INTERNATIONAL LITERACY ASSOCIATION
READING RESEARCH QUARTERLY

Developmental, Component-Based Model of Reading Fluency: An Investigation of Predictors of Word-Reading Fluency, Text-Reading Fluency, and Reading Comprehension

Young-Suk Grace Kim

Florida State University and Florida Center for Reading Research, Tallahassee, USA

ABSTRACT

The primary goal was to expand our understanding of text-reading fluency (efficiency or automaticity): how its relation to other constructs (e.g., word-reading fluency, reading comprehension) changes over time and how it is different from word-reading fluency and reading comprehension. The study examined (a) developmentally changing relations among word-reading fluency, listening comprehension, text-reading fluency, and reading comprehension; (b) the relation of reading comprehension to text-reading fluency; (c) unique emergent literacy predictors (i.e., phonological awareness, orthographic awareness, morphological awareness, letter name knowledge, vocabulary) of text-reading fluency versus word-reading fluency; and (d) unique language and cognitive predictors (e.g., vocabulary, grammatical knowledge, theory of mind) of text-reading fluency versus reading comprehension. These questions were addressed using longitudinal data (two timepoints; mean age = 5 years 2 months and 6 years 1 month, respectively) from young Korean-speaking children (N = 143). Results showed that listening comprehension was related to text-reading fluency at time 2 but not at time 1. At both times, text-reading fluency was related to reading comprehension, and reading comprehension was related to text-reading fluency over and above word-reading fluency and listening comprehension. Orthographic awareness was related to text-reading fluency over and above other emergent literacy skills and word-reading fluency. Vocabulary and grammatical knowledge were independently related to text-reading fluency and reading comprehension, whereas theory of mind was related to reading comprehension but not text-reading fluency. These results reveal the developmental nature of relations and mechanisms of text-reading fluency in reading development.

Text-reading fluency is typically defined as "the ability to read a text quickly, accurately, and with proper expression" (National Institute of Child Health and Human Development [NICHD], 2000, p. 3-5). In particular, previous studies that operationalized text-reading fluency as text-reading efficiency or automaticity excluding reading prosody have shown a strong relation of text-reading fluency to reading comprehension (Daane, Campbell, Grigg, Goodman, & Oranje, 2005; Fuchs, Fuchs, Hosp, & Jenkins, 2001; Jenkins, Fuchs, van den Broek, Espin, & Deno, 2003; Kim, Park, & Wagner, 2014; Kim, Wagner, & Lopez, 2012; Kuhn & Stahl, 2003; Riedel, 2007; Roehrig, Petscher, Nettles, Hudson, & Torgesen, 2008). Evidence from these studies suggests that text-reading fluency explains additional variance in reading comprehension over and above word reading and

Reading Research Quarterly, 0(0)
pp. 1–23 | doi:10.1002/rrq.107
© 2015 International Literacy Association.

language comprehension (Kim et al., 2012, 2014; Klauda & Guthrie, 2008)—the two critical and necessary skills of reading comprehension according to the simple view of reading (Catts, Adlof, & Ellis Weismer, 2006; Hoover & Gough, 1990; Joshi, Tao, Aaron, & Quiroz, 2012; Kim, 2015; Mancilla-Martinez, Kieffer, Biancarosa, Christodoulou, & Snow, 2011; Savage, 2006; Vellutino, Tunmer, Jaccard, & Chen, 2007).

Despite a large number of studies showing a strong relation of text-reading fluency to reading comprehension for primary-grade children, however, we have limited empirical evidence about the nature and role of text-reading fluency (efficiency) in reading development. To address this gap, the present study examined how the relation of text-reading fluency to reading comprehension changes over time and how text-reading fluency is a differentiated construct from word-reading fluency and reading comprehension by examining unique, independent predictors of text-reading fluency versus word-reading fluency, and text-reading fluency versus reading comprehension. These questions were addressed using longitudinal data (two timepoints) from Korean-speaking children.

It is important to note that in the present study, I operationalize *reading fluency* as the accuracy and rate at which the individual reads words at the lexical (i.e., reading words in isolation) and discourse levels (i.e., reading words in context). Therefore, *text-reading fluency* refers to reading words in connected texts, such as passages, and *word-reading fluency* refers to reading words in isolation or a list format. Reading prosody (or expression) is an important aspect of text-reading fluency (Kuhn, Schwanenflugel, & Meisinger, 2010; Kuhn & Stahl, 2003), but it was beyond the scope of the present study. Although I acknowledge that *automaticity* and *efficiency*[1] are more accurate terms to describe the accuracy and rate of reading words in or out of context, I use the term *fluency*, given its wide use in the literature (e.g., Adlof, Catts, & Little, 2006; D.L. Baker, Stoolmiller, Good, & Baker, 2011; Fuchs et al., 2001; Jenkins et al., 2003; Kim et al., 2014; Kim, Wagner, & Foster, 2011; Nathan & Stanovich, 1991; Roehrig et al., 2008; Schwanenflugel et al., 2006; Silverman, Speece, Haring, & Ritchey, 2013; Wolf & Katzir-Cohen, 2001). Therefore, in the present study, *word-reading fluency* refers to word-reading efficiency or automaticity, and *text-reading fluency* refers to text-reading efficiency or automaticity.

Text-Reading Fluency and Reading Comprehension

Theoretical account about the role of text-reading fluency in reading comprehension involves limited cognitive capacity (LaBerge & Samuels, 1974; Samuels, 2006). Reading words with accuracy and speed lifts cognitive constraints, allowing cognitive resources (e.g., working memory, attention) to be used for higher order meaning construction. That is, text-reading fluency unglues the child from decoding (Chall, 1983). Recent studies have shown that text-reading fluency, although highly related, is a separate construct from word-reading fluency (Kim et al., 2011, 2012, 2014; Kim & Wagner, 2015; cf. Schwanenflugel et al., 2006), and text-reading fluency was predicted not only by word-reading fluency but also by oral language comprehension (hereafter *listening comprehension*), especially after children reached a certain level of word-reading proficiency. These results are in line with Stanovich, Cunningham, and Feeman's (1984) finding that first-grade children read the same words more rapidly in context (i.e., coherent paragraph) than out of context (i.e., random, incoherent paragraph), and this difference was more pronounced at the end of the school year than the beginning.

Furthermore, the relation of text-reading fluency to reading comprehension changed over time (Kim et al., 2012, 2014; Kim & Wagner, 2015). In the beginning phase of reading development when decoding is the primary focus of development, word-reading fluency and text-reading fluency largely overlapped such that word-reading fluency strongly influenced reading comprehension, whereas text-reading fluency did not make an independent contribution to reading comprehension. At a later phase, text-reading fluency made an independent contribution to reading comprehension over and above word-reading fluency and listening comprehension. For children learning to read in an opaque orthography, English, an independent contribution of text-reading fluency was observed as early as grade 2 (Kim et al., 2012) and also grade 4 (Jenkins et al., 2003; Kim & Wagner, 2015; Klauda & Guthrie, 2008). For children learning to read in a relatively transparent orthography, Korean, an independent contribution of text-reading fluency was observed for younger children, kindergartners, in a cross-sectional study (Kim et al., 2014).

The finding in Korean raises an important question about text-reading fluency, namely, whether the developmental progression pattern observed in English (e.g., Kim et al., 2011, 2012; Kim & Wagner, 2015) is generalizable to languages with a transparent orthography. Theoretically, the pattern of developmental progression is expected to be similar across opaque and transparent orthographies: As children develop word-reading skills, their cognitive resources can be allocated to meaning construction, and children's ability to process meaning (i.e., listening comprehension) is expected to be related to text-reading fluency. Although opaque and transparent orthographies differ in terms of duration of word-reading acquisition (Frost, Katz, & Bentin, 1987; Seymour, Aro, & Erskine, 2003), the overall pattern of developmental relations of word-reading fluency, listening comprehension, text-reading fluency, and reading comprehension might be similar.

The hypothesis that text-reading fluency involves meaning comprehension to some extent (Jenkins et al., 2003; Stanovich et al., 1984; Wolf & Katzir-Cohen, 2001) is supported by two lines of studies. First, studies have suggested that reading comprehension makes an independent contribution to text-reading fluency after accounting for word-reading fluency (Jenkins et al., 2003), and word-reading fluency and decoding fluency for children (Hudson, Torgesen, Lane, & Turner, 2012). These results have been taken to suggest that text-reading fluency and reading comprehension have a bidirectional relation. The second line of studies has shown that listening comprehension is related to text-reading fluency after accounting for word-reading fluency (Kim et al., 2011, 2012, 2014; Kim & Wagner, 2015).

Together, these studies indicate that text comprehension (listening comprehension and reading comprehension) is indeed involved in text-reading fluency. However, what is unclear is whether reading comprehension versus listening comprehension matters in relation to text-reading fluency after accounting for each other. Previous studies of reading comprehension's relation to text-reading fluency did not account for listening comprehension (D.L. Baker et al., 2011; Hudson et al., 2012; Jenkins et al., 2003), and those of listening comprehension's relation to text-reading fluency did not account for reading comprehension (Kim et al., 2011, 2012, 2014; Kim & Wagner, 2015). In the present study, I addressed this gap in the literature by investigating (a) the relations of word-reading fluency and listening comprehension to text-reading fluency, and their relations to reading comprehension; and (b) the relation of reading comprehension to text-reading fluency after accounting for word-reading fluency and listening comprehension.

Emergent Literacy Skills Involved in Text-Reading Fluency Versus Word-Reading Fluency

One critical question in understanding text-reading fluency as a construct is what differentiates it from word-reading fluency. That is, what distinguishes accuracy and speed of reading words in connected text from accuracy and speed of reading context-free words? One way to examine this question is investigating how unique component emergent literacy skills differ for word-reading fluency versus text-reading fluency. If text-reading fluency is a distinctive construct from word-reading fluency, various emergent literacy skills would be somewhat differentially related to word-reading fluency versus text-reading fluency.

According to Ehri's (2002) model of word-reading development, text-reading fluency is a direct outcome of word-reading fluency, which, in turn, is the outcome of word-reading accuracy. Given that the foundational skill for text-reading fluency is word-reading fluency (Hudson et al., 2012), the influence of emergent literacy skills[2] (e.g., phonological awareness, orthographic awareness, morphological awareness, letter name knowledge, vocabulary, rapid automatized naming) on word-reading fluency versus text-reading fluency should be largely shared, particularly during the beginning phase of reading development. However, there might be unique emergent literacy skills that relate to text-reading fluency over and above word-reading fluency.

In particular, orthographic awareness (i.e., knowledge of letter patterns, word-specific orthographic representation; Apel & Apel, 2011) might play a unique role in text-reading fluency because readers, including developing readers, process words parafoveally (e.g., Plummer & Rayner, 2012; Rayner, Pollatsek, Ashby, & Clifton, 2012). Therefore, the ability to recognize multiletter units beyond one-on-one mapping (i.e., orthographic awareness, forming orthographic codes) might facilitate word reading in connected texts (Nathan & Stanovich, 1991). In fact, Barker, Torgesen, and Wagner (1992) found that orthographic awareness was more strongly related to text-reading fluency than to word-reading fluency.

To examine this hypothesis, the following emergent literacy skills were included in the present study as predictors of word-reading fluency and text-reading fluency: phonological awareness, orthographic awareness, morphological awareness, letter name knowledge, rapid automatized naming, and vocabulary. These emergent literacy skills were selected based on evidence about their relations to word reading in English and Korean (e.g., Adams, 1990; Cho & McBride-Chang, 2005; Cho, McBride-Chang, & Park, 2008; Compton, DeFries, & Olson, 2001; Kim, 2007, 2011; NICHD, 2000; Ouellette, 2006; Ricketts, Nation, & Bishop, 2007; Schatschneider, Fletcher, Francis, Carlson, & Foorman, 2004; Wang, Ko, & Choi, 2009). These emergent literacy skills were assessed at time 1, whereas word-reading fluency and text-reading fluency were assessed at both earlier (time 1) and later (time 2) timepoints. This allowed me to investigate how emergent literacy skills are similarly or differentially related to word-reading fluency and text-reading fluency at an earlier and a later phase of reading development.

Language and Cognitive Processes Involved in Text-Reading Fluency Versus Reading Comprehension

Another question about text-reading fluency as a construct involves what differentiates it from reading comprehension. Semantic processes were hypothesized to be involved in text-reading fluency (Jenkins et al., 2003; Perfetti, 1999), and evidence indeed suggests that text-reading fluency is a function of not only word reading but also text comprehension (Hudson et al., 2012; Jenkins et al., 2003; Kim et al., 2011, 2012, 2014; Nation & Snowling, 1998). Then, what comprehension processes are involved in text-reading fluency versus reading comprehension?

According to Posner and Snyder (1975), two processes are involved in information processing: (1) Automatic activation of semantically related memory is fast and does not use attentional capacity, and (2) slow-acting attention mechanism, in contrast, responds to a preceding context and costs limited-capacity cognitive processing. Similarly, the verbal efficiency theory (Perfetti, 1999) hypothesizes that variation in automatic semantic activation and conscious and/or unconscious prediction processes influence reading efficiency. Therefore, it is reasonable to hypothesize that automatic processes related to the semantic network would be implicated in text-reading fluency, whereas higher order cognitive processes that might require slow-acting attention would be uniquely implicated in reading comprehension.

Inasmuch as vocabulary captures semantic activation and related processes, vocabulary is expected to be involved in text-reading fluency. Grammatical knowledge may also be involved in text-reading fluency because morphosyntactic knowledge is essential to encoding meaning. In fact, in the verbal efficiency model, quality of lexical representation includes a network of meanings, such as vocabulary and morphosyntactic processes (Perfetti, 2007; Perfetti & Stafura, 2014). In addition, individual differences in working memory are likely to influence text-reading fluency to allow holding linguistic information temporarily (Perfetti, 1985).

Whereas some semantic activation and prediction processes might be involved in text-reading fluency (Jenkins et al., 2003; see semantic activation in reading in priming studies, e.g., Hohenstein, Laubrock, & Kliegl, 2010), reading comprehension is likely to rely on a slow-acting attention mechanism such as higher order cognitive processes. Reading comprehension requires constructing the situation model (Kintsch, 1988), which involves a deep level of meaning processing, such as evaluating initial propositions, making inferences across propositions, and integrating them with prior knowledge (Graesser, Singer, & Trabasso, 1994; Kintsch, 1988; Perfetti, Landi, & Oakhill, 2007). Therefore, higher order cognitive skills such as theory of mind, inference making, and comprehension monitoring are candidate processes unique to text comprehension (Cain, 2007; Cain, Oakhill, & Bryant, 2004; Kim, 2015; Kim & Phillips, 2014; Oakhill, Cain, & Bryant, 2003; Tompkins, Guo, & Justice, 2013).

Note that theory of mind, typically defined as one's representation of others' mental state (de Villiers, 2000; de Villiers & Pyers, 2002; Slade & Ruffman, 2005), has been studied extensively, particularly in relation to syntactic aspects of oral language and the autism spectrum (Baron-Cohen, Tager-Flusberg, & Cohen, 1994; de Villiers & Pyers, 2002; Johnston, Miller, & Tallal, 2001; Slade & Ruffman, 2005). Theory of mind is included in the present study because it captures complex cognition such as making inferences about others' thoughts or emotions, which is an important aspect of text comprehension (Graesser et al., 1994). However, evidence about the role of theory of mind in text comprehension is mixed.

Theory of mind was independently related to narrative story comprehension for English-speaking kindergartners after accounting for inhibitory control, vocabulary, and comprehension monitoring (Kim et al., 2014), and for Korean-speaking kindergartners after accounting for working memory, grammatical knowledge, vocabulary, and comprehension monitoring (Kim, 2015). In a study with English-only children and English learners in kindergarten, first grade, and second grade, theory of mind was related to comprehending fables after accounting for vocabulary and metacognitive language, all measured in English (Pelletier, 2006). In contrast, in a study with Chilean kindergartners, theory of mind was not related to comprehension of wordless picture book and story recall after accounting for working memory, vocabulary, inhibitory control, attention, inference, and comprehension monitoring (Strasser & del Río, 2014).

In addition to higher order cognitive skills, grammatical knowledge was hypothesized to be related to reading comprehension because grammatical knowledge, particularly the ability to repair grammatical errors, has been hypothesized to play a key role in integrating propositions and establishing coherence in text comprehension (Perfetti, 2007; Perfetti & Stafura, 2014). Indeed, evidence from English-speaking children has provided support for this hypothesis (Cain, 2007).

The Present Study

To expand our understanding of text-reading fluency, the present study had three guiding research questions.

The first research question asked about the developmental nature of the relations among word-reading fluency, listening comprehension, text-reading fluency, and reading comprehension. Based on previous studies, I hypothesized that word-reading fluency would be strongly related to text-reading fluency during an earlier phase of reading development, and listening comprehension would be related to text-reading fluency at a later phase when children's word-reading proficiency is more advanced. I further expected that word-reading fluency would be independently related to reading comprehension at an earlier phase of reading development, whereas text-reading fluency would be independently related to reading comprehension at a later phase. Listening comprehension was hypothesized to be related to reading comprehension at both timepoints. I did not have a specific hypothesis about the relation of reading comprehension to text-reading fluency over and above word-reading fluency and listening comprehension.

The second research question asked how various emergent literacy skills are related to word-reading fluency versus text-reading fluency. In particular, I was interested in the relations of emergent literacy skills to text-reading fluency after accounting for their contributions to word-reading fluency. It was hypothesized that orthographic awareness would be uniquely related to text-reading fluency after accounting for its relation to word-reading fluency.

The third research question asked about the language and cognitive predictors of text-reading fluency versus reading comprehension. I hypothesized that foundational language and cognitive skills, such as vocabulary, grammatical knowledge, and working memory, would be related to text-reading fluency, whereas grammatical knowledge and higher level cognitive skills, such as theory of mind and comprehension monitoring, would be independently associated with reading comprehension. Recent findings have shown that foundational and higher order skills are directly and indirectly related to text comprehension (Florit, Roch, & Levorato, 2013; Kim, 2015; Kim & Phillips, 2014), and therefore, in the present study, I examined direct and indirect relations of language and cognitive skills to text-reading fluency versus reading comprehension.

These three primary questions were addressed by using longitudinal data from kindergartners in South Korea. Although typically developing English-speaking kindergartners are not expected to have developed sufficient text-reading fluency and reading comprehension to be measured reliably, many previous studies with Korean-speaking children have indicated that kindergartners in Korea have proficient word-reading skills (Cho, 2009; Cho & McBride-Chang, 2005; Cho et al., 2008; Kim, 2007, 2011), text-reading fluency, and reading comprehension (Kim, 2011; Kim et al., 2014). These are likely to be attributed to the educational context in South Korea in which early literacy instruction is typically provided in preschool (or kindergarten year 1) and kindergarten, as well as various home-visit programs (Kim, 2011).

An additional critical factor in literacy acquisition is grapheme–phoneme consistency. The Korean language has a relatively transparent orthography called Hangul. Although its visual representation is alphasyllabic (i.e., both syllables and phonemes are visually represented), Hangul is an alphabetic system in which graphemes represent phonemes. Given a relatively rapid acquisition of word-reading skills in languages with transparent orthographies (see Seymour et al., 2003), children in the present study were assessed in a relatively short time span between timepoints, approximately eight months apart, to adequately capture the changing nature of relations.

Method

Participants

Data reported in the present study are from a larger study of reading development in Korean. The larger study consists of four timepoints of data collection from kindergarten year 1 (or prekindergarten) to kindergarten year 2. In the present study, I report data from two timepoints when measures relevant to the present study were administered. In South Korea, 143 children (63 girls) were assessed in prekindergarten (or kindergarten year 1; mean age = 5 years 2 months, standard deviation [*SD*] = 3.34 months) and again in kindergarten year 2 (mean age = 6 years 1 month, *SD* = 3.36 months). At time 1, children were assessed seven months into the academic year, and at time 2, they were assessed three months into the next academic year. At time 2, 130 children remained in the study, which corresponds to approximately 9% attrition. However, children who left the study did not differ from those who remained in the study in all the measures at time 1 ($ps \geq .24$). In addition, Little's (1988) test indicated missingness completely at random, $\chi^2(16) = 17.80$, $p = .34$. Gender imbalance reflected enrollment status in the institute.

The sample children were from a single private institute. Kindergarten attendance in Korea is virtually the norm, albeit not mandatory (Kim, 2011). Kindergarten education is offered in public and private institutes, and kindergarten tuition is partially subsidized by the government. Data on socioeconomic status were not available from individual children, but according to the school personnel and the neighborhood, the sample children were from middle class families. Korea is highly homogeneous in terms of ethnic composition, and all the children in the present study were monolingual Korean speakers without any hearing, vision, or language impairments.

Measures

Because I wanted to examine developmental patterns of the relations among word-reading fluency, text-reading fluency, reading comprehension, and listening comprehension, these constructs were assessed at times 1 and 2. However, emergent literacy skills and language and cognitive skills were assessed only at times 1 and 2, respectively, due to time and resource constraints. That is, children's emergent literacy skills, such as phonological awareness, letter name knowledge, orthographic awareness, morphological awareness, rapid automatized naming, and vocabulary, were assessed only at time 1, and language and cognitive skills (i.e., vocabulary, grammatical knowledge, working memory, theory of mind, comprehension monitoring) were assessed only at time 2. Administration times for emergent literacy skills and language and cognitive skills were determined considering developmental progression: Emergent literacy skills were expected to be critical for fundamental reading skills (e.g., word reading) at an earlier timepoint, and language and cognitive skills were hypothesized to be important to more advanced reading skills, such as text-reading fluency and reading comprehension.

No standardized and normed assessments were available in Korean at the time of the study, and thus, measures were developed and/or adapted from previous studies with Korean-speaking children and English-speaking children. Unless otherwise noted, all the items in the tasks were scored dichotomously. All the tasks had high reliability estimates (see Table 1) except for the listening comprehension task 1 at time 2, which had a relatively low estimate (.64). However, its impact is minimized due to the use of a latent variable approach in the present study.

Skills Assessed at Times 1 and 2

Reading Comprehension

Three tasks from previous studies were employed (Kim, 2011; Kim et al., 2014). In the first two tasks, the child was asked to read short passages and answer comprehension questions about characters, events, problems, and resolutions. At time 1, two passages were 100 words (294 syllables) and 97 words (314 syllables) long with five and six comprehension questions, respectively. At time 2, two passages had 112 words (313 syllables) and 158 words (507 syllables) with six and seven comprehension questions, respectively. The last task, which was administered at both times as an oral cloze task, had been adapted from the passage comprehension subtest of the third edition of the Woodcock–Johnson Tests of Achievement (Woodcock, McGrew, & Mather, 2001). In this task, the child was asked to read sentences and short passages and provide missing words. There were three practice items and 21 test items.

Text-Reading Fluency

Three previously unseen passages were used (Kim, 2011; Kim et al., 2014). The child was asked to read each passage quickly and accurately. The three passages ranged from 279 to 362 syllables. Korean is an agglutinative language, and therefore, texts used in the present study included many inflected words. The texts ranged from one- to six-syllable words[3] with two to 16 graphemes. Children's performances were measured by the number of accurately read syllables in 40 seconds. Syllables omitted or substituted and hesitations of more than three seconds were scored as errors. Test–retest correlations were reported to be greater than .91. The number of syllables, not words, is reported in the present study because the concept of word and related spacing in Korean is different from that in English (Lee & Ramsey, 2000). Instead, the syllables count is used as the metric of text volume in Korean (Kim et al., 2014).

Word-Reading Fluency

To assess children's word-reading fluency, they were shown words in a context-free list format and asked to read words aloud quickly and accurately in three tasks. A total of 60 items in each task, ranging from 175 to 195 syllables, were randomly selected from the three passages for the text-reading fluency tasks. Therefore, the same words were used in the word-reading fluency and text-reading fluency tasks. The number of accurately read items in 40 seconds was the child's score. Note that in the text-reading fluency tasks, the number of correctly read syllables is reported, whereas in the word-reading fluency task, the number of correctly read items is reported. This is because in the word-reading fluency task, items correspond to spacing in the text-reading fluency texts. For instance, 아빠한테 (*dad* + the postpositioned *to*) was presented together as an item in the word-reading fluency task because they are not separated by a word space in connected texts, although nouns and prepositions are separated by a space and considered two separate words in English (see Lee & Ramsey, 2000, for more information about the concept of words and spacing in Korean). There were four practice items that were not from the text-reading fluency passages, and there were 60 test items.

Listening Comprehension

Two tasks were used from a previous study (Kim et al., 2014). These were originally adapted from the Listening Comprehension Scale of the Oral and Written Language Scales (Carrow-Woolfolk, 1995) and the paragraph comprehension subtest of the Comprehensive Assessment of Spoken Language (Carrow-Woolfolk, 1999). In the first task, children were asked to point to the picture that best described the heard sentences out

TABLE 1
Descriptive Statistics

Variable	Cronbach's α	Mean	Standard deviation	Minimum	Maximum	Skewness	Kurtosis
Time 1							
Text-reading fluency 1	[a]	48.22	46.78	0	211	1.09	0.75
Text-reading fluency 2	[a]	47.43	45.35	0	210	1.07	0.66
Text-reading fluency 3	[a]	51.15	48.40	0	195	1.03	0.45
Word-reading fluency 1	[a]	11.92	12.87	0	46	1.07	0.20
Word-reading fluency 2	[a]	10.42	12.77	0	51	1.46	1.44
Word-reading fluency 3	[a]	10.89	12.44	0	46	1.30	0.72
Reading comprehension 1	.84	1.69	1.84	0	5	0.56	−1.18
Reading comprehension 2	.93	3.00	2.56	0	6	−0.12	−1.76
Reading comprehension 3	.93	5.49	5.19	0	20	0.80	−0.29
Listening comprehension 1	.80	15.97	3.96	4	25	−0.23	−0.05
Listening comprehension 2	.77	11.76	3.43	3	19	−0.39	−0.35
Letter-naming fluency	.93[b]	8.13	7.41	0	36	0.94	0.94
Orthographic awareness	.81	21.31	4.80	11	30	−0.39	−0.94
Phonological awareness	.91	13.14	6.91	0	27	−0.12	−0.48
Morphological awareness	.87	8.86	4.34	0	18	−0.36	−0.72
Rapid automatized naming	.86	48.94	17.16	21	120	1.66	3.71
Expressive vocabulary	.77	19.71	4.29	11	30	0.04	−0.82
Time 2							
Text-reading fluency 1	[a]	84.67	46.88	0	198	0.25	−0.56
Text-reading fluency 2	[a]	83.09	46.77	0	214	0.50	−0.16
Text-reading fluency 3	[a]	87.37	49.97	0	195	0.48	−0.40
Word-reading fluency 1	[a]	21.45	13.63	0	54	0.37	−0.54
Word-reading fluency 2	[a]	20.29	14.03	0	59	0.63	−0.14
Word-reading fluency 3	[a]	21.08	14.68	0	58	0.54	−0.51
Reading comprehension 1	.79	2.38	1.99	0	6	0.19	−1.32
Reading comprehension 2	.81	2.25	2.11	0	7	0.52	−0.97
Reading comprehension 3	.93	9.65	5.62	0	20	−0.06	−1.03
Listening comprehension 1	.64	20.65	3.81	9	31	−0.33	0.38
Listening comprehension 2	.76	14.67	3.20	6	19	−0.57	−0.45
Theory of mind	.72	10.02	3.09	2	17	0.05	−0.56
Comprehension monitoring	.72	17.28	3.86	7	23	−0.60	−0.26
Receptive vocabulary	.79	40.38	4.85	27	48	−0.64	−0.19
Grammatical knowledge	.88	18.17	5.53	6	26	−0.57	−0.82
Working memory	.79	13.05	6.18	0	26	−0.45	−0.05

[a]See Table 2 for alternate form reliability. [b]Test–retest reliability (approximately seven days apart; $n = 50$).

of four options (i.e., four pictures). There were two practice items and 34 test items. In the second task, children were asked to identify the one picture out of four that best described the answer to the question based on the short stories they heard. There were one practice item and 19 test items.

Emergent Literacy Skills Assessed at Time 1

The emergent literacy skills in the present study have been used in previous studies, and greater details are found in those studies (e.g., nature of orthographic awareness task items; Kim, 2010, 2011).

Letter-Naming Fluency

Korean alphabet letters (a total of 40) were presented in random order in a row of eight letters in 13 rows, and the child was asked to name the letter as accurately and fast as possible. The number of correctly identified letters in 40 seconds was the score. Self-corrected names were given credit.

Phonological Awareness

A deletion task was used, in which the child was asked to delete syllables and phonemes (Kim, 2011). For instance, for the syllable deletion task, the child was asked to say /ʃige/ and delete /ʃi/ from /ʃige/ (*clock* or *watch*), and the correct answer is /ge/ (*dog* or *crab*). In the phoneme deletion task, the child was asked to say /mul/ (*water*) and say the word without /l/, which is /mu/ (*radish*). There were five practice items (three syllable items and two phoneme items) and 27 test items (15 syllable items and 12 phoneme items). As seen in Table 1, it appears that on average, children were able to perform accurately at the syllable level (mean [M] = 13.14) but with large variation around the mean (SD = 6.91).

Morphological Awareness

A compound construction task was used because in Korean, compound construction is an important morphological feature (Cho et al., 2008; Kim, 2011). In the first nine items, the child was presented with scenarios in two or three sentences and asked to create a compound noun. An example item is as follows: "When a refrigerator keeps kimchi (a Korean dish) in it, we call it a kimchi refrigerator. If a refrigerator keeps a flower in it, what we would we call it?" The correct answer is a flower refrigerator. The second nine items were presented without scenarios. There were two practice items and 18 test items.

Orthographic Awareness

An orthographic choice task was used (Kim, 2010, 2011). In this task, the child's sensitivity to several orthographic constraints in the Korean writing system was assessed. For instance, in Korean, a vertical vowel letter is only permitted on the right of the preceding consonant, not on the left. Therefore, ㅏ오 is illegal, whereas 와 is legal. There were four practice items and 30 test items.

Rapid Automatized Naming

A digit task was used (Kim, 2011). In this task, five different digits were repeated randomly 10 times in five rows. The child was asked to name all the stimuli as fast as possible. As expected, there were few errors in accuracy, and thus, the latency score was used.

Expressive Vocabulary

In this task, the child was asked to provide names of items (e.g., *airplane*), synonyms (e.g., another word for *angry*), and superordinate terms (e.g., *furniture*; Kim, 2011). Items were presented with corresponding illustrations. There were three practice items and 33 test items.

Language and Cognitive Skills Assessed at Time 2

Working Memory

The listening span task from previous studies (Cain et al., 2004; Florit, Roch, Altoè, & Levorato, 2009; Kim & Phillips, 2014) was adapted to Korean. In this task, the child was asked to identify whether the sentence they heard was correct or not (i.e., yes/no response). After hearing all the sentences (e.g., two sentences), the child was asked to identify the first words in the sentences they heard. The sentences were statements involving common knowledge (e.g., "Birds fly in the sky"). Note that listening span tasks in English and other European languages require children to identify the last word in each sentence (e.g., Cain et al., 2004; Florit et al., 2009). However, this was modified in Korean as identifying the first word in each sentence because of the subject-object-verb sentence structure in Korean. Verbs and adjectives in Korean are always inflected and tend to have the same or similar final inflections in a given context. Therefore, sentence-final words (i.e., verbs with highly similar inflections) were deemed inappropriate for the task. The first words in the task were all nouns.

There were four practice items and 15 experimental items with increasing difficulty (i.e., listening to two sentences vs. three). Children's yes/no responses regarding the veracity of the statement were not scored, but their responses on the first words in correct order were given a score of 2 per item, and responses including the first words in incorrect order was given 1 point. Therefore, a total possible maximum score was 30.

Receptive Vocabulary

A receptive vocabulary task was adapted from the fourth edition of the Peabody Picture Vocabulary Test (Dunn & Dunn, 2007). In this task, the child hears a word and is asked to identify a corresponding picture out of four options. The task included 51 items with increasing difficulty that had accompanying color illustrations. Task administration stopped after six consecutive incorrect responses.

Grammatical Knowledge

The child was asked to detect and correct grammatical errors and complete unfinished sentences. In the error detection and correction part, the child was asked to identify whether the sentence they heard was correct or incorrect, and if incorrect, the child was asked to correct the sentence. In the three practice items, the child was provided explanations. For instance, the sentence "나는 가게가 갑니다" ("I go to a store") has an incorrect postposition (the underlined part). The child was told that 가 (/ka/; postposition) is incorrect, but 에 (/e/) is correct. Twelve experimental items (nine incorrect sentences) involved grammatical markers, tenses, and postpositions. In the sentence completion items (one practice item and five test items), the child was asked to complete the sentence based on the preceding sentence heard. For example, the child heard "Minsoo, did you do homework? No, later homework…." The correct response is "(I) will do." Note that verbs come at the end of the sentence in Korean.

Altogether, there were a total of 17 experimental items in the grammatical knowledge task, but a total possible maximum score was 26 because 1 point was given per correct response for 12 grammatical error identification items, 1 point for correcting nine incorrect sentences, and 1 point for each of the five sentence completion items.

Theory of Mind

First- and second-order false-belief scenarios were employed. There were four first-order scenarios, involving locations of a cake, a drawing, a birthday gift, and the contents of a snack box adapted from a previous study (Gwon & Lee, 2012). The first three involved change-of-location stories, and the last one was an appearance-reality task (or unexpected identity) using a snack box that is highly familiar to children in Korea. One second-order false-belief scenario involved different types of bread sold in a bakery, which was adapted from a previous study with English-speaking children (Kim & Phillips, 2014). The second-order task examined the child's ability to infer a story character's mistaken belief about another character's knowledge.

In all the tasks except the snack box task, the tester presented a series of illustrations to the child and explained the context. Then, the tester asked the child a series of questions involving characters' beliefs, such as, "Where do you think Jungwoo will look for his cake?" and, "Minsoo thinks that they sell only sweet potato bread at the bakery. Why does he think that?" (see, e.g., Bartsch & Wellman, 1989; Caillies, Hody, & Calmus, 2012; Caillies & Sourn-Bissaoui, 2008, for a similar approach). There were a total of 18 items: three questions in each of the four first-order tasks and six questions in the second-order task.

Comprehension Monitoring

An inconsistency detection task was adapted from the studies of L. Baker (1984) and Cain et al. (2004). A similar adapted task has been used with English-speaking kindergartners (Kim & Phillips, 2014). In the task, the child was asked to identify whether the story made sense or not, and if the story did not make sense, the child was asked to provide a brief explanation. An example of an inconsistent item is as follows: "Minhee's favorite color is blue. She wears blue every day. Minhee has blue pants and even blue shoes. Minhee likes to have everything purple!" An example of a consistent and coherent story is as follows: "Joonsoo is 5 years old. He only likes chocolate milk. He pours cool milk into a cup every evening. Joonsoo's favorite milk is chocolate milk." There were four practice items and 15 experimental items. Feedback and explanations (e.g., meaning of "not making sense") were provided in the practice items. Consistent (seven items) and inconsistent stories (eight items) were randomly spread across items. For the eight inconsistent stories, the accuracy of children's explanations were also dichotomously scored, and thus, a total possible score was 23 (15 + 8).

Procedures

Rigorously trained research assistants assessed children individually in a quiet room in the school. Assessments were counterbalanced within each session to reduce fatigue effects. Research assistants had extensive experience with children, including language and literacy assessments. The assessment battery was typically administered in four sessions, each lasting 25–30 minutes.

Data Analysis Strategy

Confirmatory factory analysis and structural equation modeling using M*plus* version 7.1 (Muthén & Muthén, 2013) were the primary data analytic strategies. Latent variables were created for the following constructs for which multiple measures were used: word-reading fluency, text-reading fluency, listening comprehension, and reading comprehension. The latent variable approach is preferred because latent variables capture common variables among observed variables (also called indicators) and thus minimize the influence of measurement error (Bollen, 1989; Kline, 2005). However, children's emergent literacy skills and language and cognitive skills were assessed by single measures for each construct due to time and resource constraints.

The research questions were addressed by fitting structural equation models. Model fits were evaluated by using the following multiple indexes: chi-square statistics, the comparative fit index (CFI), the Tucker–Lewis index (TLI), Akaike information criterion (AIC), Bayesian information criterion (BIC), root mean square error of approximation (RMSEA), and standardized root mean square residual (SRMR). Typically, RMSEA values below 0.08, CFI and TLI values equal to or greater than 0.95, and SRMR values equal to or less than 0.05 indicate an excellent model fit (Hu & Bentler, 1999), and TLI and CFI values greater than 0.90 are considered to be acceptable (Kline, 2005). Note that given multiple hypothesis testing, I applied Benjamini–Hochberg correction for statistical significance testing (Benjamini & Hochberg, 1995). Therefore, only statistically significant paths after the Benjamini–Hochberg corrections are reported, but *p*-values associated with statistically significant paths are from the uncorrected outputs.

Results

Descriptive statistics are presented in Table 1. On average, at time 1, children were able to read 10–12 words in 40 seconds in the context-free format and approximately 48–51 syllables per 40 seconds in connected text. Forty-eight syllables were equivalent to approximately 38 words in 60 seconds using the English convention of words. At time 2, this increased to an average performance of 20 or 21 words in the context-free format and 83–87 syllables in connected text. The latter performance is similar to what was reported in a previous study with kindergartners from similar backgrounds (Kim et al., 2014) and was equivalent to approximately 63 words in 60 seconds following the English convention of words.

Children's average performances at time 2 on the reading comprehension and listening comprehension tasks were also similar to a previous study with kindergartners (Kim et al., 2014). Note, however, that at time 1, the word-reading fluency task 2 and rapid automatized naming had somewhat large skewness values. The skewness value for the rapid automatized naming was driven by a few slow namers, which stretched the tail on the right (see the Appendix for the plot). The positive skew of the word-reading task also indicates some floor effect, which is a limitation of the study. Because transformations of these measures did not make substantial changes in distribution patterns, and the skewness values were on the borderline, raw scores were used in the analysis. Note that when analysis was conducted excluding outliers in the rapid automatized naming task, results were essentially the same, and thus, results from the entire sample are reported herein.

Tables 2 and 3 show correlations among measures at times 1 and 2, respectively. Correlations between time 1 and time 2 measures are not presented due to space constraints but are available upon request. All the relations are in expected directions. Emergent literacy skills were weakly to moderately related to one another ($-.28 \le rs \le .56$; see Table 2) and moderately to relatively strongly related to literacy skills ($.41 \le rs \le .68$; see Table 2). Literacy skills were all fairly strongly to strongly related to one another ($.59 \le rs \le .96$; see Tables 2 and 3). Language and cognitive skills were weakly to fairly strongly related to reading comprehension ($.17 \le rs \le .59$; see Table 3). Language and cognitive skills were also weakly to relative strongly related to listening comprehension skills ($.17 \le rs \le .65$; see Table 3), which is similar to previous studies with children speaking English, Finnish, or Italian (Florit et al., 2009; Kim & Phillips, 2014; Lepola, Lynch, Laakkonen, Silvén, & Niemi, 2012).

Research Question 1: Developmental Relations Among Word-Reading Fluency, Listening Comprehension, Text-Reading Fluency, and Reading Comprehension

Prior to addressing the research question, confirmatory factor analysis was conducted to examine whether word-reading fluency and text-reading fluency tasks are best described as a single construct or two dissociable constructs. When the tasks were considered to capture a single construct, the model fit was poor, $\chi^2(53) = 415.82$, $p < .001$; CFI = 0.91; TLI = 0.88; RMSEA = 0.22 (90% confidence interval [CI; 0.20, 0.24]); SRMR = 0.02. In contrast, model fit for two separate constructs was excellent, $\chi^2(48) = 71.77$, $p = .02$; CFI = 0.99; TLI = 0.99; RMSEA = 0.06 (90% CI [0.03, 0.09]); SRMR = 0.007. A chi-square difference test indicated that the two-factor model was superior, $\Delta\chi^2(\Delta df = 5) = 344.05$, $p < .001$.

After establishing that word-reading fluency and text-reading fluency are best described as dissociable constructs, I examined measurement invariance at two timepoints for the model in Figure 1 following procedures of Brown (2006). First, a baseline of the noninvariance model was specified by allowing the loadings to vary completely. This model yielded good fit to the data, $\chi^2(191) = 324.09$, $p < .001$; CFI = 0.97; TLI = 0.97; RMSEA = 0.07 (90% CI [0.057, 0.083]); SRMR = 0.03. When a full invariance model

TABLE 2
Correlations Among Measures in Time 1

Measure	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1. Text-reading fluency task 1	—																
2. Text-reading fluency task 2	.98	—															
3. Text-reading fluency task 3	.97	.97	—														
4. Word-reading fluency task 1	.92	.93	.92	—													
5. Word-reading fluency task 2	.90	.92	.91	.97	—												
6. Word-reading fluency task 3	.92	.92	.92	.97	.96	—											
7. Reading comprehension task 1	.76	.76	.77	.76	.74	.77	—										
8. Reading comprehension task 2	.78	.78	.78	.76	.70	.72	.80	—									
9. Reading comprehension task 3	.87	.88	.87	.86	.85	.84	.78	.80	—								
10. Listening comprehension task 1	.40	.41	.40	.38	.36	.37	.43	.37	.48	—							
11. Listening comprehension task 2	.41	.42	.40	.42	.40	.40	.52	.43	.48	.52	—						
12. Letter-naming fluency	.59	.58	.58	.68	.65	.68	.60	.66	.65	.29	.37	—					
13. Orthographic awareness	.54	.54	.55	.50	.48	.49	.51	.59	.60	.32	.26	.41	—				
14. Phonological awareness	.59	.61	.60	.59	.57	.57	.62	.66	.62	.35	.42	.56	.50	—			
15. Morphological awareness	.42	.43	.41	.41	.35	.41	.49	.47	.48	.45	.47	.43	.33	.55	—		
16. Rapid automatized naming	−.49	−.48	−.50	−.47	−.44	−.44	−.41	−.54	−.48	−.24	−.25	−.42	−.33	−.43	−.32	—	
17. Expressive vocabulary	.56	.59	.58	.59	.56	.58	.61	.54	.66	.59	.55	.46	.46	.51	.53	−.28	—

Note. All coefficients are statistically significant at the .001 level.

was fit, it was poorer than the noninvariance model, $\Delta\chi^2(\Delta df = 11) = 248.36$, $p < .001$. After inspecting loadings in the models, a partial invariance model was fitted in the final model by allowing loading constraints of the following variables: reading comprehension task 2 and listening comprehension task 1. Loadings of indicators to latent variables are presented in Figure 1.

To address the first research question, word-reading fluency and listening comprehension were hypothesized to have direct paths to text-reading fluency as well as reading comprehension. Text-reading fluency was hypothesized to have a direct path to reading comprehension (see Figure 1). The structural equation model that examined the relations of word-reading fluency, listening comprehension, and text-reading fluency to

TABLE 3
Correlations Among Measures in Time 2

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. Text-reading fluency task 1	—															
2. Text-reading fluency task 2	.96	—														
3. Text-reading fluency task 3	.95	.96	—													
4. Word-reading fluency task 1	.93	.93	.93	—												
5. Word-reading fluency task 2	.91	.92	.92	.95	—											
6. Word-reading fluency task 3	.92	.92	.93	.95	.96	—										
7. Reading comprehension task 1	.66	.68	.65	.62	.61	.59	—									
8. Reading comprehension task 2	.74	.74	.71	.70	.67	.67	.75	—								
9. Reading comprehension task 3	.84	.84	.83	.82	.78	.78	.70	.76	—							
10. Listening comprehension task 1	.44	.46	.47	.43	.39	.41	.45	.52	.55	—						
11. Listening comprehension task 2	.45	.45	.45	.40	.39	.40	.45	.49	.51	.60	—					
12. Theory of mind	.39	.40	.40	.32	.33	.32	.47	.50	.41	.45	.57	—				
13. Comprehension monitoring	.44	.44	.42	.40	.41	.41	.41	.46	.47	.45	.65	.51	—			
14. Receptive vocabulary	.51	.51	.50	.46	.44	.44	.44	.48	.50	.58	.58	.41	.44	—		
15. Grammatical knowledge	.56	.55	.54	.53	.49	.50	.58	.57	.59	.45	.61	.42	.53	.47	—	
16. Working memory	.28	.29	.29	.24	.23	.24	.17[a]	.22	.28	.17[a]	.28	.26	.35	.19	.24	—

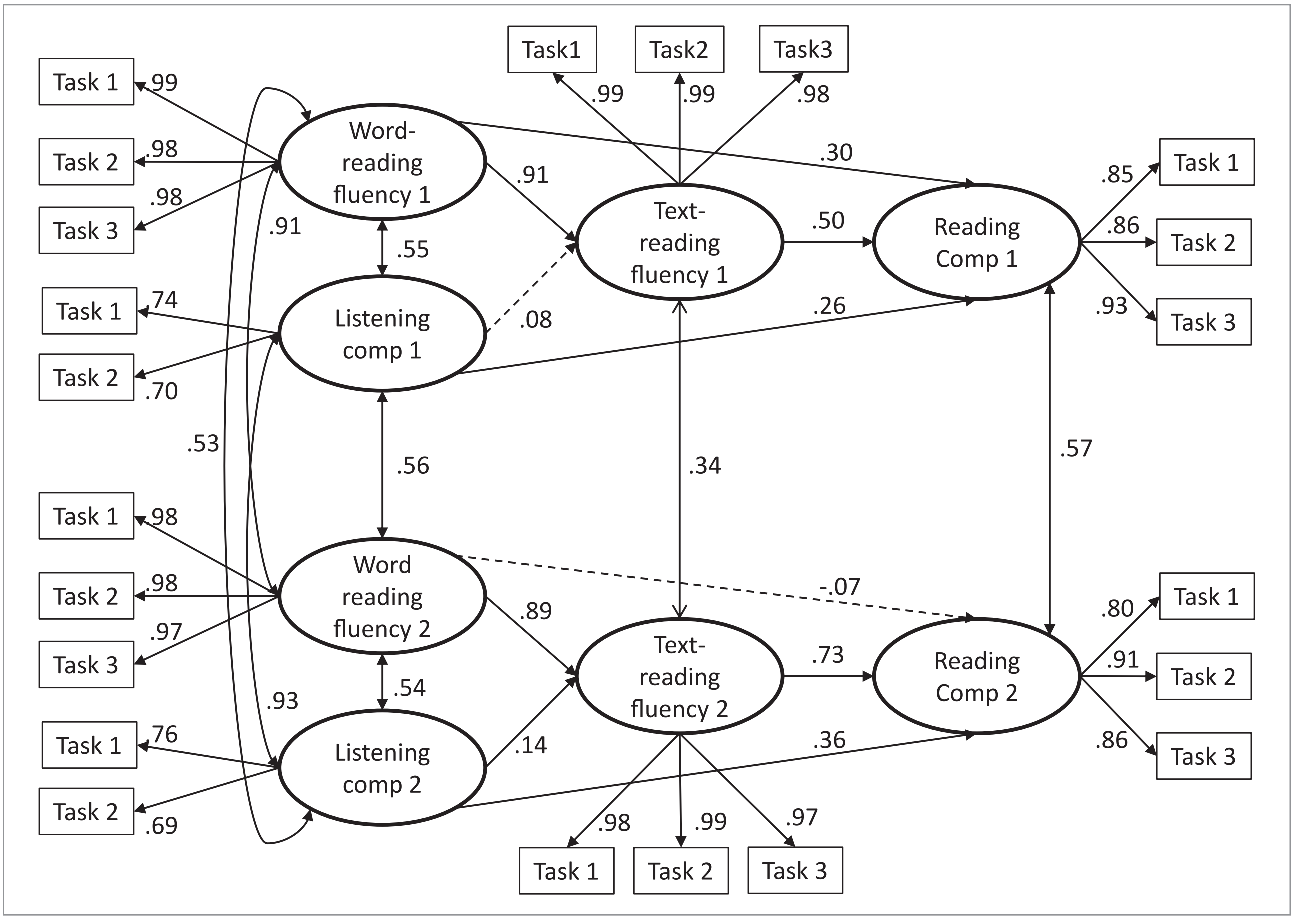
[a]All other coefficients are statistically significant at .05 except these.

reading comprehension fit the data well, $\chi^2(198) = 350.98$, $p < .001$; CFI = 0.97; TLI = 0.97; AIC = 17,197.567; BIC = 17,425.166; RMSEA = 0.074 (90% CI [0.061, 0.086]); SRMR = 0.034. Standardized coefficients are shown in Figure 1.

At both times 1 and 2, word-reading fluency was strongly related to text-reading fluency (γs = 0.91 and 0.89 for times 1 and 2, respectively, $p < .001$) after accounting for listening comprehension. Listening comprehension was weakly related to text-reading fluency and was not statistically significant at time 1 ($\gamma = 0.08$, $p = .05$) but was related to text-reading fluency at time 2 ($\gamma = 0.14$, $p < .001$) after accounting for word-reading fluency. Word-reading fluency was somewhat weakly related to reading comprehension at time 1 ($\gamma = 0.30$, $p = .01$) but not at time 2 ($\gamma = -0.07$, $p = .73$) after accounting for text-reading fluency and listening comprehension. Listening comprehension was consistently but somewhat weakly related to reading comprehension at time 1 ($\gamma = 0.26$, $p < .001$) and moderately at time 2 ($\gamma = 0.36$, $p < .001$) after accounting for word-reading fluency and text-reading fluency. Text-reading fluency was moderately related to reading comprehension at time 1 ($\beta = 0.50$, $p < .001$) and fairly strongly at time 2 ($\beta = 0.73$, $p < .001$). Total amounts of variance explained were 0.90 in text-reading fluency and 0.92 in reading comprehension at time 1 and 0.94 in text-reading fluency and 0.87 in reading comprehension at time 2.

The relation of reading comprehension to text-reading fluency was also examined using a structural equation model (see Figure 2). The model fit the data well, $\chi^2(198) = 345.36$, $p < .001$; CFI = 0.97; TLI = 0.97; AIC = 17,191.948; BIC = 17,419.547; RMSEA = 0.072

FIGURE 1
Standardized Structural Regression Weights in Which Word-Reading Fluency and Listening Comprehension Predict Text-Reading Fluency, and Word-Reading Fluency, Listening Comprehension, and Text-Reading Fluency Predict Reading Comprehension at Times 1 and 2



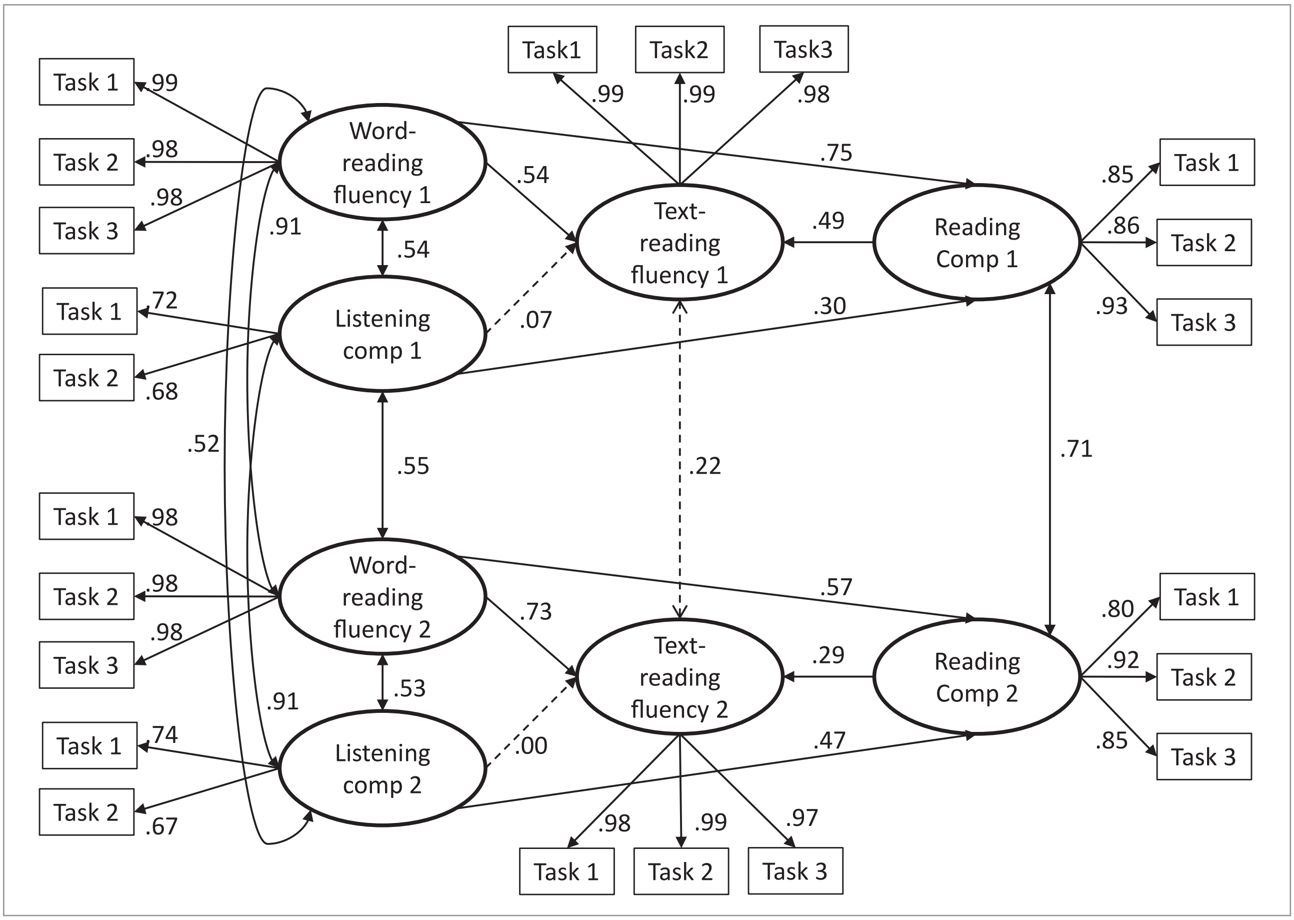
Note. Listening comp = Listening comprehension; Reading Comp = reading comprehension. Solid lines represent statistically significant relations, and dashed lines represent statistically nonsignificant relations.

(90% CI [0.060, 0.085]); SRMR = 0.033. Model fits between Figures 1 and 2 can be compared using BIC differences because these models are not nested. A BIC difference of 5.62 is considered meaningful, albeit weak, evidence (Kass & Raftery, 1995; Raftery, 1995), such that the model in Figure 2 fit the data better than the model in Figure 1. However, caution needs to be taken because ΔBIC is not large, and model fit comparison based on ΔBIC values is highly unstable (Preacher & Merkle, 2012). As shown in Figure 2, reading comprehension was independently related to text-reading fluency at time 1 ($\beta = 0.49$, $p < .001$) and time 2 ($\beta = 0.29$, $p < .001$) after accounting for word-reading fluency and listening comprehension. In contrast, listening comprehension was not independently related to text-reading fluency at time 1 ($\gamma = 0.07$, $p = .22$) and time 2 ($\gamma = 0.00$, $p = 1$) after accounting for word-reading fluency and reading comprehension. A total of 93%, 95%, 89%, and 86% of variance was explained, respectively, in text-reading fluency at time 1, text-reading fluency at time 2, reading comprehension at time 1, and reading comprehension at time 2.

Research Question 2: Relations of Emergent Skills to Word-Reading Fluency and Text-Reading Fluency

To examine whether emergent literacy skills are related to text-reading fluency over and above word-reading fluency (research question 2), I compared two alternative sets of models. In one set, word-reading fluency was hypothesized to completely mediate the relation between emergent literacy skills and text-reading fluency (full mediation model), such that emergent literacy skills are not related to text-reading fluency once word-reading fluency is accounted for. In the other set, word-reading fluency was hypothesized to partially mediate the relation between emergent literacy skills and text-reading

FIGURE 2
Standardized Structural Regression Weights in Which Word-Reading Fluency and Listening Comprehension Predict Text-Reading Fluency, and Word-Reading Fluency, Listening Comprehension, and Reading Comprehension Predict Text-Reading Fluency at Times 1 and 2



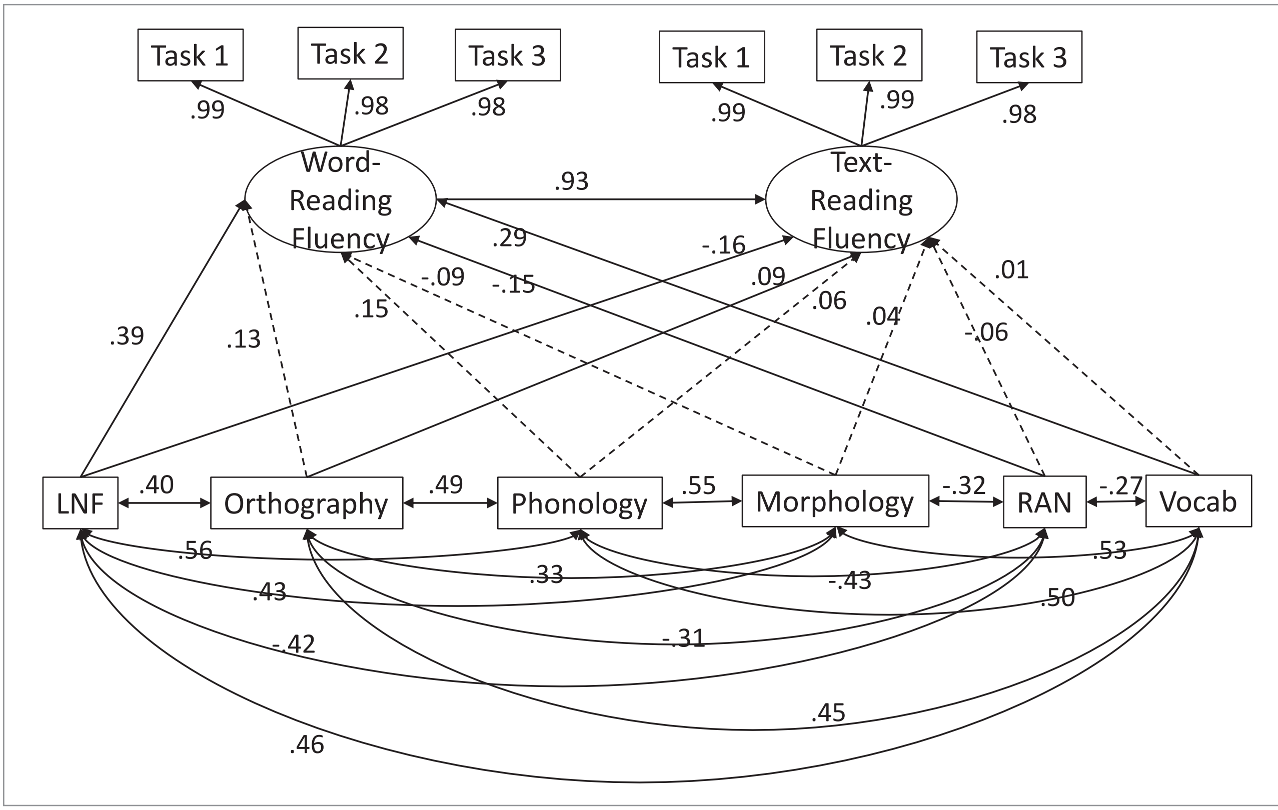
Note. Listening comp = Listening comprehension; Reading Comp = reading comprehension. Solid lines represent statistically significant relations, and dashed lines represent statistically nonsignificant relations.

fluency (partial mediation model), such that some emergent literacy skills are related to text-reading fluency after accounting for word-reading fluency. The unique relations of emergent literacy skills to text-reading fluency can be examined only if the partial mediation model fits the data better. Therefore, these alternative models were fitted to the data at time 1 as well as time 2.

Results showed that partial mediation models are superior to full mediation models for text-reading fluency at both times: $\Delta\chi^2 = 30.94$, $\Delta df = 7$, $p < .001$ for the text-reading fluency model at time 1; $\Delta\chi^2 = 24.76$, $\Delta df = 7$, $p < .001$ for the text-reading fluency model at time 2. These results indicate that emergent literacy skills are related to word-reading fluency as well as to text-reading fluency, permitting an examination of unique emergent literacy skills related to word-reading fluency versus text-reading fluency. See loadings of indicators to latent variables in Figures 3 and 4.

The structural equation model at time 1 (partial mediation model) fit the data very well, $\chi^2(32) = 48.73$, $p = .03$; CFI = 0.99; TLI = 0.99; AIC = 11,154.39; BIC = 11,325.83; RMSEA = 0.061 (90% CI [0.02, 0.093]); SRMR = 0.008. Standardized results for time 1 are shown in Figure 3. Letter-naming fluency, rapid automatized naming, and vocabulary were independently related to word-reading fluency with weak to moderate magnitudes of strength ($-0.15 \le \gamma s \le 0.39$, $ps \le .017$). For the text-reading fluency outcome, orthographic awareness was weakly but positively related to text-reading fluency ($\gamma = 0.09$, $p = .009$) after accounting for word-reading fluency. Letter-naming fluency had a negative suppression effect ($\gamma = -0.16$, $p < .001$; Tzelgov & Henik, 1991): It was positively related to text-reading fluency in bivariate correlations (see Table 2) but negatively related to the outcome after accounting for other predictors in the model. Approximately 62% and 92% of the total variance were explained in the word-reading fluency and text-reading fluency outcomes, respectively.

FIGURE 3
Standardized Structural Regression Weights for Word-Reading Fluency and Text-Reading Fluency at Time 1 Predicted by Letter-Naming Fluency, Orthographic Awareness, Phonological Awareness, Morphological Awareness, Rapid Automatized Naming, and Vocabulary



Note. LNF = letter-naming fluency; Morphology = morphological awareness; Orthography = orthographic awareness; Phonology = phonological awareness; RAN = rapid automatized naming; Vocab = vocabulary. Solid lines represent statistically significant relations, and dashed lines represent statistically nonsignificant relations.

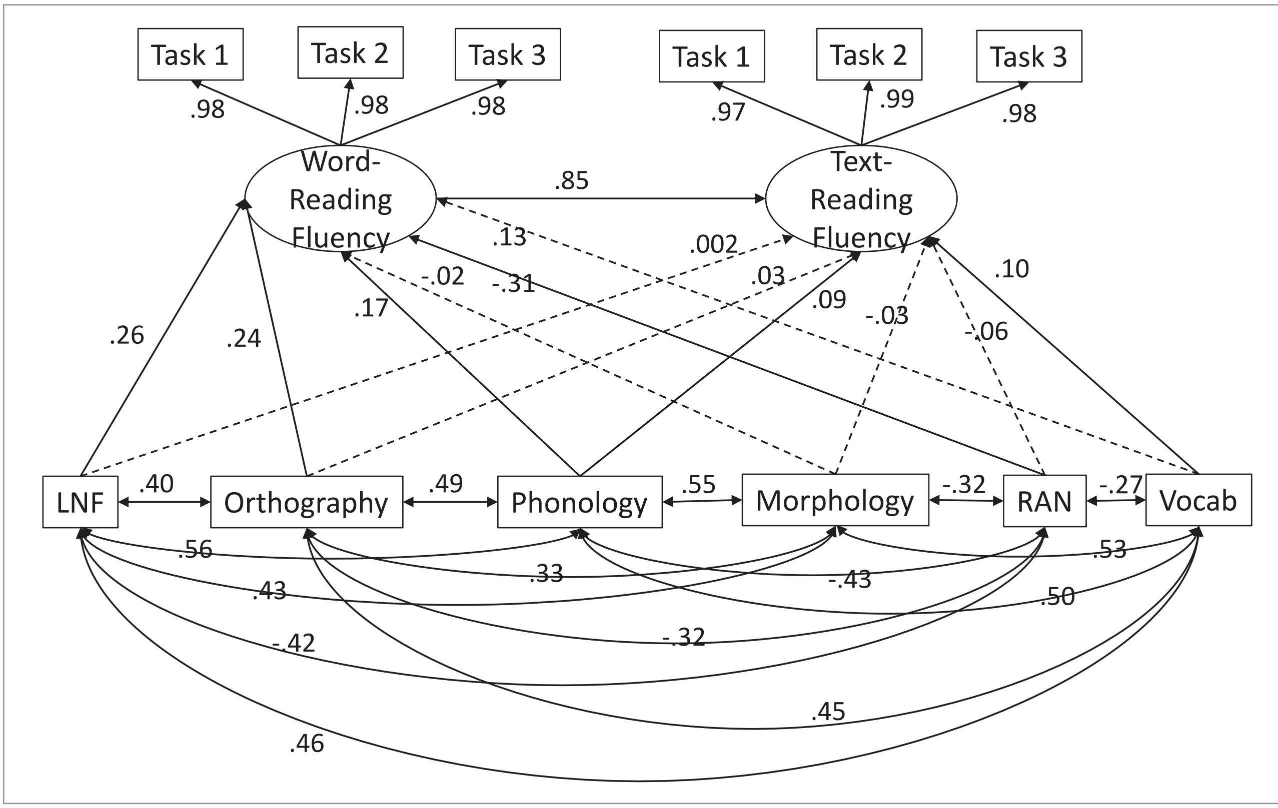
Figure 4 shows results for the word-reading fluency and text-reading fluency outcomes at time 2. Model fit was excellent, $\chi^2(32) = 38.92$, $p = .17$; CFI = 1.00; TLI = 0.99; AIC = 10,895.06; BIC = 11,066.50; RMSEA = 0.039 (90% CI [0.00, 0.077]); SRMR = 0.009. For the word-reading fluency outcome, all but morphological awareness ($p = .83$) and vocabulary ($p = .07$) were independently related to word-reading fluency. For the text-reading fluency outcome, phonological awareness ($\gamma = 0.09$, $p = .01$) and vocabulary ($\gamma = 0.10$, $p = .002$) were independently related to text-reading fluency after accounting for word-reading fluency. Approximately 64% and 95% of the total variance were explained in the word-reading fluency and text-reading fluency outcomes, respectively.

Research Question 3: Relations of Language and Cognitive Skills to Text-Reading Fluency and Reading Comprehension

To address the third research question, text-reading fluency and reading comprehension were hypothesized to be directly predicted by higher order cognitive skills (theory of mind and comprehension monitoring). In addition, the foundational language and cognitive skills (vocabulary, grammatical knowledge, and working memory) were hypothesized to be related to text-reading fluency and reading comprehension directly, and indirectly via higher order skills (see Figure 5). It was hypothesized, and evidence supports, that higher order cognitive skills are built on foundational language and cognitive skills (Davis & Pratt, 1995; Kim, 2015; Oakhill et al., 2003; Yuill, Oakhill, & Parkin, 1989). Because my primary question asked how language and cognitive skills are uniquely related to text-reading fluency versus reading comprehension, text-reading fluency and reading comprehension were allowed to covary without any directional paths between them (i.e., text-reading fluency predicting reading comprehension or vice versa).

The model had an excellent fit to the data, $\chi^2(28) = 40.26$, $p = .06$; CFI = 0.99; TLI = 0.98; AIC = 8,556.70; BIC = 8,697.21; RMSEA = 0.058 (90% CI [0.00, 0.096]); SRMR = 0.023. As shown in Figure 5, for the text-reading fluency outcome, vocabulary ($\gamma = 0.30$, $p < .001$)

FIGURE 4
Standardized Structural Regression Weights for Word-Reading Fluency and Text-Reading Fluency at Time 2 Predicted by Letter-Naming Fluency, Orthographic Awareness, Phonological Awareness, Morphological Awareness, Rapid Automatized Naming, and Vocabulary



Note. LNF = letter-naming fluency; Morphology = morphological awareness; Orthography = orthographic awareness; Phonology = phonological awareness; RAN = rapid automatized naming; Vocab = vocabulary. Solid lines represent statistically significant relations, and dashed lines represent statistically nonsignificant relations.

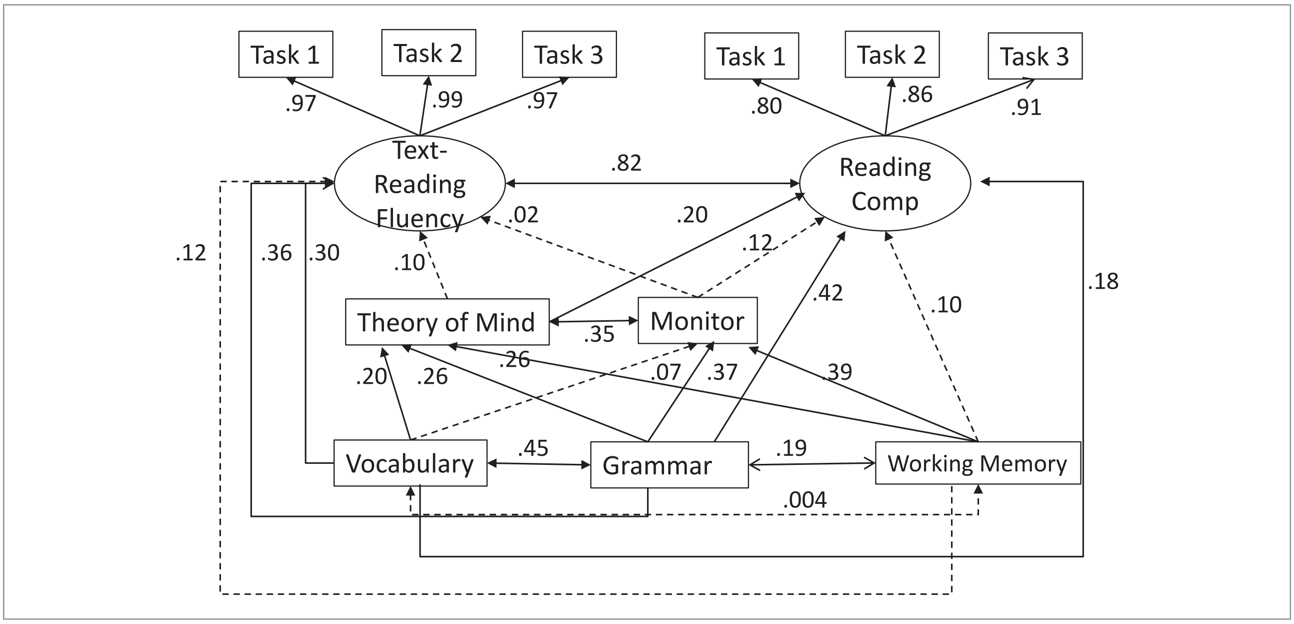
and grammatical knowledge ($\gamma = 0.36$, $p < .001$) were independently related, whereas working memory ($\gamma = 0.12$, $p = .14$), theory of mind ($\beta = 0.10$, $p = .23$), and comprehension monitoring ($\beta = 0.02$, $p = .87$) were not. For reading comprehension, vocabulary ($\gamma = 0.18$, $p = .02$), grammatical knowledge ($\gamma = 0.42$, $p < .001$), and theory of mind ($\beta = 0.20$, $p = .02$) were related, whereas working memory ($\gamma = 0.10$, $p = .20$) and comprehension monitoring ($\beta = 0.12$, $p = .19$) were not. Theory of mind was predicted by all three foundational language and cognitive skills ($0.20 \leq \gamma \leq 0.26$, ps < .025). Comprehension monitoring was predicted by grammatical knowledge ($\gamma = 0.37$, $p < .001$) and working memory ($\gamma = 0.39$, $p < .001$) but not vocabulary ($\gamma = 0.07$, $p = .37$). Approximately 42% of the total variance was explained by text-reading fluency and 55% by reading comprehension.

Discussion

The primary aim of the present study was to enhance our understanding about text-reading fluency, defined as accuracy and rate of reading connected texts, and its role in reading development. This goal was addressed in several ways by examining (a) developmental progression of the relations of word-reading fluency, listening comprehension, and text-reading fluency to reading comprehension; (b) the relation of reading comprehension to text-reading fluency; (c) emergent literacy predictors of text-reading fluency versus word-reading fluency; and (d) language and cognitive predictors of text-reading fluency versus reading comprehension.

One critical premise prior to examining these questions is that word-reading fluency and text-reading fluency are two dissociable constructs. This was supported in the present study. In conjunction with previous studies with English-speaking children (Kim et al., 2011, 2012; Kim & Wagner, 2015) and Korean-speaking children (Kim et al., 2014), the present finding indicates that word-reading fluency and text-reading fluency are separable skills. Then, what explains the difference between word-reading fluency and text-reading fluency? According to theoretical accounts, text-reading fluency captures factors that originate from context; that is, postlexical

FIGURE 5
Standardized Structural Regression Weights in a Model in Which Reading Comprehension and Text-Reading Fluency Are Predicted by Theory of Mind, Comprehension Monitoring, Vocabulary, Grammatical Knowledge, and Working Memory



Note. Grammar = grammatical knowledge; Monitor = comprehension monitoring; Reading Comp = reading comprehension. Solid lines represent statistically significant relations, and dashed lines represent statistically nonsignificant relations.

meaning processes are involved in text-reading fluency (Jenkins et al., 2003; LaBerge & Samuels, 1974; Samuels, 2006). Consistent with this hypothesis, I found that listening comprehension was related to text-reading fluency, particularly after children developed a certain level of reading proficiency. Furthermore, reading comprehension was related to text-reading fluency over and above word-reading fluency and listening comprehension at both times 1 and 2.

The present findings, in conjunction with previous studies, suggest that text comprehension is implicated in text-reading fluency (D.L. Baker et al., 2011; Hudson et al., 2012; Jenkins et al., 2003; Kim et al., 2011, 2012, 2014), and text-reading fluency and reading comprehension may have a reciprocal relation (D.L. Baker et al., 2011; Hudson et al., 2012; Jenkins et al., 2003). Text-reading fluency has been described as a bridge between word-reading fluency and reading comprehension (Kuhn et al., 2010; Pikulski & Chard, 2005; Rasinski, 2004). The present findings suggest that the bridging or mediating role of text-reading fluency is due to the fact that it captures some comprehension processes (see below for further discussion) as well as word-reading fluency. Furthermore, the bridge appears to be a two-way street, such that text-reading fluency predicts reading comprehension, and reading comprehension predicts text-reading fluency.

Interestingly, after accounting for reading comprehension, listening comprehension was not independently related to text-reading fluency, suggesting that although individual differences in listening comprehension influence text-reading fluency, the influence is largely indirect via reading comprehension, at least at this point of reading development. In contrast, reading comprehension was independently related to text-reading fluency. This might be because when children are still developing reading skills, semantic access is constrained by decoding processes (e.g., converting orthography to phonology; see Perfetti & Stafura, 2014) to a greater extent than when reading skills are more advanced. Because reading comprehension and text-reading fluency both involve decoding processes, whereas listening comprehension does not, this might explain the unique, independent relation of reading comprehension to text-reading fluency.

In contrast, at a more advanced phase of reading development, differences in meaning access in listening and reading are likely to decrease. This speculation is supported by the trend of a stronger magnitude of the relation between reading comprehension and text-reading fluency at time 1 ($\beta = 0.49$) than at time 2 ($\beta = 0.29$). Furthermore, the relation of listening comprehension to reading comprehension becomes stronger as children develop their reading skills (Adlof et al., 2006; Gernsbacher, Varner, & Faust, 1990; Kim & Wagner, 2015). In fact, extremely strong relations (greater than .90) have been observed for children in grade 8 (Adlof et al., 2006) and college students (Gernsbacher et al., 1990).

It is striking that the pattern of relations found in Figure 1 is highly similar to findings from a longitudinal study with English-speaking children: The independent contribution of listening comprehension to text-reading fluency after accounting for word-reading fluency was found at a later phase of reading development (advanced first graders and typically developing second graders) but not at an early phase (average first graders; Kim et al., 2011, 2012). A highly similar pattern found for English-speaking children and Korean-speaking children suggests that this developmental progression of relations might be similar in languages with varying depth of orthography. However, cautions need to be taken due to age differences between previous studies with English-speaking children and the present study. English-speaking children in previous studies were older (i.e., first and second graders) and, therefore, are likely to be more advanced in language and cognitive skills.

As noted earlier, age differences in previous studies with English-speaking children and Korean-speaking children are primarily due to differences in educational context and transparency of orthography. English-speaking children are not typically expected to have developed sufficient reading in connected texts until first grade, whereas children in Korea are expected to have developed sufficient foundational reading skills prior to first grade. Therefore, studying first and second graders in Korea would entail missing an important window of time when foundational word reading, text-reading fluency, and reading comprehension skills are acquired. Furthermore, evidence indicates that orthographic depth, not age, is likely to be the main factor contributing to differences in word-reading acquisition in various languages (Seymour et al., 2003; also see Ellis et al., 2004). Taking these findings together, it appears that despite potential differences in the level of language and cognitive skills between English-speaking children and Korean-speaking children in these studies, overall covariance (or correlational) patterns in the relations among listening comprehension, word-reading fluency, and text-reading fluency are similar in English and Korean.

When it comes to the relations of word-reading fluency, text-reading fluency, and listening comprehension to reading comprehension, at an earlier phase of reading development, both word-reading fluency and text-reading fluency were independently related to reading comprehension after accounting for listening comprehension. At a later phase, only text-reading fluency, not word-reading fluency, was independently related to reading comprehension. A very similar developmental progression was found for children learning to read in English (Jenkins et al., 2003; Kim et al., 2012). These findings suggest that text-reading fluency, although highly related to word-reading fluency, makes an independent contribution over and above word-reading fluency and listening comprehension. Therefore, the relation of text-reading fluency to reading comprehension is not static but changes over time, and the pattern of changing relations is similar in languages with varying orthographic depths. However, again, studies with English-speaking children were conducted with older children. Therefore, replications are needed with children learning to read in languages with transparent orthographies where word-reading acquisition occurs at a later age than in Korean-speaking children due to later introduction of literacy instruction (e.g., German; see Seymour et al., 2003).

Another way to expand our understanding about text-reading fluency is to investigate what differentiates it from word-reading fluency and from reading comprehension. For the former, I investigated the relations of emergent literacy skills to word-reading fluency versus text-reading fluency at two developmental timepoints. At an earlier timepoint, letter-naming fluency, rapid automatized naming, and vocabulary were uniquely related to word-reading fluency. For text-reading fluency, orthographic awareness made an independent contribution after accounting for its contribution to word-reading fluency and the contribution of word-reading fluency to text-reading fluency (see Figure 3). This is convergent with a finding from a study with English-speaking children by Barker et al. (1992) and suggests that children's ability to process words in chunks is particularly facilitative in connected text reading. At a more advanced phase, vocabulary and phonological awareness made independent contributions to text-reading fluency (see Figure 4). The finding that vocabulary was uniquely related to text-reading fluency at a later phase (time 2) is in line with the fact that children were able to utilize comprehension processes in text-reading fluency at that point of reading development (Kim et al., 2011, 2012, 2014).

To tease out comprehension processes involved in text-reading fluency and reading comprehension, I examined how language and cognitive skills are related to text-reading fluency versus reading comprehension. Based on the two-process theoretical account of information processing (Perfetti, 1985; Posner & Snyder, 1975), I hypothesized that automatic processes related to the semantic network, such as vocabulary and grammatical knowledge, would be related to text-reading fluency, whereas slow-acting, attention-requiring, higher order processes such as theory of mind and comprehension monitoring would be related to reading comprehension. Grammatical knowledge was also hypothesized to uniquely relate to reading comprehension (Cain, 2007; Perfetti & Stafura, 2014).

Results in the present study largely support these hypotheses. Vocabulary and grammatical knowledge were independently related to text-reading fluency and reading comprehension, whereas theory of mind was independently related to reading comprehension. The contributions of vocabulary and grammatical knowledge to text-reading fluency suggest that automatic lexical access and semantic encoding are indeed involved in fast reading of words in connected text (i.e., text-reading fluency). The roles of vocabulary and grammatical knowledge in reading comprehension are in line with previous studies (Cain, 2007; Cain et al., 2004; O'Connor, Swanson, & Geraghty, 2010; Quinn, Wagner, Petscher, & Lopez, 2015; Tunmer & Chapman, 2012) and with the hypothesis that lexical quality, including morphosyntactic processes, is involved in the construction and integration of propositions (Perfetti, 2007; Perfetti & Stafura, 2014).

When it comes to the relation of higher order cognitive processes (comprehension monitoring and theory of mind) to reading comprehension, my hypothesis was partially supported, in that theory of mind was independently related to reading comprehension, but comprehension monitoring was not. Integration processes needed for the situation model require reasoning and inference making, which is resource (attention) demanding and thus would not be used in text-reading fluency but in reading comprehension. These results are in line with previous studies that have shown the role of theory of mind in text comprehension (e.g., Kim, 2015; Kim & Phillips, 2014; Pelletier, 2006; cf. Strasser & del Río, 2014). In contrast to theory of mind, comprehension monitoring was not independently related to reading comprehension when controlling for the other variables in the model.

These results are divergent from previous studies (e.g., Cain et al., 2004). However, these results cannot be directly compared with those of previous studies. In particular, language and cognitive predictors taken into consideration in statistical models are different. For instance, in Cain et al.'s (2004) study, comprehension monitoring was independently related to reading comprehension after accounting for word reading, vocabulary, and verbal IQ. In comparison, in the present study, three foundational language and cognitive skills (vocabulary, grammatical knowledge, and working memory) and a higher order skill (theory of mind) were accounted for in the model. Future replications are warranted to illuminate the precise role of comprehension monitoring in reading comprehension in the context of other higher order skills.

Limitations, Future Directions, and Conclusion

Several weaknesses are worth noting. First, there were slight floor effects in reading tasks at time 1, which would have limited variance in these variables to some extent. Second, the sample size, particularly at time 2, was relatively small (N = 130). Post hoc power analysis revealed that to detect a small effect size of .10 for the given design of the present study, a minimum sample size is 138. Third, due to time and resource constraints, emergent literacy skills and language and cognitive skills were assessed with single measures, and therefore latent variables were not used for these constructs. In addition, due to a lack of standardized and normed measures in the target skills of the present study, measures used in the study were experimental, although many were used in previous studies. This limits external validity of the findings.

The correlational nature of the present study limits inferences related to practical implications. However, in conjunction with previous studies, the present findings suggest that instructional attention to listening comprehension would benefit not only reading comprehension but also text-reading fluency. That is, the independent relation of listening comprehension to text-reading fluency suggests that listening comprehension makes a contribution to the accuracy and rate of connected text reading over and above word-reading fluency. Several approaches have been shown to be effective in improving oral language, including effective read-alouds (e.g., book reading) and vocabulary instruction (Coyne et al., 2010; Silverman, 2007; Whitehurst et al., 1994). In addition, converging with previous studies, attention to emergent literacy skills would facilitate children's word-reading fluency. In particular, however, instruction on orthographic awareness—letter patterns and multiletter units (e.g., graphemes, phonograms)—should be considered as part of text-reading fluency instruction, particularly during an earlier phase of reading development.

Despite these limitations, I believe that the findings of the present study revealed and supported several important theoretical hypotheses about text-reading fluency: how it is differentially related to reading comprehension over time and how it is different from word-reading fluency as well as reading comprehension in terms of component skills. Overall, these results suggest that text-reading fluency (efficiency or automaticity) is an important construct in reading development.

NOTES

The work reported in the present study was supported by grants from the National Research Foundation of Korea (2013S1A3A2054928), the Institute of Education Sciences of the U.S. Department of Education (R305A120147), and the National Institute of Child Health and Human Development (P50 HD052120). The views expressed herein are those of the author and have not been reviewed or approved by the granting agencies.

[1] Note that *automaticity* and *efficiency* are not equivalent, as the former refers to effortlessness, whereas the latter refers to accuracy and speed (see Stanovich, 1980).

[2] The term *emergent literacy skills* is used broadly in the present study to refer to sublexical skills such as phonological awareness, orthographic awareness, and letter naming, as well as vocabulary.

[3] In an agglutinative language such as Korean, words are formed by joining morphemes together. For instance, a six-syllable word used in the text-reading fluency task, 부탁드려야겠다, is composed of several morphemes (a main verb, a future tense, and an auxiliary verb denoting one's intention). Different morphemes or inflections are not separated by spaces in Korean. Many root words in Korean are two and three syllables long (Kim, 2007).

REFERENCES

Adams, M.J. (1990). *Beginning to read: Thinking and learning about print*. Cambridge, MA: MIT Press.

Adlof, S.M., Catts, H.W., & Little, T.D. (2006). Should the simple view of reading include a fluency component? *Reading and Writing*, *19*(9), 933–958. doi:10.1007/s11145-006-9024-z

Apel, K., & Apel, L. (2011). What is orthographic knowledge? *Language, Speech, and Hearing Services in Schools*, *42*(4), 592–603. doi:10.1044/0161-1461(2011/10-0085)

Baker, D.L., Stoolmiller, M., Good, R.H., & Baker, S.K. (2011). Effects of reading comprehension on passage fluency in Spanish and English for second-grade English learners. *School Psychology Review*, *40*(3), 331–351.

Baker, L. (1984). Children's effective use of multiple standards for evaluating their comprehension. *Journal of Educational Psychology*, *76*(4), 588–597.

Barker, T.A., Torgesen, J.K., & Wagner, R.K. (1992). The role of orthographic processing skills on five different reading tasks. *Reading Research Quarterly*, *27*(4), 334–345. doi:10.2307/747673

Baron-Cohen, S., Tager-Flusberg, H., & Cohen, D. (Eds.) (1994). *Understanding other minds: Perspectives from autism*. New York, NY: Oxford University Press.

Bartsch, K., & Wellman, H.M. (1989). Young children's attribution of action to beliefs and desires. *Child Development*, *60*(4), 946–964. doi:10.2307/1131035

Benjamini, Y., & Hochberg, Y. (1995). Controlling the false recovery rate: A practical and powerful approach to multiple testing. *Journal of the Royal Statistical Society: Series B (Methodological)*, *57*(1), 289–300.

Bollen, K.A. (1989). *Structural equations with latent variables*. New York, NY: John Wiley & Sons. doi:10.1002/9781118619179

Brown, T.A. (2006). *Confirmatory factor analysis for applied research*. New York, NY: Guilford.

Caillies, S., Hody, A., & Calmus, A. (2012). Theory of mind and irony comprehension in children with cerebral palsy. *Research in Developmental Disabilities*, *33*(5), 1380–1388. doi:10.1016/j.ridd.2012.03.012

Caillies, S., & Sourn-Bissaoui, S.L. (2008). Chidren's understanding of idioms and theory of mind development. *Developmental Science*, *11*(5), 703–711. doi:10.1111/j.1467-7687.2008.00720.x

Cain, K. (2007). Grammatical awareness and reading ability: Is there any evidence for a special relationship? *Applied Psycholinguistics*, *28*(4), 679–694. doi:10.1017/S0142716407070361

Cain, K., Oakhill, J., & Bryant, P. (2004). Children's reading comprehension ability: Concurrent prediction by working memory, verbal ability, and component skills. *Journal of Educational Psychology*, *96*(1), 31–42. doi:10.1037/0022-0663.96.1.31

Carrow-Woolfolk, E. (1995). *Oral and Written Language Scales*. Bloomington, MN: Pearson Assessment.

Carrow-Woolfolk, E. (1999). *Comprehensive Assessment of Spoken Language*. Bloomington, MN: Pearson Assessment.

Catts, H.W., Adlof, S., & Ellis Weismer, S. (2006). Language deficits in poor comprehenders: A case for the simple view of reading. *Journal of Speech, Language, and Hearing Research*, *49*(2), 278–293. doi:10.1044/1092-4388(2006/023)

Chall, J.S. (1983). *Stages of reading development*. New York, NY: McGraw-Hill.

Cho, J.-R. (2009). Syllable and letter knowledge in early Korean Hangul reading. *Journal of Educational Psychology*, *101*(4), 938–947. doi:10.1037/a0016212

Cho, J.-R., & McBride-Chang, C. (2005). Correlates of Korean Hangul acquisition among kindergartners and second graders. *Scientific Studies of Reading*, *9*(1), 3–16. doi:10.1207/s1532799xssr0901_2

Cho, J.-R., McBride-Chang, C., & Park, S.-G. (2008). Phonological awareness and morphological awareness: Differential associations to regular and irregular word recognition in early Korean Hangul readers. *Reading and Writing*, *21*(3), 255–274. doi:10.1007/s11145-007-9072-z

Compton, D.L., DeFries, J.C., & Olson, R.K. (2001). Are RAN and phonological awareness deficits additive in children with reading disabilities? *Dyslexia*, *7*(3), 125–149. doi:10.1002/dys.198

Coyne, M.D., McCoach, D.B., Loftus, S., Zipoli, R., Ruby, M., Crevecoeur, Y.C., & Kapp, S. (2010). Vocabulary instruction in kindergarten: Investigating transfer effects. *Journal of Research on Educational Effectiveness*, *3*(2), 93–120. doi:10.1080/19345741003592410

Daane, M.C., Campbell, J.R., Grigg, W.S., Goodman, M.J., & Oranje, A. (2005). *Fourth-grade students reading aloud: NAEP 2002 special study of oral reading* (NCES 2006-469). Washington, DC: National Center for Education Statistics, Institute of Education Sciences, U.S. Department of Education.

Davis, H.L., & Pratt, C. (1995). The development of children's theory of mind: The working memory explanation. *Australian Journal of Psychology*, *47*(1), 25–31. doi:10.1080/00049539508258765

de Villiers, J.G. (2000). Language and theory of mind: What are the developmental relationships? In S. Baron-Cohen, H. Tager-Flusberg, & D. Cohen (Eds.), *Understanding other minds: Perspectives from developmental cognitive neuroscience* (2nd ed., pp. 83–123). New York, NY: Oxford University Press.

de Villiers, J.G., & Pyers, J.E. (2002). Complements to cognition: A longitudinal study of the relationship between complex syntax and false-belief-understanding. *Cognitive Development*, *17*(1), 1037–1060. doi:10.1016/S0885-2014(02)00073-4

Dunn, L.M., & Dunn, D.M. (2007). *Peabody Picture Vocabulary Test* (4th ed.). Bloomington, MN: Pearson.

Ehri, L.C. (2002). Phases of acquisition in learning to read words and implications for teaching. *British Journal of Educational Psychology: Monograph Series*, *II*, 7–28.

Ellis, N.C., Natsume, M., Stavropoulou, K., Hoxhallari, L., van Daal, V.H.P., Polyzoe, N., … Petalas, M. (2004). The effects of orthographic depth on learning to read alphabetic, syllabic, and logographic scripts. *Reading Research Quarterly*, *39*(4), 438–468. doi:10.1598/RRQ.39.4.5

Florit, E., Roch, M., Altoè, G., & Levorato, M.C. (2009). Listening comprehension in preschoolers: The role of memory. *British Journal of Developmental Psychology*, *27*(4), 935–951. doi:10.1348/026151008X397189

Florit, E., Roch, M., & Levorato, M.C. (2013). The relationship between listening comprehension of text and sentences in preschoolers: Specific or mediated by lower or higher level components? *Applied Psycholinguistics*, *34*(2), 395–415. doi:10.1017/S0142716411000749

Frost, R., Katz, L., & Bentin, S. (1987). Strategies for visual word recognition and orthographical depth: A multilingual comparison. *Journal of Experimental Psychology: Human Perception and Performance*, *13*(1), 104–115. doi:10.1037/0096-1523.13.1.104

Fuchs, L.S., Fuchs, D., Hosp, M.K., & Jenkins, J.R. (2001). Oral reading fluency as an indicator of reading competence: A theoretical, empirical, and historical analysis. *Scientific Studies of Reading*, *5*(3), 239–256. doi:10.1207/S1532799XSSR0503_3

Gernsbacher, M.A., Varner, K.R., & Faust, M.E. (1990). Investigating differences in general comprehension skill. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *16*(3), 430–445.

Graesser, A.C., Singer, M., & Trabasso, T. (1994). Constructing inferences during narrative text comprehension. *Psychological Review*, *101*(3), 371–395. doi:10.1037/0033-295X.101.3.371

Gwon, E.-Y., & Lee, H.-J. (2012). Children's development of lying, false belief and executive function. *The Korean Journal of Developmental Psychology*, *25*, 165–184.

Hohenstein, S., Laubrock, J., & Kliegl, R. (2010). Semantic preview benefit in eye movements during reading: A parafoveal fast-priming study. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *36*(5), 1150–1170. doi:10.1037/a0020233

Hoover, W.A., & Gough, P.B. (1990). The simple view of reading. *Reading and Writing*, *2*(2), 127–160.

Hu, L.-T., & Bentler, P.M. (1999). Cutoff criteria for fit indices in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling*, *6*(1), 1–55. doi:10.1080/10705519909540118

Hudson, R.F., Torgesen, J.K., Lane, H.B., & Turner, S.J. (2012). Relations among reading skills and sub-skills and text-level reading proficiency in developing readers. *Reading and Writing*, *25*(2), 483–507. doi:10.1007/s11145-010-9283-6

Jenkins, J.R., Fuchs, L.S., van den Broek, P., Espin, C., & Deno, S.L. (2003). Sources of individual differences in reading comprehension and reading fluency. *Journal of Educational Psychology*, *95*(4), 719–729. doi:10.1037/0022-0663.95.4.719

Johnston, J.R., Miller, J., & Tallal, P. (2001). Use of cognitive state predicates by language-impaired children. *International Journal of Language and Communication Disorders*, *36*(3), 349–370.

Joshi, R.M., Tao, S., Aaron, P.G., & Quiroz, B. (2012). Cognitive component of componential model of reading applied to different orthographies. *Journal of Learning Disabilities*, *45*(5), 480–486. doi:10.1177/0022219411432690

Kass, R.E., & Raftery, A.E. (1995). Bayes factors. *Journal of the American Statistical Association*, *90*(430), 773–795. doi:10.1080/01621459.1995.10476572

Kim, Y.-S. (2007). Phonological awareness and literacy skills in Korean: An examination of the unique role of body-coda units. *Applied Psycholinguistics*, *28*(1), 69–94. doi:10.1017/S014271640707004X

Kim, Y.-S. (2010). Componential skills in early spelling development in Korean. *Scientific Studies of Reading*, *14*(2), 137–158.

Kim, Y.-S. (2011). Considering linguistic and orthographic features in early literacy acquisition: Evidence from Korean. *Contemporary Educational Psychology*, *36*(3), 177–189. doi:10.1016/j.cedpsych.2010.06.003

Kim, Y.-S. (2015). Language and cognitive predictors of text comprehension: Evidence from multivariate analysis. *Child Development*, *86*(1), 128–144. doi:10.1111/cdev.12293

Kim, Y.-S., Park, C., & Wagner, R.K. (2014). Is oral/text reading fluency a "bridge" to reading comprehension? *Reading and Writing*, *27*(1), 79–99. doi:10.1007/s11145-013-9434-7

Kim, Y.-S., & Phillips, B. (2014). Cognitive correlates of listening comprehension. *Reading Research Quarterly*, *49*(3), 269–281.

Kim, Y.-S.G., & Wagner, R.K. (2015). Text (oral) reading fluency as a construct in reading development: An investigation of its mediating role for children from grades 1 to 4. *Scientific Studies of Reading*. Advance online publication. doi:10.1080/10888438.2015.1007375

Kim, Y.-S., Wagner, R.K., & Foster, E. (2011). Relations among oral reading fluency, silent reading fluency, and reading comprehension: A latent variable study of first-grade readers. *Scientific Studies of Reading*, *15*(4), 338–362. doi:10.1080/10888438.2010.493964

Kim, Y.-S., Wagner, R.K., & Lopez, D. (2012). Developmental relations between reading fluency and reading comprehension: A longitudinal study from grade 1 to grade 2. *Journal of Experimental Child Psychology*, *113*(1), 93–111. doi:10.1016/j.jecp.2012.03.002

Kintsch, W. (1988). The use of knowledge in discourse processing: A construction–integration model. *Psychological Review*, *95*(2), 163–182. doi:10.1037/0033-295X.95.2.163

Klauda, S.L., & Guthrie, J.T. (2008). Relationships of three components of reading fluency to reading comprehension. *Journal of Educational Psychology*, *100*(2), 310–321. doi:10.1037/0022-0663.100.2.310

Kline, R.B. (2005). *Principles and practice of structural equation modeling* (2nd ed.). New York, NY: Guilford.

Kuhn, M.R., Schwanenflugel, P.J., & Meisinger, E.B. (2010). Aligning theory and assessment of reading fluency: Automaticity, prosody, and definitions of fluency. *Reading Research Quarterly*, *45*(2), 230–251. doi:10.1598/RRQ.45.2.4

Kuhn, M.R., & Stahl, S.A. (2003). Fluency: A review of developmental and remedial practices. *Journal of Educational Psychology*, *95*(1), 3–21. doi:10.1037/0022-0663.95.1.3

LaBerge, D., & Samuels, S.J. (1974). Toward a theory of automatic information processing in reading. *Cognitive Psychology*, *6*(2), 293–323. doi:10.1016/0010-0285(74)90015-2

Lee, I., & Ramsey, R. (2000). *The Korean language*. Albany: State University of New York Press.

Lepola, J., Lynch, J., Laakkonen, E., Silvén, M., & Niemi, P. (2012). The role of inference making and other language skills in the development of narrative listening comprehension in 4–6-year-old children. *Reading Research Quarterly*, *47*(3), 259–282.

Little, R.J.A. (1988). A test of missing completely at random for multivariate data with missing values. *Journal of the American Statistical Association*, *83*(404), 1198–1202. doi:10.1080/01621459.1988.10478722

Mancilla-Martinez, J., Kieffer, M.J., Biancarosa, G., Christodoulou, J., & Snow, C.E. (2011). Investigating English reading comprehension growth in adolescent language minority learners: Some insights from the simple view. *Reading and Writing*, *24*(3), 339–354. doi:10.1007/s11145-009-9215-5

Muthén, L.K., & Muthén, B.O. (2013). *Mplus 7.1*. Los Angeles, CA: Muthén and Muthén.

Nathan, R.G., & Stanovich, K.E. (1991). The causes and consequences of differences in reading fluency. *Theory Into Practice*, *30*(3), 176–184. doi:10.1080/00405849109543498

Nation, K., & Snowling, M.J. (1998). Individual differences in contextual facilitation: Evidence from dyslexia and poor reading comprehension. *Child Development*, *69*(4), 996–1011. doi:10.1111/j.1467-8624.1998.tb06157.x

National Institute of Child Health and Human Development. (2000). *Report of the National Reading Panel. Teaching children to read: An evidence-based assessment of the scientific research literature on reading and its implications for reading instruction* (NIH Publication No. 00-4769). Washington, DC: U.S. Government Printing Office.

Oakhill, J.V., Cain, K., & Bryant, P.E. (2003). The dissociation of word reading and text comprehension: Evidence from component skills. *Language and Cognitive Processes*, *18*(4), 443–468. doi:10.1080/01690960344000008

O'Connor, R.E., Swanson, H.L., & Geraghty, C. (2010). Improvement in reading rate under independent and difficult text levels: Influences on word and comprehension skills. *Journal of Educational Psychology*, *102*(1), 1–19. doi:10.1037/a0017488

Ouellette, G.P. (2006). What's meaning got to do with it: The role of vocabulary in word reading and reading comprehension. *Journal of Educational Psychology*, *98*(3), 554–566. doi:10.1037/0022-0663.98.3.554

Pelletier, J. (2006). Relations among theory of mind, metacognitive language, reading skills and story comprehension in L1 and L2 learners. In A. Antonietti, O. Liverta-Sempio, & A. Marchetti (Eds.), *Theory of mind and language in developmental contexts* (pp. 77–92). New York, NY: Springer. doi:10.1007/0-387-24997-4_4

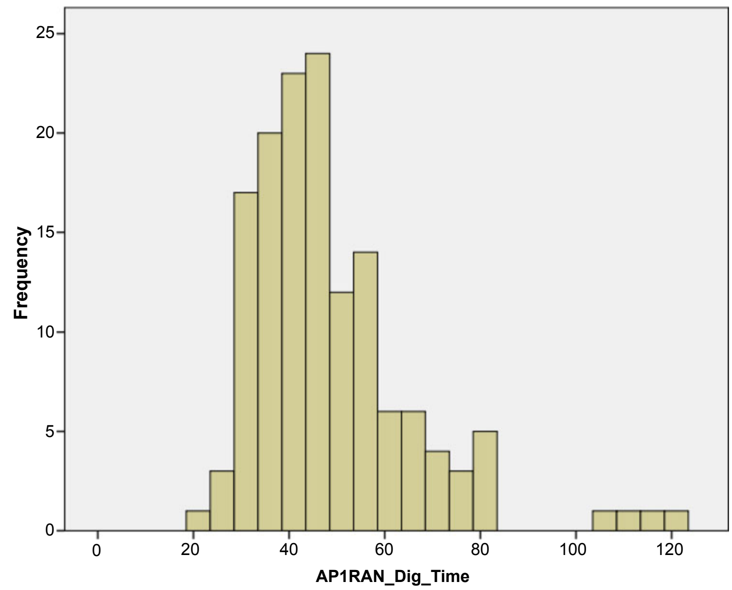
Perfetti, C.A. (1985). *Reading ability*. New York, NY: Oxford University Press.
Perfetti, C.A. (1999). Comprehending written language: A blueprint of the reader. In C. Brown & P. Hagoort (Eds.), *The neurocognition of language* (pp. 167–208). New York, NY: Oxford University Press.
Perfetti, C.A. (2007). Reading ability: Lexical quality to comprehension. *Scientific Studies of Reading*, *11*(4), 357–383. doi:10.1080/10888430701530730
Perfetti, C.A., Landi, N., & Oakhill, J. (2007). The acquisition of reading comprehension skill. In M.J. Snowling & C. Hulme (Eds.), *The science of reading: A handbook* (pp. 227–247). Malden, MA: Blackwell.
Perfetti, C.A., & Stafura, J. (2014). Word knowledge in a theory of reading comprehension. *Scientific Studies of Reading*, *18*(1), 22–37. doi:10.1080/10888438.2013.827687
Pikulski, J.J., & Chard, D.J. (2005). Bridge between decoding and reading comprehension. *The Reading Teacher*, *58*(6), 510–519. doi:10.1598/RT.58.6.2
Plummer, P., & Rayner, K. (2012). Effects of parafoveal word length and orthographic features in initial fixation positions in reading. *Attention, Perception, & Psychophysics*, *74*(5), 950–963. doi:10.3758/s13414-012-0286-z
Posner, M.I., & Snyder, C.R.R. (1975). Attention and cognitive control. In R.L. Solo (Ed.), *Information processing and cognition: The Loyola symposium* (pp. 55–85). Hillsdale, NJ: Erlbaum.
Preacher, K.J., & Merkle, E.C. (2012). The problem of model selection uncertainty in structural equation modeling. *Psychological Methods*, *17*(1), 1–14. doi:10.1037/a0026804
Quinn, J.M., Wagner, R.K., Petscher, Y., & Lopez, D. (2015). Developmental relations between vocabulary knowledge and reading comprehension: A latent change score modeling study. *Child Development*, *86*(1), 159–175. doi:10.1111/cdev.12292
Raftery, A.E. (1995). Bayesian model selection in social research. *Sociological Methodology*, *25*, 111–163. doi:10.2307/271063
Rasinski, T. (2004). Creating fluent readers. *Educational Leadership*, *61*(6), 46–51.
Rayner, K., Pollatsek, A., Ashby, J., & Clifton, C., Jr. (2012). *The psychology of reading* (2nd ed.). New York, NY: Psychology.
Ricketts, J., Nation, K., & Bishop, D.V.M. (2007). Vocabulary is important for some but not all reading skills. *Scientific Studies of Reading*, *11*(3), 235–257. doi:10.1080/10888430701344306
Riedel, B.W. (2007). The relation between DIBELS, reading comprehension, and vocabulary in urban first-grade students. *Reading Research Quarterly*, *42*(4), 546–567. doi:10.1598/RRQ.42.4.5
Roehrig, A.D., Petscher, Y., Nettles, S.M., Hudson, R.F., & Torgesen, J.K. (2008). Not just speed reading: Accuracy of the DIBELS oral reading fluency measure for predicting high-stakes third grade reading comprehension outcomes. *Journal of School Psychology*, *46*(3), 343–366. doi:10.1016/j.jsp.2007.06.006
Samuels, S.J. (2006). Toward a model of reading fluency. In S.J. Samuels & A.E. Farstrup (Eds.), *What research has to say about fluency instruction* (pp. 24–46). Newark, DE: International Reading Association.
Savage, R. (2006). Reading comprehension is not always the product of nonsense word decoding and linguistic comprehension: Evidence from teenagers who are extremely poor readers. *Scientific Studies of Reading*, *10*(2), 143–164. doi:10.1207/s1532799xssr1002_2
Schatschneider, C., Fletcher, J.M., Francis, D.J., Carlson, C., & Foorman, B.R. (2004). Kindergarten prediction of reading skills: A longitudinal comparative analysis. *Journal of Educational Psychology*, *96*(2), 265–282. doi:10.1037/0022-0663.96.2.265
Schwanenflugel, P.J., Meisinger, E.B., Wisenbaker, J.M., Kuhn, M.R., Strauss, G.P., & Morris, R.D. (2006). Becoming a fluent and automatic reader in the early elementary school years. *Reading Research Quarterly*, *41*(4), 496–522. doi:10.1598/RRQ.41.4.4
Seymour, P.H.K., Aro, M., & Erskine, J.M. (2003). Foundation literacy acquisition in European orthographies. *British Journal of Psychology*, *94*(2), 143–174. doi:10.1348/000712603321661859
Silverman, R.D. (2007). Vocabulary development of English-language and English-only learners in kindergarten. *The Elementary School Journal*, *107*(4), 365–383. doi:10.1086/516669
Silverman, R.D., Speece, D.L., Haring, J.R., & Ritchey, K.D. (2013). Fluency has a role in the simple view of reading. *Scientific Studies of Reading*, *17*(2), 108–133. doi:10.1080/10888438.2011.618153
Slade, L., & Ruffman, T. (2005). How language does (and does not) relate to theory of mind: A longitudinal study of syntax, semantics, working memory and false belief. *British Journal of Developmental Psychology*, *23*(1), 117–141. doi:10.1348/026151004X21332
Stanovich, K.E. (1980). Toward an interactive-compensatory model of individual differences in the development of reading fluency. *Reading Research Quarterly*, *16*(1), 32–71. doi:10.2307/747348
Stanovich, K.E., Cunningham, A.E., & Feeman, D.J. (1984). Relation between early acquisition and word decoding with and without context: A longitudinal study of first-grade children. *Journal of Educational Psychology*, *76*(4), 668–677. doi:10.1037/0022-0663.76.4.668
Strasser, K., & del Río, F. (2014). The role of comprehension monitoring, theory of mind, and vocabulary depth in predicting story comprehension and recall of kindergarten children. *Reading Research Quarterly*, *49*(2), 169–187.
Tompkins, V., Guo, Y., & Justice, L.M. (2013). Inference generation, story comprehension, and language in the preschool years. *Reading and Writing*, *26*(3), 403–429. doi:10.1007/s11145-012-9374-7
Tunmer, W.E., & Chapman, J.W. (2012). The simple view of reading redux: Vocabulary knowledge and the independent components hypothesis. *Journal of Learning Disabilities*, *45*(5), 453–466. doi:10.1177/0022219411432685
Tzelgov, J., & Henik, A. (1991). Suppression situations in psychological research: Definitions, implications, and applications. *Psychological Bulletin*, *109*(3), 524–536. doi:10.1037/0033-2909.109.3.524
Vellutino, F.R., Tunmer, W.E., Jaccard, J.J., & Chen, R. (2007). Components of reading ability: Multivariate evidence for a convergent skills model of reading development. *Scientific Studies of Reading*, *11*(1), 3–32.
Wang, M., Ko, I.Y., & Choi, J. (2009). The importance of morphological awareness in Korean-English biliteracy acquisition. *Contemporary Educational Psychology*, *34*(2), 132–142. doi:10.1016/j.cedpsych.2008.12.002
Whitehurst, G.J., Epstein, J.N., Angell, A.L., Payne, A.C., Crone, D.A., & Fischel, J.E. (1994). Outcomes of an emergent literacy intervention in Head Start. *Journal of Educational Psychology*, *86*(4), 542–555. doi:10.1037/0022-0663.86.4.542
Wolf, M., & Katzir-Cohen, T. (2001). Reading fluency and its intervention. *Scientific Studies of Reading*, *5*(3), 211–239. doi:10.1207/S1532799XSSR0503_2
Woodcock, R.W., McGrew, K., & Mather, N. (2001). *Woodcock-Johnson Tests of Achievement* (3rd ed.). Itasca, IL: Riverside.
Yuill, N., Oakhill, J., & Parkin, A. (1989). Working memory, comprehension ability and the resolution of text anomaly. *British Journal of Psychology*, *80*(3), 351–361. doi:10.1111/j.2044-8295.1989.tb02325.x

Submitted September 22, 2014
Final revision received March 3, 2015
Accepted March 3, 2015

YOUNG-SUK GRACE KIM is an associate professor at Florida State University and the Florida Center for Reading Research, Tallahassee, USA; e-mail ykim@fcrr.org.

APPENDIX

Distribution of Rapid Automatized Naming Task



Note. AP1RAN_Dig_Time = latency score in the RAN task.