from that of Tardif et al. (2007) that collected data at four time points. Using a multi-level model, Tardif et al. studied the impact of between-children differences in sentential complementation at the initial stage (time 1) of a study on the between-children differences in FB development across times 2–4. This approach, while informative and important, does not address how each child’s developments in complementation and general language over time are associated with his or her own FB development over time. In contrast, the multi-level growth model in our study showed that each child’s developmental trajectory of FB understanding was parallel to his or her vocabulary development over time, but not those of complements other than think. Considering the individual differences in language development, it is important to investigate within each child the language variables that

\(^2\) We thank an anonymous reviewer for this suggestion.
might show similar developmental trajectories as that of FB. This approach also allowed us to control initial FB understanding, which is not frequently done.

Finally, the present study also showed that rate of FB development was faster in Korean-speaking than English-speaking children even though their initial FB development level was about the same. The faster rate of FB development in Korean children could be attributed to either social (e.g., socio-economic status) or cognitive factors. For example, executive functioning (EF) has also been shown to be related to FB development (Carlson & Moses, 2001; Low, 2010; Tardif et al., 2007). Oh and Lewis (2008) reported that Korean children did have an advantage over Western children in inhibitory control and switching, but not an advantage in FB. However, since their study was not longitudinal, it is unclear whether rate of development would differ. Regardless, these cross-linguistic findings provide further support regarding the role of language in FB development.

Some limitations of the study provide directions for future research. Because there were no standardized general language measures common to both Korean and English, we used receptive vocabulary only as a measure of general language ability. Future studies should develop or identify other measures to assess general language that reflect both semantic and syntactic abilities in both Korean and English. Relatedly, it is possible that other factors, not assessed in the present study, could also have contributed to children’s FB development, such as inhibitory control and memory, as discussed above. Future researchers may wish to include these types of measures as well. The present study found evidence against the role of complementation even when only one aspect of general language (i.e., vocabulary) was controlled. Controlling for other aspects of language may further confirm the role of general language over complementation in FB development.

The inclusion of additional time points would also provide a richer picture of the development of FB and language. Because three time points are needed to estimate the developmental trajectory of FB using a multi-level growth model, we were unable to study whether variables at time 1 would affect the developmental trajectories of FB understanding across multiple later time points (e.g., time 2 through time 4 or beyond). This type of analysis requires a minimum of four time points. Relatedly, we were unable to make direct statements about causal relationships among our variables. This limitation is inherent in MGM when there are only three time points and all the language variables and FB understanding are measured at the same time (Singer & Willett, 2003). Future studies with at least four time points may be able to uncover whether general language developments are the direct causes of later FB development. Furthermore, three time points limited us to assuming the developmental trajectories are linear. Future studies with four or more time points are needed to investigate the appropriateness of complex developmental trajectories to describe the relation between language and FB development.

In conclusion, we found that FB development in children learning either Korean or English was best predicted by receptive vocabulary and complement using think. There was no support for the argument that sentential complements per se were related to FB for either group of children since complements using say and want were unrelated to FB. These results support the position that general language plays a critical role in FB development. These results contribute to the relatively small literature that has systematically tested the complementation hypothesis against the general language hypothesis by including both measures. Studies that have done so, using a longitudinal design and controlling for initial FB understanding, have found support for the general language hypothesis (Cheung, 2006). More broadly, considering the importance of correctly understanding others’ beliefs in social interaction and the resulting consequences, improving receptive vocabulary and other aspects of general language appears crucial to children’s social cognitive development.

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