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Theory of mind mediates the relations of language and domain-general cognitions to discourse comprehension

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ABSTRACT

Theory of mind has received intensive attention in research as an important skill to develop. Furthermore, recent evidence indicates its role in discourse comprehension. In the current study, we examined the mediating role of theory of mind in the relations of foundational language and cognitive skills (working memory, attentional control, vocabulary, and grammatical knowledge) to discourse comprehension using the direct and indirect effects model of text comprehension and production (Kim, 2016) as a theoretical framework, and using longitudinal data from kindergarten to Grade 2. Structural equation model results showed that theory of mind partially mediated the relations in both grades, and the effects (standardized regression weights) were similar in kindergarten and Grade 2. Interestingly, the relations of language and cognitive skills to theory of mind differed in kindergarten versus Grade 2. Language and cognitive skills had moderate to strong longitudinal stability, and these skills in kindergarten were indirectly related to discourse comprehension in Grade 2 via the language and cognitive skills in Grade 2. These results support the mediating role of theory of mind as well as the nature of structural and longitudinal relations among language and cognitive skills and to discourse comprehension.

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Introduction

Theory of mind refers to one's understanding of others' mental states or perspectives, including beliefs, thoughts, intents, desires, and emotions (Wellman, Cross, & Watson, 2001). Theory of mind is at the heart of social and communicative interactions because it is critical for analyzing and interpreting others' behaviors and for explaining one's thoughts, emotions, and desires to others (Astington & Edward, 2010). As such, theory of mind has been extensively studied as an outcome (e.g., Arslan, Hohenberger, & Verbrugge, 2017; Carlson, Moses, & Claxton, 2004; de Villiers & Pyers, 2002; Devine & Hughes, 2014; Dunn, Brown, Slomkowski, Tesla, & Youngblade, 1991; Farrant, Maybery, & Fletcher, 2012; Fernyhough, 2008; Gordon & Olson, 1998; Tompkins, Benigno, Lee, & Wright, 2018; Valle, Massaro, Castelli, & Marchetti, 2015). Recently, however, growing evidence indicates that theory of mind plays an important role in discourse skills such as listening comprehension, oral discourse production, reading comprehension, and written composition (Atkinson, Slade, Powell, & Levy, 2017; Boerma, Mol, & Jolles, 2017; Guajardo & Cartwright, 2016; Kim, 2015, 2017a; Kim & Park, 2019; Kim & Schatschneider, 2017; Pelletier, 2006; Pelletier & Beaty, 2015). In the current study, we expanded our understanding of theory of mind by investigating its mediating role in the relations of foundational language and cognitive skills (i.e., working memory, attentional control, vocabulary, and grammatical knowledge) to discourse comprehension (i.e., listening comprehension) and by examining the nature of longitudinal relations among language and cognitive skills, using data from kindergarten to Grade 2.

Discourse comprehension

According to the construction integration model (Kintsch, 1988), successful comprehension of texts (oral or written) is achieved when one constructs a coherent and integrated representation of the state of affairs described in the text called the situation model. The construction of an accurate and rich situation model involves constructing and revising lower-level mental models of the text in memory (i.e., Kintsch, 1988; Kintsch & van Dijk, 1978). Initial propositions (i.e., textbase representation) constructed based on the linguistic information in the text (i.e., surface code) need to undergo integration processes to establish a global coherence in the situation model (e.g., Barnes, Ahmed, Barth, & Francis, 2015; Barnes, Dennis, & Haefele-Kalvaitis, 1996; Cain, Oakhill, & Bryant, 2004; Kim, 2017a; see McNamara & Magliano, 2009, for a review). Studies have shown that the construction and integration processes draw on the language and cognitive skills of working memory, inhibitory and attentional control, vocabulary, and grammatical knowledge (Kim, 2015, 2016, 2017a; Barnes et al., 1996, 2015; Cain et al., 2004; Cromley & Azevedo, 2007; Daneman & Carpenter, 1980; Daneman & Merikle, 1996; Elleman, Lindo, Morphy, & Compton, 2009; Florit, Roch, & Levorato, 2011, 2014; Kendeou, Bohn-Gettler, White, & van den Broek, 2008; Kim & Phillips, 2014; Lepola, Lynch, Laakkonen, Silvén, & Niemi, 2012; Strasser & del Rio, 2014; Tompkins, Guo, & Justice, 2013). Furthermore, essential in the integration process are higher-order cognitive skills such as comprehension monitoring and inferencing. Initial propositions are prone to inaccuracy and inconsistency, which needs to be detected and repaired using a comprehension monitoring skill (Baker, 1984; Cain et al., 2004; Elliot-Faust & Pressley, 1986; Kim, 2015, 2016, 2017a; Kim & Phillips, 2014; Markman, 1979; Oakhill, Cain, & Bryant, 2003). Making inferences is also essential in the integration process. Texts rarely provide all necessary information explicitly; thus, one needs to infer implicit information by connecting propositions across the text and with one's background knowledge (McNamara & Magliano, 2009). Not surprisingly, studies have shown the relation of one's inferencing skill to discourse comprehension (Ahmed, Francis, York, Fletcher, & Barnes, 2016; Barnes et al., 2015; Cain et al., 2004; Cromley & Azevedo, 2007; Kendeou et al., 2008; Kim, 2016, 2017a).

Theory of mind is inferential reasoning about others' mental states and is well aligned with inference on agents' intent, goals, and emotions (see Graesser, Singer, & Trabasso, 1994, for typology of inferences; Dore, Amendum, Golinkoff, & Hirsh-Pasek, 2018). Then, theory of mind would play an important role in discourse skills. Recent evidence indeed supports this speculation such that theory of mind was related to discourse comprehension in oral language (i.e., listening comprehension;

Guajardo & Cartwright, 2016; Kim, 2016, 2017a; Kim & Phillips, 2014; Pelletier & Beaty, 2015), reading comprehension (Atkinson et al., 2017; Boerma et al., 2017; Guajardo & Cartwright, 2016; Kim, 2015, 2017a; Pelletier, 2006), and written composition (Kim, 2020a; Kim & Graham, 2020).

Mediating role of theory of mind

Research during the last four decades has revealed that theory of mind draws on domain-general cognitive skills or executive function, including working memory, and inhibitory and attentional control. Understanding others' mental states involves juggling multiple processes. For example, in a classic theory of mind task—the false belief task (e.g., Wimmer & Perner, 1983)—the child is presented with a story involving two characters, say, Sally and Anne. Sally leaves an object (e.g., chocolate) in a basket and leaves the room. Another character, Anne, comes into the room and moves the object to another location (e.g., in a box). The child is asked to predict where Sally will look for the object when she returns to the room. To be successful in this task, the child needs working memory in that he or she should be able to hold and process the information about Sally's and Anne's behaviors to understand their mental representations of the situation as well as one's own mental representation. Evidence has supported the role of working memory in theory of mind (Arslan et al., 2017; Davis & Pratt, 1995; Gordon & Olson, 1998; Hughes, 1998; Mutter, Alcorn, & Welsh, 2006; Valle et al., 2015).

Evidence also indicates the role of inhibitory and attentional control in theory of mind. Attentional control is necessary for the perception and encoding of stimuli to memory and acts as a gatekeeper for information processing (Scerif, 2010); thus, it would be important to children's performance on theory of mind. Attentional control is a multidimensional construct that includes several processes and aspects such as alerting, orienting, inhibition, and sustained attention (Scerif, 2010; Wilson & Kipp, 1998). Of these, previous studies have largely focused on the role of inhibitory control because theory of mind requires the child to focus on the salient but inaccurate perspective of the protagonist while suppressing the child's own accurate perspective (Moses, 2001; Moses, Carlson, & Sabbagh, 2005). Findings from these studies indicate the relation of inhibitory control to theory of mind (e.g., Hughes, 1998; Kim & Phillips, 2014; Moses et al., 2005; Müller, Liebermann-Finestone, Carpendale, Hammond, & Bibok, 2012; Pellicano, 2007). In addition, recent studies showed that children's attentional control (i.e., ignoring extraneous stimuli and sustained attention) is also related to theory of mind (Kim, 2020b; Kim, 2016).

Furthermore, foundational oral language skills such as vocabulary and syntactic knowledge have likewise received substantial empirical attention for their roles in theory of mind. For vocabulary, children's use of specific words that are related to mental states such as *think* and *know* was related to their theory of mind (e.g., de Villiers & Pyers, 2002; Furrow, Moore, Davidge, & Chiasson, 1992; Miller, 2006). Children's general vocabulary knowledge, beyond mental state words, was also related to their theory of mind (Hughes, 1998; Ruffman, Slade, Rowlandson, Rumsey, & Garnham, 2003; Watson, Painter, & Bornstein, 2001). Similarly, children's knowledge of specific aspects of syntax such as relative clauses and complements for embedded structure (de Villiers & de Villiers, 2009; Farrar, Benigno, Tompkins, & Gage, 2017; Miller, 2004), as well as general syntactic skills (e.g., Astington & Jenkins, 1999; Slade & Ruffman, 2005), were related to theory of mind.

In summary, evidence suggests that theory of mind draws on the language and cognitive skills of working memory, inhibitory and attentional control, vocabulary, and grammatical knowledge. Yet, as reviewed above in the "Discourse comprehension" section, these same language and cognitive skills also contribute to discourse skills. In other words, there is a large overlap of language skills (e.g., vocabulary) and domain-general cognitive skills (e.g., working memory) that contribute to theory of mind and discourse skills—*and* theory of mind contributes to discourse skills. Then, it is reasonable to speculate that theory of mind would act as a mediator—at least a partial mediator—of the relations of language skills and domain-general cognitive skills to discourse skills. In fact, according to the direct and indirect effects model of text comprehension and production (DIET; Kim, 2016, 2020b, 2020c, in press), language, cognitive, and discourse skills have hierarchical structural relations such that low-level skills are necessary for, and have cascading effects on, higher-level skills (i.e., hierarchical relations hypothesis). The relations among working memory, vocabulary, theory of mind, and listening comprehension are an example. Working memory is related to theory of mind (Arslan et al., 2017;

Davis & Pratt, 1995; Valle et al., 2015) and discourse comprehension (Daneman & Carpenter, 1980; Daneman & Merikle, 1996; Peng et al., 2018). Working memory is also related to vocabulary (Gathercole, Service, Hitch, Adams, & Martin, 1999, Gathercole, Tiffany, Briscoe, Thorn, & ALSPAC Team, 2005; Kim, 2017b), which is important to theory of mind (Astington & Jenkins, 1999; Slade & Ruffman, 2005) and discourse comprehension (Ahmed et al., 2016; Kim, 2015; Elleman et al., 2009; Kim, 2016; Lepola et al., 2012). These suggest the following chain of relations: working memory → vocabulary → theory of mind → discourse comprehension (see Fig. 1). In this example, the roles of working memory and vocabulary in discourse comprehension would be mediated, at least partially, by theory of mind.

The hierarchical relations hypothesis is based on a large body of studies as well as the mapping between various mental representations during discourse processes (i.e., surface code, textbase, and situation model), and language and cognitive skills that the discourse processes draw on; domain-general cognitions and foundational language skills are necessary for the surface code representation and textbase representation, whereas higher-order cognitions are needed for an accurate and rich situation model (see Fig. 1). In other words, domain-general cognitions (or executive function such as working memory, inhibitory and attentional control, and shifting) support vocabulary and grammatical knowledge, which in turn support higher-order cognitive skills, which support discourse skills. A corollary of the hierarchical relations is a chain of mediated relations, including theory of mind and other skills (see Fig. 1).

DIET also hypothesizes that the nature of relations among component skills changes as a function of development and text characteristics (i.e., dynamic relations hypothesis; see Kim, 2020b, 2020c). Although the overall hierarchical relations are expected to remain across developmental phases, relative contributions of component skills to discourse skills are expected to change as a function of development and text features. Specifically, the relative roles of higher-order cognitive skills such as theory of mind are expected to increase with development. As children develop their theory of mind, their increased understanding of various aspects of mental states (e.g., desires, diverse beliefs, false belief, belief emotion; see Wellman & Liu, 2004) will allow them to connect and integrate propositions to a greater extent and build a more accurate situation model. Then, the relative contribution of theory of mind to discourse comprehension may be greater at a more advanced developmental phase. Another important factor that interacts with development is text characteristics or demands (see Author, 2019, for details). Texts vary in many aspects, including vocabulary and syntactic knowledge demands, organizational structures, complexity and density of information, and demands of perspective taking (e.g., Bailey, 2007; Friedman & Miyake, 2000; Schleppegrell, 2001; Seigneuric & Ehrlich, 2005); thus, the extent to which specific skills and knowledge contribute to discourse skills would vary depending on the textual demands. The complexity of texts typically increases as children develop (by age or grades; Bailey, 2007; Schleppegrell, 2001), although text demands also vary within the same grade.

The current study

An overarching goal of the current study was to examine the mediating role of theory of mind in the relations of language and cognitive skills (working memory, attention, vocabulary, and grammatical knowledge) to discourse comprehension in oral language (i.e., listening comprehension) in light of the hierarchical relations hypothesis and the dynamic relations hypothesis of DIET using longitudinal data from kindergarten and Grade 2. In addition, we investigated the nature of longitudinal relations of language and cognitive skills to discourse comprehension. Previous studies have shown that language and cognitive skills at an earlier time point predict later discourse comprehension (e.g., Alonzo, Yeomans-Maldonado, Murphy, Bevens, & LARRC, 2016; Kim & Park, 2019; Muter, Hulme, Stevenson, & Snowling, 2004; Tunmer, 1989). For example, children's working memory, vocabulary, and syntactic knowledge in prekindergarten predicted children's listening comprehension in Grade 2 (Alonzo et al., 2016). Unclear from these longitudinal studies are the pathways of their relations—whether the relations of the language and cognitive skills at an earlier time point to discourse skills

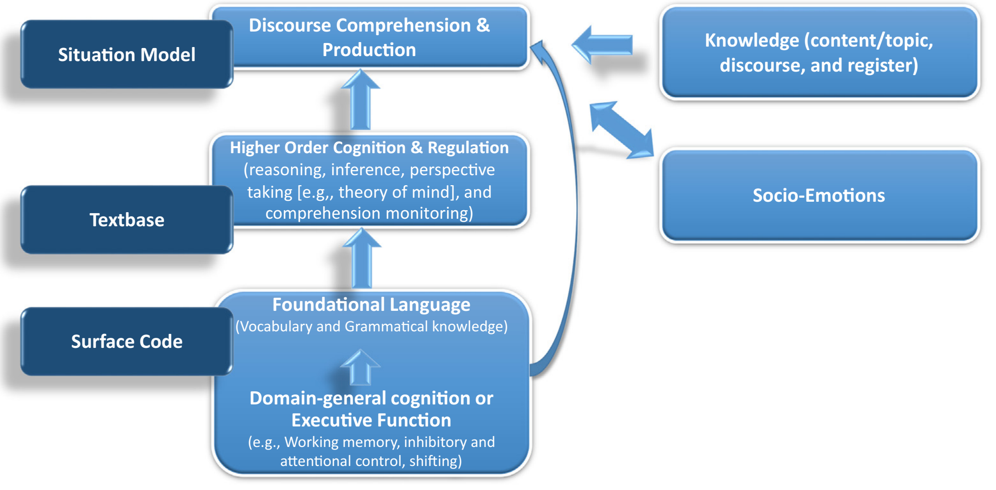

Fig. 1. A modified version of the direct and indirect effects model of text comprehension and production. When discourse comprehension and production involve written texts (i.e., reading comprehension and written composition), print-related skills (e.g., word reading and transcription skills) are also necessary beyond what is shown here (see Kim, 2020b, 2020c; Kim & Graham, 2020).

at a later point are mediated by language and cognitive skills at a later point or they have direct relations. Specific research questions were as follows:

1. Does theory of mind, along with other higher-order cognitive skills (knowledge-based inference and comprehension monitoring), mediate the relations of foundational language and cognitive skills to listening comprehension? How are language and cognitive skills (working memory, attention, vocabulary, and grammatical knowledge) related to theory of mind and discourse comprehension (i.e., listening comprehension) in kindergarten and Grade 2, respectively?
2. Does the relative contribution of theory of mind to listening comprehension increase from kindergarten to Grade 2?
3. How do language and cognitive skills in kindergarten relate to those in Grade 2? Do the skills in kindergarten have direct relations to Grade 2 listening comprehension, or are their relations completely mediated by language and cognitive skills in Grade 2?

These questions were addressed using longitudinal data from children who were assessed on language and cognitive skills in kindergarten and Grade 2, an important period when children's theory of mind (particularly from first order to second order) as well as language and domain-general cognitive skills (e.g., working memory) rapidly develop. We hypothesized that in both grades theory of mind would partially mediate the relations such that language and cognitive skills would be related to theory of mind, which in turn would be related to listening comprehension; and language and cognitive skills would also be directly related to listening comprehension. We also expected that theory of mind would make a greater contribution to listening comprehension in Grade 2 than in kindergarten. Finally, the language and cognitive skills in kindergarten were expected to be related to those in Grade 2 (i.e., have stability) and to be indirectly related to Grade 2 listening comprehension via Grade 2 language and cognitive skills. It should be noted that our research questions and associated data analysis did not address whether the language and cognitive skills contribute to development (growth rate) of theory of mind or discourse comprehension from kindergarten to Grade 2. Instead, our goal was to examine structural relations among language and cognitive skills in two developmental timepoints, kindergarten and Grade 2, using longitudinal data.

Method

Participants

Data were from 262 children in kindergarten and Grade 2 (55% boys; kindergarten: mean age = 5.33 years, *SD* = 0.45, range = 5.0–6.9; Grade 2: mean age = 7.19 years, *SD* = 0.34, range = 7.0–8.06) from 31 classrooms in seven schools in the southeastern United States. Findings from an analysis of vocabulary acquisition using part of these kindergarten data were reported previously (Kim, 2017b). However, other kindergarten cognitive data (e.g., theory of mind, monitoring) as well as longitudinal Grade 2 data were not reported before. According to the district record, the racial and ethnic backgrounds of kindergarten children were as follows: approximately 53% Caucasian, 34% African American, 3% Hispanic, .4% Asian, and 5% mixed race. Approximately 71% of the children were eligible for free or reduced-price lunch. There were three English language learners in kindergarten. These demographic characteristics reflect the local student population where the study was conducted. Approximately 9% of the children (n = 24) received speech services. Approximately 0.8% of the children (n = 2) were identified to have language delay, and 0.8% were identified with developmental delay. All these children were included in the analysis. Of the 262 children who participated in kindergarten, 179 of them remained in the study in Grade 2 (32% attrition). Little's test revealed no statistical significance, $\chi^2(171)$ = 166.73, p = .58, indicating that the null hypothesis of data missing completely at random (MCAR) could not be rejected.

Measures

Children were assessed on the following constructs: listening comprehension, theory of mind, knowledge-based inference, comprehension monitoring, vocabulary, grammatical knowledge, working memory, and attention. All the tasks were administered in oral language contexts. Unless otherwise noted, children's responses were scored dichotomously (1 = correct, 0 = incorrect) for each item, and all the items were administered to children. Higher scores reflect better performance on the tasks. Reliability estimates ranged from acceptable to excellent (see Table 1).

Listening comprehension

Children's listening comprehension was assessed by the Narrative Comprehension subtest of the Test of Narrative Language (TNL; Gillam & Pearson, 2004), an experimental expository comprehension task, and the Listening Comprehension subscale of the Oral and Written Language Scales–Second Edition (OWLS-II; Carrow-Woolfolk, 2011). In the TNL Narrative Comprehension subtest, children heard three narrative stories and were asked to retell each story to the assessor. Then, children were asked open-ended comprehension questions for each story (a total of 30 items across the three stories). Children's responses were scored according to the TNL manual: the majority of questions were scored using a dichotomous 0–1 scale (22 items), but some were scored using a 0–1–2 scale (6 items) or 0–1–2–3 scale (2 items). The total possible raw score was 40.

The experimental expository comprehension task was composed of three expository passages from Primer Level (for kindergarten) and Level 2 passages (for Grade 2) from the Qualitative Reading Inventory–5 (Leslie & Caldwell, 2011). Titles of the passages were as follows: "Who lives near lakes?" (74 words), "Living and not living" (61 words), and "Air" (85 words) for kindergarten; and "Changing matter" (140 words), "Whales and fish" (200 words), and "Where do people live?" (282 words) for Grade 2. After listening to each passage, children were asked comprehension questions (a total of 18 questions with a total possible score of 18 in kindergarten and 24 questions with a total possible score of 24 in Grade 2). Finally, in the OWLS-II Listening Comprehension task, children listened to stimulus sentences and were asked to point to one of four pictures that corresponded to the heard sentences. Test administration was discontinued after four consecutive incorrect items.

Table 1
Descriptive statistics.

	Kindergarten					Grade 2				
Variable	α	*M* (*SD*)	Min–Max	Skew	Kurtosis	α	*M* (*SD*)	Min–Max	Skew	Kurtosis
TNL Comprehension	.85	17.56 (6.61)	1–35	−0.33	−0.49	.80	26.07 (5.46)	3–35	−1.29	2.27
TNL Comprehension SS	–	8.01 (2.71)	2–18	0.16	−0.22	–	8.81 (2.82)	1–16	−0.40	0.14
Expo Comprehension	.71	5.89 (3.17)	0–16	0.40	−0.12	.70	8.69 (3.66)	0–18	0.06	−0.28
OWLS Comprehension	.95	51.37 (15.02)	13–91	0.08	−0.02	.95	73.97 (14.92)	20–100	−0.76	0.59
OWLS Comprehension SS	–	96.21 (14.60)	56–134	−0.10	0.08	–	97.08 (16.33)	43–125	−0.78	0.33
Theory of Mind	.76	4.24 (2.44)	0–10	0.12	−0.65	.85	8.21 (4.40)	0–18	−0.09	−0.82
CASL Inference	.87	3.20 (3.59)	0–20	1.59	3.20	.90	10.01 (6.63)	0–32	0.61	−0.19
CASL Inference SS	–	–	–	–	–	–	93.00 (12.36)	66–132	0.14	−0.21
Comprehension Monitor	.67	5.44 (2.70)	0–18	1.12	1.74	.71	6.60 (2.98)	1–16	0.66	0.03
WJ Picture Vocabulary	.69	16.60 (2.78)	6–26	−0.20	1.30	.70	19.75 (2.95)	11–28	0.00	0.02
WJ Picture Vocabulary SS	–	99.23 (9.50)	58–129	−0.39	2.05	–	96.48 (9.91)	68–121	−0.17	−0.01
CASL Grammaticality	.94	11.09 (9.49)	0–43	1.07	0.54	.95	29.24 (12.99)	1–59	0.07	−0.34
CASL Grammaticality SS	–	–	–	–	–	–	94.77 (12.40)	62–122	−0.32	0.05
Working Memory	.89	6.87 (5.93)	0–23	0.50	−0.84	.77	6.94 (4.21)	0–18	0.21	−0.34
Attention	.99	121.41 (31.17)	46–206	0.34	0.19	.98	121.22 (30.87)	40–210	0.39	0.41

Note. Unless otherwise noted, values are raw scores. Min–Max, minimum–maximum; Skew, skewness; TNL, Test of Narrative Language; SS, standard score; Expo, expository; OWLS Comprehension, Listening Comprehension subscale of the Oral and Written Language Scales-II; CASL, Comprehensive Assessment of Spoken Language; Inference, knowledge-based inference; Monitor, monitoring; WJ, Woodcock Johnson–Third Edition.

Theory of mind

Studies have shown that first-order theory of mind develops around 4 years of age (Wellman et al., 2001), whereas second-order theory of mind develops around 5–7 years of age (Perner & Wimmer, 1985; Sullivan, Zaitchik, & Tager-Flusberg, 1994). Considering these developmental phases, two first-order scenarios and one second-order scenario were administered in kindergarten, whereas three second-order scenarios were administered in Grade 2. First-order theory of mind scenarios assessed children's ability to infer a story character's knowledge, whereas second-order scenarios examined children's ability to infer a story character's mistaken belief about another character's knowledge. In each scenario, a story was presented with a series of illustrations, followed by questions. Children were administered target questions even if they had an incorrect answer in memory and reality questions. However, in the data analysis, students' responses on the theory of mind questions, but not on the memory and reality questions, were included. A total possible score was 10 in kindergarten and 18 in Grade 2.

Knowledge-based inference

Knowledge-based inference was measured by the Inference task of the Comprehensive Assessment of Spoken Language (CASL; Carrow-Woolfolk, 1999). In this task, after hearing one- to three-sentence scenarios, children were asked a question that required inference based on background knowledge. For instance, children heard "Mandy wanted to wear last year's dress to school one day, but when she tried it on, she could not wear it. Why?" The correct responses must reference the fact that Mandy has grown or the dress does not fit anymore. This task is normed for children aged 7 years and over; thus, we developed and pilot-tested 11 easy items for kindergartners and used them in conjunction with the items in the Inference task of the CASL (this was only the case in kindergarten). Test administration was discontinued after five consecutive incorrect items.

Comprehension monitoring

Comprehension monitoring was operationalized by the ability to identify inconsistency (Baker, 1984; Cain et al., 2004; Wagoner, 1983). Children heard a short scenario (in kindergarten scenarios consisted of 4–7 short sentences, whereas in Grade 2, scenarios consisted of 5–13 short sentences) and were asked to identify whether the story made sense or not. If children indicated that the story did not make sense, they were asked to provide a brief explanation and to fix the story so that it made sense. The meaning of "not making sense" was explained as sentences not going together in practice items. There were two practice items and nine experimental items. Consistent stories (three items) and inconsistent stories (six items) were randomly ordered. For all nine items, accuracy of children's answer about whether a scenario was consistent or inconsistent was dichotomously scored. For the six inconsistent stories, the accuracy of children's explanation and repair of the story were also dichotomously scored; thus, the total possible score was 21.

Vocabulary

A standardized and normed task, the Picture Vocabulary task of the Woodcock Johnson–Third Edition (WJ-III; Woodcock, McGrew, & Mather, 2001), was used. In this task, children were asked to identify pictured objects. Test administration discontinued after six consecutive incorrect items.

Grammatical knowledge

A standardized and normed task, the Grammaticality Judgment task of the CASL (Carrow-Woolfolk, 1999), was used. Children were asked whether a heard sentence was grammatically correct. If it was grammatically incorrect, children were asked to correct the sentence. Similar to the inference task, this task was normed for children aged 7 years and over; therefore, a few easy items were developed, test-piloted, and used in conjunction with the items in the CASL (this was only the case in kindergarten). Test administration was discontinued after five consecutive incorrect items.

Working memory

Working memory was measured by a listening span task (Kim, 2015, 2016; Cain et al., 2004; Daneman & Merikle, 1996) in which children were presented with a short sentence involving common knowledge to children (e.g., "Birds can fly") and were asked to identify whether the heard sentence was correct or not. After hearing two or three sentences, children were asked to identify the last word in each of those sentences. There were four practice items and 14 experimental items in kindergarten, and there were 13 experimental items in Grade 2. In kindergarten, there was a greater number of easier items (i.e., items based on two heard sentences) in order to prevent a floor effect. Children's yes/no responses regarding the veracity of the statement were not scored, but their responses on the last words in correct order were given a score of 0–2: 2 for correctly identifying all the last words in correct order, 1 for correct last words in incorrect order, and 0 for incorrect last words. Testing was discontinued after three incorrect responses. The total possible score was 28 and 26 in kindergarten and Grade 2, respectively.

Attention

The Strengths and Weaknesses of ADHD (attention-deficit/hyperactivity disorder) Symptoms and Normal Behavior Scale (SWAN; Swanson et al., 2006) was used to measure children's attentiveness (e.g., "Engages in tasks that require sustained mental effort") and hyperactivity (see Sáez, Folsom, Al Otaiba, & Schatschneider, 2012, for factor analysis and its predictive validity; see also Kim, 2015). The SWAN is a behavioral checklist that includes 30 items that are rated on a 7-point scale ranging from 1 (*far below average*) to 7 (*far above average*) to allow for ratings of relative strengths (above average) as well as weaknesses (below average). Higher scores represent greater attentiveness and less hyperactivity. Participating children's teachers completed the SWAN checklist. The total possible score was 210 (7 points * 30 items).

Procedures

Research assistants were rigorously trained and needed to achieve 99% accuracy in administration of the assessments before working with children individually in a quiet space in the school. The assessment battery was administered in several sessions, with each session being 30–40 min long.

Data analysis strategy

Primary data analytic strategies were confirmatory factor analysis and structural equation modeling using Mplus 7.4 (Muthen & Muthen, 2013). Full information maximum likelihood estimation was used for all analyses. A latent variable was created for listening comprehension, whereas observed variables were used for the language and cognitive skills because they were assessed by single measures for each construct. Measurement invariance for the listening comprehension latent variable was examined following procedures for multigroup analysis (see Brown, 2006, and Thompson & Green, 2006, for details).

To address Research Questions 1 and 2, models shown in Fig. 2 were fitted to the data where language and cognitive skills were allowed to have direct and indirect relations to each other and to theory of mind and listening comprehension. To address Research Question 3, four competing models were fitted to the data. The first one was a baseline model (Model 1) where kindergarten skills were hypothesized to predict the skills at the same hierarchical level in Grade 2 (see Fig. 3). In other words, kindergarten listening comprehension predicted Grade 2 listening comprehension; higher-order cognitive skills (theory of mind, inference, and comprehension monitoring) in kindergarten predicted higher-order cognitive skills in Grade 2; vocabulary and grammatical knowledge in kindergarten predicted the same skills in Grade 2; and working memory and attention in kindergarten predicted the same skills in Grade 2. In the subsequent alternative models, kindergarten language and cognitive skills were hypothesized to have direct paths to Grade 2 listening comprehension over and above their longitudinal relations with language and cognitive skills in Grade 2. In Model 2, kindergarten higher-order cognitions were posited to have direct relations to Grade 2 listening comprehension over and above the baseline model shown in Fig. 3. In Model 3, kindergarten vocabulary and grammatical knowledge were hypothesized to make direct contributions to Grade 2 listening comprehension over and above the baseline model. In Model 4, direct contributions of kindergarten working memory and attention to Grade 2 listening comprehension were added to the baseline model.

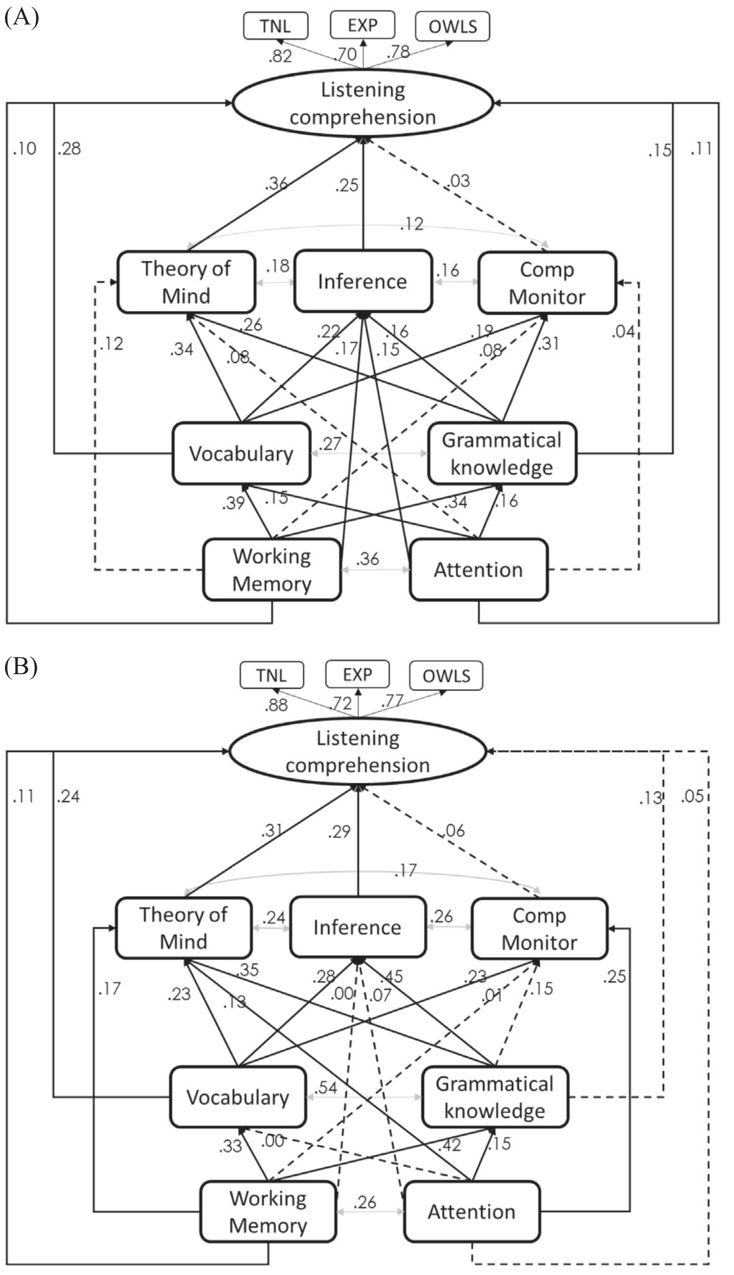

Fig. 2. Standardized structural regression weights for the direct and indirect effects model of text comprehension for kindergarten (A) and Grade 2 (B). Solid paths are statistically significant at $p < .05$; dashed paths are not statistically significant. Two-sided arrows represent covariances. TNL, Test of Narrative Language; EXP, experimental expository task; OWLS, Listening Comprehension subscale of the Oral and Written Language Scales-II; Comp Monitor, comprehension monitoring.

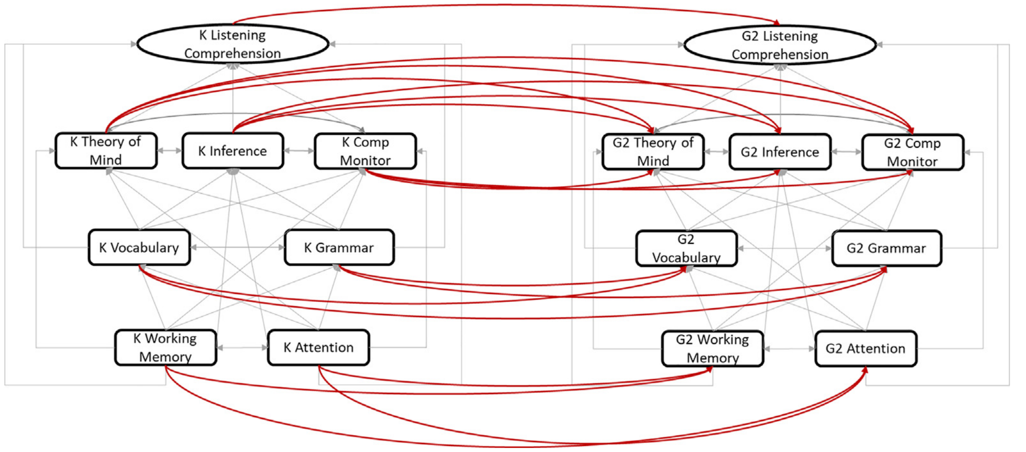

Fig. 3. Longitudinal prediction of language and cognitive skills. Those in red are longitudinal paths, whereas those in gray are cross-sectional paths. K, kindergarten; G2, Grade 2. (For interpretation of the references to color in this figure legend, the reader is referred to the Web version of this article.)

Model fit was evaluated by the chi-square statistic, comparative fit index (CFI), root mean square error of approximation (RMSEA), and standardized root mean square residual (SRMR). Typically, RMSEA values below .08, CFI values equal to or greater than .95, and SRMR values equal to or less than .05 indicate an excellent model fit. CFI values greater than .90 are considered to be good, and RMSEA values greater than .10 indicate a poor fit (Kline, 2005). Model fits for nested models (i.e., the four alternative models described above) were compared using chi-square difference tests.

Results

Descriptive statistics and preliminary analysis

Table 1 shows descriptive statistics, including the mean, standard deviation, minimum, maximum, skewness, and kurtosis of each variable. Children's mean performances on the normed tasks (i.e., vocabulary, grammaticality judgment, inference, TNL comprehension, and OWLS comprehension) were in the low average to average range ($94.77 \leq Ms \leq 99.23$ and 8.01–8.81 for TNL comprehension, which had a standard score on a scale of 10 for the mean and 3 for standard deviation). Distributional properties of the variables were appropriate as indicated by skewness (±2) and kurtosis values (<7) (West, Finch, & Curran, 1995). Raw scores were used in the subsequent analyses.

Bivariate correlations between measures in each grade are displayed in Table 2. In each grade, theory of mind was moderately related to listening comprehension ($.53 \leq rs \leq .66$ in kindergarten and $.58 \leq rs \leq .64$ in Grade 2). Across grades, listening comprehension tasks (TNL, expository text, and OWLS comprehension) were moderately to fairly strongly related to each other ($.46 \leq rs \leq .72$). Working memory and attention were weakly to moderately related to each other ($.26 \leq rs \leq .36$), to vocabulary and grammatical knowledge ($.08 \leq rs \leq .45$), to theory of mind ($.28 \leq rs \leq .44$), and to listening comprehension ($.21 \leq rs \leq .49$). Vocabulary and grammatical knowledge were moderately related to theory of mind ($.47 \leq rs \leq .60$) and to listening comprehension tasks ($.42 \leq rs \leq .63$). Higher-order cognitive skills (theory of mind, inference, and comprehension monitoring) were moderately related to each other ($.35 \leq rs \leq .57$).

Research questions 1 and 2: Mediating roles of theory of mind in kindergarten and Grade 2

Prior to fitting the structural equation model shown in Fig. 2, measurement invariance for the listening comprehension latent variable was examined. The configural model had a good fit,

Table 2
Bivariate correlations between variables within each grade.

Variable	1	2	3	4	5	6	7	8	9	10
1. TNL Comprehension	–	.65	.64	.65	.53	.37	.63	.43	.45	.40
2. Expo Comprehension	.61	–	.46	.53	.48	.27	.52	.42	.39	.32
3. OWLS Comprehension	.72	.52	–	.59	.51	.44	.49	.60	.48	.34
4. Theory of Mind	.64	.61	.58	–	.42	.37	.51	.47	.40	.29
5. CASL Inference	.67	.54	.56	.57	–	.35	.40	.36	.38	.32
6. Comprehension Monitor	.38	.39	.42	.40	.46	–	.36	.43	.31	.21
7. WJ Picture Vocabulary	.58	.52	.57	.51	.55	.35	–	.41	.44	.28
8. CASL Grammaticality	.62	.55	.56	.60	.64	.37	.60	–	.40	.29
9. Working Memory	.37	.39	.49	.44	.32	.22	.33	.45	–	.36
10. Attention	.26	.21	.22	.28	.21	.31	.08+	.26	.26	–

Note. Values above the diagonal are in kindergarten, and those below the diagonal are in Grade 2. All coefficients are statistically significant at $p < .05$ except for one indicated by a plus symbol (+). TNL, Test of Narrative Language; Expo, expository; OWLS Comprehension, Listening Comprehension subscale of the Oral and Written Language Scales-II; CASL, Comprehensive Assessment of Spoken Language; Inference, knowledge-based inference; Monitor, monitoring; WJ, Woodcock Johnson–Third Edition.

$\chi^2(8) = 37.49$, $p < .001$, CFI = .96, RMSEA = .11 [.082–.158], SRMR = .056. The metric model where factor loadings were constrained to be the same across the grades also had a poorer fit, $\chi^2(10) = 57.28$, $p < .001$, CFI = .93, RMSEA = .134 [.102–.169]; SRMR = .116. After examining the unstandardized factor loadings in the two grades, in the subsequent structural equation models, the partial invariance model where the loading of the expository comprehension task was freely estimated was fitted. The correlation of the latent listening comprehension variable in kindergarten and Grade 2 was strong ($r = .95$).

The multigroup model shown in Fig. 2 was fitted to the data, and it had an overall good fit, $\chi^2(29) = 88.94$, $p < .001$, CFI = .97, RMSEA = .097 [.074–.120], SRMR = .035. Standardized path coefficients of the structural equation model in kindergarten are presented in Fig. 2A. Theory of mind (.36, $p < .001$), inference (.25, $p = .001$), vocabulary (.28, $p < .001$), grammatical knowledge (.15, $p = .001$), working memory (.10, $p = .03$), and attention (.11, $p = .009$) all were directly and uniquely related to listening comprehension, whereas comprehension monitoring was not (.03, $p = .53$). Theory of mind was independently predicted by vocabulary (.34, $p < .001$) and grammatical knowledge (.26, $p < .001$), but not by working memory (.12, $p = .05$) or attention (.08, $p = .15$). Inference was predicted by vocabulary (.22, $p < .001$), grammatical knowledge (.16, $p = .009$), working memory (.17, $p = .008$), and attention (.15, $p = .01$). Comprehension monitoring was predicted by vocabulary (.19, $p = .002$) and grammatical knowledge (.31, $p < .001$). Finally, working memory and attention predicted vocabulary (.39, $p < .001$ for working memory and .15, $p = .01$ for attention) and grammatical knowledge (.34, $p < .001$ for working memory and .16, $p = .008$ for attention). Approximately 86% of variance in listening comprehension was explained by these language and cognitive skills.

Results for Grade 2 were overall similar to those for kindergarten (see Fig. 2B) in that theory of mind (.31, $p < .001$), inference (.29, $p = .001$), vocabulary (.24, $p < .001$), and working memory (.11, $p = .04$) were directly and uniquely related to listening comprehension, whereas comprehension monitoring was not (.06, $p = .30$). However, some differences were also found. Specifically, grammatical knowledge (.13, $p = .07$) and attention (.05, $p = .31$) were not directly related to listening comprehension. Furthermore, theory of mind was directly predicted by working memory (.17, $p = .008$) and attention (.13, $p = .04$) in addition to by vocabulary (.23, $p = .001$) and grammatical knowledge (.35, $p < .001$). In contrast, inference was no longer directly predicted by working memory (.00, $p = .98$) and attention (.07, $p = .21$) after accounting for vocabulary and grammatical knowledge. Approximately 81% of total variance in listening comprehension in Grade 2 was explained by the included variables.

Based on the results shown in Fig. 2, total effects, including both direct and indirect effects (standardized regression weights), of language and cognitive skills on listening comprehension and theory of mind were estimated (see Table 3). Total effects on listening comprehension of the language and cognitive skills were substantial for theory of mind (.31–.36), inference (.25–.29), vocabulary (.40–.46), grammatical knowledge (.30–.38), working memory (.45–.47), and attention (.18–.29). An exception was that of comprehension monitoring (.03–.06). The total effects of vocabulary (.23–

Table 3
Direct, indirect, and total effects, as measured by standardized regression weights and associated standard errors, of language and cognitive skills on listening comprehension and theory of mind in kindergarten and Grade 2.

Variable	K Listening comprehension			G2 Listening comprehension		
	Direct effect	Indirect effect	Total effect	Direct effect	Indirect effect	Total effect
Theory of Mind	.36 (.05)	–	.36 (.05)	.31 (.06)	–	.31 (.06)
Inference	.25 (.05)	–	.25 (.05)	.29 (.07)	–	.29 (.07)
Comp Monitor	.03 (.04)	–	.03 (.04)	.06 (.05)	–	.06 (.05)
Vocabulary	.28 (.05)	.18 (.03)	.46 (.05)	.24 (.06)	.16 (.04)	.40 (.07)
Grammar	.15 (.05)	.15 (.03)	.30 (.05)	.13 (.07)	.25 (.05)	.38 (.07)
Working Memory	.10 (.05)	.37 (.05)	.47 (.06)	.11 (.05)	.34 (.06)	.45 (.07)
Attention	.11 (.04)	.18 (.05)	.29 (.06)	.05 (.05)	.13 (.06)	.18 (.07)
	K Theory of Mind			G2 Theory of Mind		
Vocabulary	.34 (.06)	–	.34 (.06)	.23 (.07)	–	.23 (.07)
Grammar	.26 (.06)	–	.26 (.06)	.35 (.07)	–	.35 (.07)
Working Memory	.12 (.06)	.22 (.04)	.34 (.06)	.17 (.06)	.22 (.04)	.39 (.06)
Attention	.08 (.05)	.09 (.03)	.17 (.06)	.13 (.06)	.05 (.04)	.18 (.07)

Note. Standard errors are in parentheses. K, kindergarten; G2, Grade 2; Inference, knowledge-based inference; Comp Monitor, comprehension monitoring.

Table 4
Bivariate correlations between variables between grades.

	Kindergarten									
Grade 2	1	2	3	4	5	6	7	8	9	10
1. TNL Comprehension	.73	.51	.61	.58	.41	.30	.54	.42	.36	.43
2. Expo Comprehension	.63	.56	.49	.53	.43	.29	.51	.39	.37	.44
3. OWLS Comprehension	.61	.42	.64	.60	.38	.31	.48	.35	.35	.40
4. Theory of Mind	.59	.45	.53	.56	.33	.30	.48	.43	.41	.47
5. CASL Inference	.60	.57	.52	.48	.36	.35	.45	.46	.38	.38
6. Comprehension Monitor	.39	.39	.46	.44	.36	.28	.32	.22	.29	.26
7. WJ Picture Vocabulary	.63	.46	.62	.59	.41	.39	.68	.44	.43	.35
8. CASL Grammaticality	.58	.43	.52	.51	.28	.30	.46	.47	.42	.42
9. Working Memory	.32	.24	.31	.33	.18	.15	.25	.33	.38	.33
10. Attention	.10+	.11+	.25	.11+	.20	.20	.16	.16	.31	.47

Note. All coefficients are statistically significant at $p < .05$ except for three indicated by a plus symbol (+). TNL, Test of Narrative Language; Expo, expository; OWLS Comprehension, Listening Comprehension subscale of the Oral and Written Language Scales-II; CASL, Comprehensive Assessment of Spoken Language; Inference, knowledge-based inference; Monitor, monitoring; WJ, Woodcock Johnson–Third Edition.

.34), grammatical knowledge (.26–.35), working memory (.34–.39), and attention (.17–.18) on theory of mind were also substantial.

Research question 3: Longitudinal relations of language and cognitive skills from kindergarten to Grade 2

Bivariate correlations between grades are reported in Table 4. Not surprisingly, the same skills in kindergarten and Grade 2 were moderately to strongly related ($.36 \leq rs \leq .73$; see the values on the diagonal), with the exception of comprehension monitoring, which had a weak stability ($r = .28$). Relations between skills across the grades (see off the diagonal in Table 4) ranged from weak (.10) to moderate (.63). For example, foundational language and cognitive skills (working memory, attention, vocabulary, and grammatical knowledge) in kindergarten were weakly to moderately related to listening comprehension in Grade 2 ($.10 \leq rs \leq .63$).

To examine the longitudinal relations of language and cognitive skills in kindergarten to those in Grade 2, and to listening comprehension in Grade 2, the four alternative models described above were fitted to the data. The baseline model (Model 1) (Fig. 3) had an acceptable fit to the data,

$\chi^2(111) = 322.39$, $p < .0001$, CFI = .89[1], RMSEA = .085 [.074–.096], SRMR = .087. The model fits for the other alternative models were as follows: $\chi^2(108) = 320.00$, $p < .0001$, CFI = .89, RMSEA = .086 [.076–.097], SRMR = .087 in the model (Model 2) where kindergarten higher-order cognitions were hypothesized to directly relate to Grade 2 listening comprehension; $\chi^2(109) = 314.48$, $p < .0001$, CFI = .90, RMSEA = .085 [.074–.096], SRMR = .086 in the model (Model 3) where kindergarten vocabulary and grammatical knowledge were hypothesized to directly relate to Grade 2 listening comprehension; and $\chi^2(109) = 313.53$, $p < .0001$, CFI = .90, RMSEA = .084 [.074–.095], SRMR = .087 in the model (Model 4) where kindergarten working memory and attention were hypothesized to directly relate to Grade 2 listening comprehension. Model 2 was not different from Model 1 in terms of model fit ($\Delta\chi^2 = 2.39$, $\Delta df = 3$, $p = .50$). Models 3 and 4 had statistically smaller chi-square values than the baseline model (Model 1), $7.91 \leq \Delta\chi^2 \leq 8.86$ ($\Delta df = 2$), $.02 \leq p \leq .01$. However, these were due to suppressor effects (of kindergarten grammatical knowledge in Model 3 and kindergarten working memory in Model 4 on Grade 2 listening comprehension). Given the complexity of these models, the causes of the suppressor effects were unclear; thus, the baseline model shown in Fig. 3 was chosen as the final model.

Standardized path coefficients of the final model between kindergarten and Grade 2 skills are presented in Table 5. Note that these relations are after accounting for the other variables in the model, in contrast to simple bivariate relations shown in Table 4. Most of the language and cognitive skills showed statistically significant longitudinal stability between grades, as shown in Table 5. However, not surprisingly the relations were weaker than those in Table 4. After accounting for other variables in the model, vocabulary (.61), listening comprehension (.55), and attention (.40) were moderately stable between grades, and the remaining skills were weakly stable. For example, inference in kindergarten was weakly related to inference in Grade 2 (.12) after accounting for the other variables in the model. Similarly, theory of mind in kindergarten and theory of mind in Grade 2 were not related ($-.05$) after accounting for the variables in the model. Longitudinal cross-construct relations (e.g., theory of mind in kindergarten predicting inference in Grade 2) were weak (.00–.20). A total of 90% of variance in Grade 2 listening comprehension was explained.

Discussion

Theory of mind has received substantial attention as an important outcome skill to develop. Recent evidence further indicates its role in discourse comprehension and production. In the current study, we investigated the mediating role of theory of mind in the relations of language and cognitive skills to discourse comprehension (i.e., listening comprehension), as well as the nature of longitudinal relations, using DIET as a theoretical framework and using longitudinal data from kindergarten to Grade 2.

DIET described the data in kindergarten and Grade 2 very well, and the included variables explained a large amount of variance in listening comprehension (>80%), convergent with recent studies with children in primary grades (e.g., Kim, 2016). Importantly, the results showed the mediating role of theory of mind in kindergarten and Grade 2, supporting the hierarchical relations hypothesis of DIET. As shown in Fig. 2, working memory, attentional control, vocabulary, and grammatical knowledge were directly and indirectly related to theory of mind and to discourse comprehension (albeit different patterns in kindergarten vs. Grade 2), and theory of mind was related to discourse comprehension. In other words, theory of mind partially mediated the relations of language and cognitive skills to discourse comprehension. The vast majority of previous studies have investigated direct relations or unique contributions of focal skills on an outcome. Although informative for the purpose of identifying unique contributors, this approach fails to explain chains of relations (or indirect effects) or the nature of relations among language and cognitive skills. However, according to the hierarchical relations hypothesis of DIET and extant evidence, skills, including theory of mind, are involved in

[1] The CFI value barely missed the conventional value of .90 for an acceptable model, and given the overall pattern along with other values, these models were considered good. Modification index suggested allowing covariance between residual variances of listening comprehension tasks between grades (e.g., OWLS listening comprehension in kindergarten and Grade 2), and when they were allowed the CFI value improved to the criterion of a good model fit of .90. However, the parameter estimates and patterns of results were identical, and results without allowing the residual covariances are reported.

Table 5
Standardized path coefficients between language and cognitive skills in kindergarten and Grade 2 based on the model in Fig. 3.

K skill → G2 skill	β (*SE*)	*p*
K Listening Comp → G2 Listening Comp	.52 (.09)	<.001
K Theory of Mind → G2 Theory of Mind	−.05 (.06)	.38
K Theory of Mind → G2 Inference	.15 (.06)	.006
K Theory of Mind → G2 Monitor	−.00 (.07)	.96
K Inference → G2 Theory of Mind	.09 (.06)	.13
K Inference → G2 Inference	.12 (.06)	.05
K Inference → G2 Monitor	.20 (.07)	.006
K Monitor → G2 Theory of Mind	.05 (.06)	.38
K Monitor → G2 Inference	.11 (.06)	.06
K Monitor → G2 Monitor	.08 (.07)	.25
K Vocabulary → G2 Vocabulary	.61 (.05)	<.001
K Vocabulary → G2 Grammar	.28 (.06)	<.001
K Grammar → G2 Vocabulary	.17 (.06)	.003
K Grammar → G2 Grammar	.25 (.06)	<.001
K Working Mem → G2 Working Mem	.30 (.07)	<.001
K Working Mem → G2 Attention	.16 (.07)	.02
K Attention → G2 Working Mem	.21 (.07)	.004
K Attention → G2 Attention	.39 (.07)	<.001

Note. K, kindergarten; G2, Grade 2; Comp, comprehension; Inference, knowledge-based inference; Monitor, monitoring; Mem, memory.

chains of relations, and the consistent results in kindergarten and Grade 2 in the current study are in line with the DIET hypothesis that the hierarchical relations remain across development.

Theory of mind captures one's inferential reasoning about others' mental states, such as thoughts, beliefs, desires, and emotions (Astington & Edward, 2010; de Villiers & Pyers, 2002), and is hypothesized to be an important skill for the integration process during discourse comprehension (Kim, 2020b, 2020c; Kim, 2016). The role of inference during the integration process in discourse comprehension has been widely recognized in theoretical models of discourse comprehension (see McNamara & Magliano, 2009, for a review) and has been supported in a large body of evidence (see Elleman, 2017, for a review). DIET and the current findings add to this literature in two important ways. First, DIET includes perspective taking (theory of mind) as an important component skill that is involved in the integration process. Inference is a broad category that encompasses a variety of types (see Graesser et al., 1994) and nature of inferences (knowledge-based or text-connecting inferences). In the current study, we included and controlled for knowledge-based inference, which has been widely examined in the relation of inference to discourse comprehension (e.g., Barnes et al., 1996; Hannon & Daneman, 1998). Both theory of mind and knowledge-based inference are inferencing skills and, not surprisingly, they were moderately correlated (see Table 2). Yet, theory of mind was independently related to discourse comprehension, indicating that theory of mind captures a unique inferencing ability beyond what is captured in knowledge-based inferencing (e.g., inferring and reflecting on intentions or goals) (see Van Overalle, 2009).

It should be noted that listening comprehension in the current study included both narrative and expository texts. In DIET, the importance of theory of mind in discourse comprehension is not limited to only narrative texts but also applies to expository texts because underlying theory of mind is general inferential reasoning ability not specific to socioemotional aspects alone. This does not, however, deny the fact that theory of mind may be more strongly related to comprehension of narrative texts than to expository texts. Investigation into this speculation is beyond the scope of the current article and was not investigated in the current study because the comprehension questions in the narrative and expository texts were not specifically designed to examine potentially differential relations of theory of mind to narrative versus expository texts. Future studies are needed.

The second way the current findings expand prior work is by showing structural relations of working memory, attentional control, vocabulary, and grammatical knowledge to theory of mind. Their relations to theory of mind are in line with previous studies (Arslan et al., 2017; de Villiers & Pyers, 2002; de Villiers & de Villiers, 2009; Furrow et al., 1992; Kim, 2015, 2017a; Kim & Phillips, 2014; Moses et al., 2005; Müller et al., 2012; Ruffman et al., 2003; Slade & Ruffman, 2005; Valle et al., 2015), but the vast majority of prior work did not reveal the hierarchical relations among them. Interestingly, patterns of the relations were different in kindergarten versus Grade 2 (see Fig. 2A and B). In kindergarten, vocabulary and grammatical knowledge made direct contributions to theory of mind, whereas working memory and attention were indirectly related via vocabulary and grammatical knowledge—that is, in kindergarten, the relations of working memory and attention to theory of mind were completely mediated by vocabulary and grammatical knowledge. In Grade 2, in addition to vocabulary and grammatical knowledge, working memory and attention both were directly related to theory of mind, indicating that vocabulary and grammatical knowledge partially, but not completely, mediated the relations of working memory and attention to theory of mind. It is important to note that the total effects of working memory and attention on theory of mind were similar in kindergarten and Grade 2 (see the bottom panel of Table 3).

These results suggest that the nature of the relations of language and cognitive skills (working memory, attention, vocabulary, and grammatical knowledge) to theory of mind may change as children develop their language and cognitive skills. The causes for the changing relations are unclear. However, one explanation may include differential demands of vocabulary and grammatical knowledge in the theory of mind tasks in kindergarten versus Grade 2. In kindergarten, vocabulary and grammatical knowledge demands in the theory of mind tasks are higher because of students' lower level of vocabulary due to developmental reasons; thus, the roles of working memory and attention are completely mediated by the language demands. In Grade 2, on the other hand, with development of children's vocabulary and grammatical knowledge, the relative demands of vocabulary and grammatical knowledge in theory of mind tasks are reduced, and individual differences in working memory and attentional control are directly related to children's performance on theory of mind. Thus, although the total effects of domain-general cognitions on theory of mind might not vary by development, the mediated nature via vocabulary and grammatical knowledge may change with development, at least in kindergarten and Grade 2.

Alternatively, the different patterns may be due to the differences in first- and second-order theory of mind scenarios. As noted above, in Grade 2 theory of mind was measured by second-order scenarios, whereas in kindergarten it was measured by first- and second-order scenarios. Second-order scenarios involve greater complexity than first-order scenarios and, thus, may draw on working memory and attentional control to a greater extent. Future longitudinal investigations are necessary.

In addition to hierarchical relations, DIET also posits dynamic relations as a function of development and text characteristics, and we expected that theory of mind would make a relatively greater contribution to discourse comprehension in Grade 2 than in kindergarten. However, this was not supported in the current study. The magnitudes of correlations between the two discourse comprehension tasks, TNL and OWL comprehension[2], and theory of mind were not different in kindergarten versus Grade 2 (see Table 2). Furthermore, total effects (regression weights) of theory of mind on listening comprehension in Table 3 were similar in magnitude. In fact, the total effect in Grade 2 (.31) appears to be somewhat smaller than the total effect in kindergarten (.36) descriptively. However, this is likely due to the shared variance between theory of mind and knowledge-based inference (see Table 2; .44 in kindergarten and .57 in Grade 2) and slightly increased strength of the relation of knowledge-based inference to discourse comprehension from kindergarten to Grade 2 (see Table 2).

A potential explanation for the absence of a stronger relation of theory of mind to discourse comprehension in Grade 2 compared with kindergarten is that changes in the relative contribution hypothesized in DIET may be observed in a longer time span (e.g., kindergarten vs. upper elementary grade) than what was examined in the current study. A future longitudinal study with a longer time span can shed light on this speculation (see Kim, 2020b).

The final question in this study was nature of longitudinal relations of language and cognitive skills, which was also revealing in several aspects. First, the skills in kindergarten had moderate to strong

[2] Texts for expository comprehension were different in kindergarten and Grade 2 and, therefore, are not compared between kindergarten and Grade 2.

stability through Grade 2 in bivariate correlations (Table 4). After accounting for the language and cognitive component skills (Table 5), however, the relations weakened. The most striking example is the listening comprehension latent variable. The bivariate correlation between kindergarten and Grade 2 was .95, but it had a considerably reduced magnitude of .55 after accounting for the language and cognitive component skills, indicating that the strong longitudinal stability of listening comprehension is largely due to its language and cognitive component skills. Similarly, theory of mind between kindergarten and Grade 2 had a moderate bivariate correlation (r = .56), but after accounting for the contributions of vocabulary, grammatical knowledge, working memory, and attentional control, it was reduced to −.05 (see Table 5).

Another interesting finding in the longitudinal relations is cross-construct relations. Although the relations tended to be weak to moderate (Table 4), particularly after accounting for the language and cognitive skills (Table 5), some relations (e.g., vocabulary, grammatical knowledge) did have longitudinal predictive relations. These may indicate potential interactive developmental relations among these language and cognitive skills—development of one skill may bootstrap development of the other skill (see Bloom, 1994, and Fisher, 1996, for the bootstrapping relations between vocabulary and grammatical knowledge). Finally, the contributions of kindergarten language and cognitive skills to Grade 2 listening comprehension were *indirect* via Grade 2 language and cognitive skills. Although this is not surprising theoretically, by demonstrating the pathways of relations, this finding extends previous studies showing that language and cognitive skills at an early time point predicted later listening comprehension (e.g., Alonzo et al., 2016; Muter et al., 2004).

Limitations, implications, and conclusion

Findings of the current study should be interpreted with the following limitations in mind. First, the language and cognitive component skills such as vocabulary and working memory were measured by observed variables (i.e., single measures), but it would have been ideal to measure each by latent variables in order to reduce measurement error. Although ideal from a measurement perspective, latent variables require administering multiple measures per construct, which presents challenges in terms of resources and practicality of working in school settings (e.g., limited assessment time), particularly when multiple constructs need to be measured (i.e., large assessment battery). Second, reliability estimates of a couple of measures were less than ideal. Specifically, vocabulary and comprehension monitoring in kindergarten were less than .70. Future replications are warranted. Third, the current study should be replicated with a larger sample given the complexity of the statistical model, particularly for the longitudinal relations examined in the third research question. Finally, given our focus on the mediating role of theory of mind in this study, we focused on structural relations in kindergarten and Grade 2 using structural equation modeling. However, another important question that should be addressed in future studies is developmental trajectories of the language and cognitive skills and their relations with development of theory of mind and discourse skills.

The current findings about the mediating role of theory of mind, in conjunction with DIET and previous evidence, offer several implications. One obvious implication is the role of theory of mind in discourse skills. According to DIET (Kim, 2016, 2020b, 2020c; Kim & Graham, 2020) and other speculations (Dore et al., 2018), improving theory of mind should improve discourse skills such as listening comprehension, reading comprehension, and written composition. Provided validation of its causal role in discourse comprehension in future experimental studies, theory of mind merits instructional attention. To our best knowledge, theory of mind rarely receives instructional attention in education settings, although evidence is clear that theory of mind can be taught and improved with explicit instruction (see Hofmann et al., 2016, for a meta-analysis). Another implication is a need for considering multiple language and cognitive skills to enhance one's theory of mind and discourse skills. What DIET illustrates is chains of systematic relations among language and cognitive skills. This entails that teaching multiple language and cognitive skills, rather than a single skill, is necessary to maximally improve higher-order skills such as theory of mind and discourse skills.

In conclusion, theory of mind is a higher-order skill that is central for social interactions and development of language and literacy skills. In the current study, we examined theory of mind in terms of its mediating role in the relations of language and cognitive skills to discourse comprehension using

DIET. Our findings indicate a web of systematic relations among language and cognitive skills and underscore the importance of understanding the nature of such relations.

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