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Is Oral/Text Reading Fluency a "Bridge" to Reading Comprehension?

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Abstract

In the present study we investigated developmental relations among word reading fluency, listening comprehension, and text reading fluency to reading comprehension in a relatively transparent language, Korean. A total of 98 kindergartners and 170 first graders in Korea were assessed on a series of tasks involving listening comprehension, word reading fluency, text reading fluency, and reading comprehension. Results from multigroup structural equation models showed that text reading fluency was a dissociable construct for both kindergartners and first graders. In addition, a developmental pattern emerged: listening comprehension was not uniquely related to text reading fluency for first graders, but not for kindergartners, over and above word reading fluency. In addition, text reading fluency was uniquely related to reading comprehension for kindergartners, but not for first graders, after accounting for word reading fluency and listening comprehension. For first graders, listening comprehension dominated the relations. There were no differences in the pattern of relations for skilled and less skilled readers in first grade. Results are discussed from a developmental perspective for reading comprehension component skills including text reading fluency.

Keywords

Developmental model; Listening comprehension; Oral/text reading fluency; Reading comprehension; Transparent orthography; Korean

Introduction

Accurate and fast reading of connected text, widely known as oral/text reading fluency[1], has been shown to have a strong concurrent and predictive relation to reading comprehension (e.g., Author et al., 2010a; Daane, Campbell, Grigg, Goodman, & Oranje, 2005; Fuchs et al.,

2001; Hudson, Pullen, Lane, & Torgesen, 2009; Kuhn, Schwanenflugel, & Meisinger, 2010; Kuhn & Stahl, 2003). Despite our expanding understanding of reading fluency in the last decade, however, we have at least two gaps in theorizing and empirical studies. First, previous studies have been conducted almost exclusively with English-speaking children. This is limiting in terms of generalizability of previous findings to other languages, given that English has one of the most opaque orthographies (Share, 2008). Second, the majority of previous studies have focused on a snapshot relation between text reading fluency and reading comprehension (e.g., Ridel, 2007; Rohrieg, Petscher, Nettles, Hudson, & Torgesen, 2008), limiting our understanding of developmental relations among component skills of reading comprehension such as listening comprehension, context-free word reading skill (word reading fluency hereafter), and text reading fluency. In an effort to fill some of these gaps in the literature, in the present study we investigated interrelations among listening comprehension, word reading fluency, text reading fluency, and reading comprehension using data from children who differed in their reading proficiency – kindergarten and first grade children – in a relatively transparent orthography, Korean.

Developmental Relations

Although it is well known that reading comprehension is a juggling act of coordinating multiple processes, two critical skills in particular, word reading and oral language comprehension, have been shown to be necessary foundational components of reading comprehension (i.e., simple view of reading; Hoover & Gough, 1990; Joshi & Aaron, 2000). While studies have shown that the simple view of reading explains reading comprehension quite adequately for monolingual English-speaking children (Catts, Adlof, Hogan, & Weismer, 2005; Johnston & Kirby, 2006; Joshi & Aaron, 2000; Savage, 2006), English-language learners (Mancilla-Martinez, Kieffer, Biancarosa, Christodoulou, & Snow, 2011), and children learning to read in languages other than English (Joshi, Tao, Aaron, & Quiroz, 2012), these studies tended to focus on accuracy of context-free word reading (i.e., word recognition). Recently, however, text reading fluency has gained much empirical attention for its strong relation to reading comprehension for typically developing children as well as children with reading difficulties (Author et al., 2010a; Breznitz, 1997, 2006; Catts, Petscher, Schatschneider, Bridges, & Mendoza, 2009; Jenkins et al., 2003; Hudson, Torgesen, Lane, & Turner, 2012; NICHD, 2000; Ridel, 2007; Rohrieg et al., 2008; Schilling, Carlisle, Scott, & Zeng, 2007; Vadasy & Sanders, 2008; Wolf, 2001). Beyond a strong bivariate relation to reading comprehension, text reading fluency is uniquely related to reading comprehension over and above word reading fluency (Author et al., 2012; Jenkins, Fuchs, van den Broek, Espin, & Deno, 2003). The unique contribution of text reading fluency to reading comprehension is explained by the fact that reading fluency captures, to some extent, the same two foundational skills for reading comprehension hypothesized by the simple view of reading, that is, word reading (Adams, 1990; Ehri, 2002; Harn, Stoolmiller, & Chard, 2008; National Institute of Child Health and Human Development [NICHD], 2000; Stanovich, 1980) and language comprehension (Author et al, 2011, 2012).

[1]Although oral reading fluency has been widely used in the literature, we use the term, text reading fluency, to refer to fast and accurate reading of connected text, excluding reading prosody. Please see Kuhn, Schwanenflugel, and Meisinger (2010), and Kuhn & Stahl (2003) for the importance of reading prosody as part of reading fluency definition. We also use the term word reading fluency to refer to the fast and accurate word reading in a list format.

Automaticity – characterized as "speed, effortlessness, autonomy, and lack of conscious awareness" (Logan, 1997, p. 124) – of word reading in connected text is an essential aspect of text reading fluency. In a complex task such as reading comprehension which requires coordination of multiple processes and thus considerable cognitive resources, word reading automaticity is critical (LaBerge & Samuels, 1974; Logan, 1988) because automaticity in one component (i.e., word reading) frees limited cognitive resources to be available for other critical processes (i.e., language comprehension).

In addition to word reading automaticity, language comprehension processes during connected text reading, including automatic semantic activation and conscious prediction processes (Posner & Snyder, 1975) and morphological, semantic, and syntactic processes (Wolf & Katzir-Cohen, 2001), facilitate children's word reading, and result in faster reading of words in context than in a list format (Biemiller, 1977–1978; Jenkins et al., 2003). Critically, however, the facilitation of language comprehension appears to depend on children's reading proficiency. Text reading fluency was uniquely predicted by children's listening comprehension over and above word reading fluency only after children reached a certain level of word reading proficiency – for skilled word readers but not average word readers in first grade (Authors, 2011). Furthermore, the difference between words read correctly in connected text versus in list format was much greater at a later phase of reading development when children's listening comprehension made a contribution to text reading fluency (Author, 2011) as children's attention can be utilized for meaning construction according to the automaticity theory (LaBerge & Samuels, 1974). Thus, it appears that text reading fluency captures "individual differences in the efficient operation of local processes" (Perfetti, 1985, p. 100) by which temporary text representations are established.

Taken together, theory (LaBerge & Samuels, 1974; Samuels, 2006; Wolf & Katzir-Cohen, 2001) and empirical studies (Author et al., 2012; Breznitz, 1997; 2006; Jenkins et al., 2003) suggest that in addition to word reading and listening comprehension, text reading fluency may be another critical component of reading comprehension. In fact, it has been speculated that text reading fluency might be a "bridge" between word reading and reading comprehension (Chard, Pikulski, & McDonagh, 2006; Kuhn, Schwanenflugel, & Meisinger, 2010; Pikulski & Chard, 2005; Rasinski, 2004) although the nature of the bridging role has not been specified. This hypothesis requires an examination of whether text reading fluency is a dissociable construct from word reading fluency, and if so, how text reading fluency is related to word reading fluency, language comprehension, and reading comprehension (i.e., the nature of this bridging role). A few existing studies showed mixed results. Reading fluency was not a distinct construct from reading accuracy for children in second, fourth, and eighth grades (Adlof et al., 2006) and children in grades one, two, and three (Schwanenflugel et al., 2006). However, these two studies examined text reading fluency using a single measure, which is not ideal in examining factor structure of a construct. In contrast, in a recent multivariate study using multiple measures, text reading fluency was a separate construct from word reading fluency and reading comprehension (Author et al., 2011, 2012). Furthermore, previous studies are not clear about the unique relation of text reading fluency to reading comprehension. On the one hand, Schwanenflugel and her colleagues (2006) found that text reading fluency was not uniquely related to reading comprehension after accounting for word reading fluency and autonomous reading

interference for children in grades one, two, and three. On the other hand, evidence suggests that text reading fluency is uniquely related to reading comprehension and importantly, the unique relation of text reading fluency to reading comprehension may depend on children's reading skill level. Text reading fluency made a unique contribution to reading comprehension for fourth graders (Jenkins et al., 2003) and for second graders with skilled word reading proficiency (Authors, 2012), but not for second graders with average word reading fluency or first graders (Authors, 2012). These results suggest that similar to the developmental relations of word reading and listening comprehension to reading comprehension (Catts et al., 2005; Gough, Hoover & Peterson, 1996), the mediating role of text reading fluency might not be static, but might change as children's reading skills develop.

Our expanding understanding about text reading fluency has been limited to English despite a speculation that reading fluency might play an even more important role in overall reading development in a transparent orthography than in an opaque orthography (Share, 2008; de Jong & van der Leij, 2003; Wimmer, 1993) because achieving word reading accuracy is relatively easier in transparent orthographies (Seymour et al, 2003). However, majority of previous studies on reading fluency in transparent orthographies has been measured at a sublexical level, typically by rapid automatized naming (RAN; see, for example, de Jong & van der Leij, 1999, 2003; Aro & Wimmer, 2003; see Kirby, Georgiou, Martinussen, & Parilla, 2010; Vukovic & Siegel, 2006; see Huemer, Landerl, Aro, & Lyytinen, 2008 for a training study) and at a lexical level (e.g., timed word reading tasks; Morfidi et al., 2007). A few studies which examined text reading fluency in transparent orthographies suggest that text reading fluency was uniquely explained by children's syntactic skills after accounting for digit span and phonological awareness for Hebrew-speaking fifth graders (Cohen-Mimran, 2009), but it was not uniquely related to reading comprehension for Korean-speaking kindergartners (Author, 2011) and fourth grade Hebrew-speaking children (Primor, Pierce, & Katzir, 2011). Despite growing understanding from these few studies, however, no studies have examined whether both word reading and language comprehension are component skills of text reading fluency and if so, how their relations might be similar or different for children in different developmental stages of reading in a transparent orthography.

The Korean Language

The Korean oral language has drastically different characteristics (syllable structure and syntactic structure) from English such that its syllable structure is simple and the syllable is salient (Author, 1007; Sohn, 1999). Also note that although the Korean writing system, called Hangul, is overall transparent (please see Author, 2007, 2011 for details about orthographic characteristics in Korean), orthographically opaque words exist due to the morphophonemic nature and phonological shifts (e.g., resyllabification, tensification, and palatalization) in certain phonological contexts (see Author, in press, for further details). Specifically, approximately 10%[2] of syllables (*SD* = 5%) in stories of the first grade reading text book, on average, underwent phonological alternations. Although it is not clear how much challenge various phonological alternations place on children's literacy acquisition, a recent study suggested that tensification (certain consonants becoming a tensified phoneme)

has little effect on children's spelling whereas words involving resyllabification are much more difficult to spell accurately compared to transparent words and words involving tensification (Author, in press).

Present Study

In summary, in the present study we extend previous studies by investigating and comparing developmental relations among listening comprehension, word reading fluency, text reading fluency, and reading comprehension in a relatively transparent orthography, Korean. We compared results for kindergartners and first graders as well as results for skilled and less skilled word readers in first grade to have a first look at potentially changing nature of relations. The following were specific research questions: (1) is text reading fluency a dissociable construct?; (2) Is listening comprehension uniquely related to text reading fluency over and above word reading fluency?; and (3) Is text reading fluency uniquely related to reading comprehension after accounting for listening comprehension and word reading fluency? These questions were addressed comparing results from kindergartners, first graders, as well as skilled and less skilled first graders to examine developmental progression of relations. We employed a latent variable approach as a primary analytic strategy which improves precision by modeling common variance among observed variables, thereby minimizing effects of measurement error.

Method

Participants

Two convenience samples of 98 kindergartners (45% females) and 170 first graders (49% females) in South Korea participated in the study. They were all monolingual Korean students. Mean age was 71.27 months (*SD* = 3.82) for kindergartners and 82.91 months (*SD* = 3.52) for first graders. In Korea formal schooling starts in first grade, in which uniform national curriculum is implemented. Before formal schooling, however, the majority of children receive literacy and numeracy instruction at public and private kindergarten, daycare, or via widely available home visit programs, typically starting at age four (Author, 2010, 2011). Literacy education in prekindergarten and kindergarten is provided in public or many private institutes. The kindergartners in the present study were from 3 classes in a single private school. The kindergartners in the present study were exposed to a whole language approach of literacy instruction in which words are presented as a unit. Teachers read books to children but they did not provide any explicit and systematic instruction on letter names, sounds, and phonological awareness. First grade children were from 7 classrooms in three elementary schools. First graders received literacy instruction based on the national curriculum in which CV syllables are introduced briefly (e.g., a week) followed by coda letters. However, instruction on fundamental literacy skills is very brief and only in the beginning of the year because the majority of children are already readers. The SES

[2]To estimate the extent to which children are likely to interact with orthographically opaque words in written texts, we examined a Korean reading text book for first graders (Korean Ministry of Education). A total of 28 stories (directions for children were excluded) were included in the analysis. These stories included, on average, 208.29 syllables with a large variation (*SD* =212.25), ranging from 27 syllables to 790 syllables.

information on individual children was not available, but according to school personnel, the majority of children were from middle class homes.

Measures

Multiple measures were used to assess the following constructs: listening comprehension, word reading accuracy, word reading fluency, text reading fluency, and reading comprehension. Word reading accuracy was used to classify the first grade sample to skilled and less skilled readers to examine whether relations are different as a function of their word reading skill, but was not used in the structural equation modeling.

Listening comprehension—Two tasks were used to assess children's listening comprehension. The two tasks were adapted from the Listening Comprehension Scale of Oral and Written Language Scales (OWLS; Carrow-Woolfolk, 1995) and Paragraph Comprehension subtest of Comprehensive Assessment of Spoken Language (CASL; Carrow-Woolfolk, 1999). The adaptation included modifying a few illustrations that were not culturally appropriate to Korean children. For instance, young Korean children do not typically associate a firefighter with an ax (an item in the OWLS). Therefore, the ax was modified to a water hose. In the first task, children heard sentences and were asked to point to the picture that best describe the heard sentences. There were 34 test items with 2 practice items. In the second task, children heard short stories and were asked to identify a picture that best described the answer to the question based on the short stories. There were 19 test items with 1 practice item. Children's answers were scored dichotomously (1 = correct; 0 = incorrect) for each item. Reliabilities (Cronbach's alpha) were estimated to be .62 and .66, respectively. Although these Cronbach's alpha estimates are somewhat low, this is of less concern in a latent variable analysis because common variance among indicators is used in the parameter estimation, reducing the influence of measurement error (Kline, 2005).

Word reading fluency—To assess children's word reading fluency, children were shown words in a context-free list format and were asked to read aloud words quickly and accurately in three tasks. A total of 60 items[3] in each task, ranging from 175 to 195 in syllables, were randomly selected from the three passages for the text reading fluency task (see below). In other words, the same words were used in the word reading fluency task as well as in text reading fluency tasks. In the latter, words were placed in connected texts (stories) whereas in the former, these words were randomly arranged in a list (context-free) format. The number of accurately read items in 40 seconds was the child's score. There were 4 practice items that were not from the text reading fluency passages. There were a total of 3 tasks corresponding to the three passages used to assess text reading fluency. Test-retest correlations with a week apart were greater than .92.

Text reading fluency—Three previously unseen passages were used to assess children's reading rate with accuracy in connected texts (Author, 2011a). The child was asked to read each passage quickly and accurately. The three passages ranged from 279 to 362 syllables

[3]In the word reading fluency tasks, many items consisted of more than one word, but included those that occur together separated by spacing. In Korean, spacing does not occur after each word, but complex (see Author et al, 2012b; Lee & Ramsey, 2000 for more information). For instance, 아빠가 (dad + a subject case marker) was presented together in an item as found in connected texts.

(Author, 2011a). Students' performances were measured by the number of accurately read syllables in 40 sec. Syllables omitted, substituted, and hesitations of more than 3 seconds were scored as errors. Test-retest correlations were reported to be greater than .91 (Author, 2011a). Number of syllables, not words, is reported in the present study because the concept of word[4] and related spacing in Korean is different from that in English (Lee & Ramsey, 2000). Instead, number of syllables, which are salient in the Korean language and orthography (Author, 2007), is the metric used as an indicator of text volume in Korea. It should be noted that when analyses were conducted using words, the results were identical and thus results using the number of syllables are presented in the present article. In addition, time to read the entire passage in seconds was also measured. Preliminary analysis showed identical results, and thus results using 40 sec is reported in the present article.

Reading comprehension—Reading comprehension was measured by three tasks used in a previous study (Author, 2011a). In two tasks, the child was asked to read short passages (298 and 252 syllables) and presented 5 open-ended and 6 multiple choice comprehension questions, respectively. The last task was an oral cloze task, adapted from the Woodcock-Johnson III Passage Comprehension subtest (Woodcock, McGrew, & Mather, 2001). In this task, the child was asked to read a sentence or short passages and to provide a missing word. There were 21 test items and 3 practice items. Children's answers were scored dichotomously (1 = correct; 0 = incorrect) for each question. Reliabilities (Cronbach's alpha) were estimated to be .46[5], .70, and .74, respectively.

Word reading accuracy—Two tasks, word identification and pseudoword reading, were adapted from word identification and pseudoword reading tasks in previous studies (Author, 2009) to assess children's accuracy in word reading and decoding. The adaptation included replacing a few words and reducing the number of items. In the word identification task, the child was asked to read words aloud accurately. There were 3 practice items and 34 test items with increasing difficulty. The test items were all multi-syllabic words ranging from 2 to 4 syllables and many items included orthographically opaque words. In the pseudoword reading task, children were told that the words were not real, and were asked to read each word aloud accurately. There were 40 test items with 3 practice items. The test items included multi-syllabic words ranging from 2 to 4 syllables. Children's answers were scored dichotomously (1 = correct; 0 = incorrect) for each question. Reliabilities (Cronbach's alpha) were estimated to be .76 and .86 for word identification and nonword reading tasks, respectively. Children's performances on these word reading accuracy measures were used to identify more and less skilled readers in first grade, but not used in the latent variable analysis.

[4]This is partly due to the agglutinative nature of Korean in which words are formed by joining morphemes together.

[5]When the first two passages were collapsed, Cronbach's alpha was estimated to be .72. However, in the latent variable approach, we used students' performance on these two tasks as separate tasks in order to have higher degrees of freedom. When analysis was conducted using two indicators of reading comprehension (i.e., the sum score of tasks 1 and 2, and score for task 3), the results were identical.

Procedures

Children were assessed individually in two sessions, each session lasting approximately 30 minutes, two months after the school year started. The administration of assessments was systematically varied across children in order to reduce fatigue effect.

Data Analysis

Confirmatory factor analysis and structural equation modeling using MPLUS 5.1 (Muthen & Muthen, 2006) were employed as the primary analytic strategy. Preliminary analyses confirmed that overall multivariate normality assumptions were met (see below for a couple of exceptions), and all the measurement models were appropriate. Model fits were evaluated by the following multiple indices: Chi-square statistics, comparative fit index (CFI), the Tucker-Lewis index (TLI), root mean square error of approximation (RMSEA), and standardized root mean square residuals (SRMR). RMSEA values below .08, CFI and TLI values equal to or greater than .95, and SRMR equal to or less than .05 indicate an excellent model fit (Hu & Bentler, 1999). TLI and CFI values greater than .90 are considered to be acceptable (Kline, 2005). Because the analysis involved two separate samples involving kindergartners and first graders, and more skilled and less skilled word readers in first grade, multigroup analysis was conducted following procedures described in Brown (2006) and Thompson and Green (2006).

Results

Descriptive statistics and preliminary analyses

Table 1 presents descriptive statistics (i.e., means, standard deviations, minimum, and maximum). First-grade children's performances were superior on all the measures (Multivariate analysis of variance: Wilks lamda = .52, F [13, 251] = 17.55, $p < .001$; univariate $Fs \geq 5.10$, $ps \leq .02$). Univariate distributions were symmetrical except for the reading comprehension passage 1 and 2 for first graders, in which some ceiling effects were found (e.g., 35% of the first graders scored the maximum possible score) whereas the distribution for the cloze reading comprehension task was adequate.

First-grade children were divided into two groups based on their performance on the word identification task. Although efforts were made to divide an equal number of children into two groups, because many children had the same score, the number of children in more skilled and less skilled word readers groups was not identical. Children who scored 31 and above were considered as more skilled word readers ($n = 95$) and those who scored 30 and below as less skilled word readers ($n = 75$). Skilled word readers in first grade had higher mean scores on all the measures ($Fs > 7.92$, $ps \leq .005$). Note that for Korean-speaking first grade children, although all the items in the word identification task included multisyllabic words many of which were orthographically opaque, it was negatively skewed ($M = 30.20$, $SD = 3.18$; skewness = −1.51; Kurtosis = 3.76). Given the fairly transparent nature of the Korean orthography, this is not surprising. However, students' performance on pseudoword reading had a fairly symmetric distribution with a mean of 31.15 ($SD = 5.93$) out of a total possible maximum score of 40. Despite the slight negative skew in the word identification task, the patterns of results were essentially identical when we used the word identification

task or the pseudoword reading task to identify skilled and less skilled readers in first grade. Thus, in the present study, results from the word identification task are reported. Table 2 shows bivariate correlations among measures. As expected, the vast majority of variables were statistically significantly related with each other.

Using the observed variables, measurement models were fitted for the following latent variables: listening comprehension, word reading fluency, text reading fluency, and reading comprehension. All factor loadings were statistically significant at the .001 level for all the variables (see Table 3 for standardized loadings and p values). Given the ceiling effects in the two reading comprehension tasks above, the latent variable analyses were conducted using robust estimation in maximum likelihood estimation as well as maximum likelihood estimation methods. Results were identical. In multigroup analyses of kindergarten and first grade, a baseline model of non-invariance was first specified in which the loadings were allowed to vary completely. This model demonstrated a good fit to the data: (χ^2 [90] = 165.11, p = .00; CFI = .97; TLI = .97; RMSEA = .079; SRMR = .07). When a full invariance model was fit, it had a statistically poorer fit (χ^2 [93] = 309.99, p = .00; CFI = .92; TLI = .90; RMSEA = .13; SRMR = .13) ($\Delta\chi^2$ [Δdf = 3] =144.88, p < .001). Thus, we fitted partial invariance models in subsequent analysis by examining the loadings of each observed variable to the latent variable, and relaxing equal loading constraints of reading comprehension passage 2. For the comparison of the skilled and less skilled first grade children, similar results were founds with a full invariance model with a statistically poorer fit than a no invariance model ($\Delta\chi^2$ [Δdf = 3] =15.61, p = .001). In the partial invariance model, the residual variance of the reading comprehension passage 2 for the less skilled readers was fixed at zero.

Research question 1: Is text reading fluency a dissociable construct?

In order to examine whether word reading fluency and text reading fluency are best described as a single construct or they are related but dissociable constructs, confirmatory factor analyses were conducted. The models with word reading fluency and text reading fluency as separate latent variables had statistically significantly better fit according to chi-square difference tests ($\Delta\chi^2$ = 343.29, Δdf = 8, ps < .001). Thus, in subsequent analysis, word reading fluency and text reading fluency were modeled as separate variables.

Research question 2: Is listening comprehension uniquely related to text reading fluency over and above word reading fluency?

Bivariate correlations among latent variables are presented in Table 4 (χ^2 [89] = 154.15, p <. 001, CFI = .98, TLI = .97, RMSEA =.074 [.054 – .093], SRMR = .064 for kindergarten and first grade children; χ^2 [91] = 127.87, p = .007, CFI = .97, TLI = .96, RMSEA =.069 [.038 – .096], SRMR = .11 for skilled and less skilled first grade children). Overall, the relation of listening comprehension to reading comprehension became stronger from .55 for kindergarteners to .91 for first graders. In contrast, the magnitude of relations of word reading fluency and text reading fluency to reading comprehension decreased from .90 for kindergarteners to .43 for first graders. Finally, word reading fluency was more strongly related to text reading fluency in kindergarten (r = .94) than in first grade (r = .70; $\Delta\chi^2$ (Δdf = 1) = 10.41, p < .01).

Multigroup structural equation modeling was conducted to examine the relations of word reading, listening comprehension, text reading fluency, and reading comprehension. Word reading fluency and listening comprehension were hypothesized to have direct paths to text reading fluency. In addition, word reading fluency, listening comprehension, and text reading fluency were hypothesized to have direct paths to reading comprehension. Two multigroup structural equation models were fitted: One model with kindergarten and first grade using entire samples (Figure 1), and the other model with skilled versus less skilled word readers in grade one (Figure 2). The model fits were good in both models: χ^2 (89) = 150.03, $p < .001$, CFI = .98, TLI = .97, RMSEA = .07, SRMR = .06) for full samples of kindergarten and first grade model; and χ^2 (91) = 128.25, $p = .006$, CFI = .96, TLI = .95, RMSEA = .07, SRMR = .11) for skilled and less skilled first graders. Figure 1A shows results for kindergarteners. Word reading fluency ($\gamma = .91$, $p < .001$) was strongly related to text reading fluency whereas listening comprehension was not ($\gamma = .07$, $p = .14$). In grade one (see Figure 1B), both word reading fluency ($\gamma = .58$, $p < .001$) and listening comprehension ($\gamma = .23$, $p = .03$) were uniquely related to text reading fluency. Total amount of variance explained in text reading fluency was .53 and .89 for kindergartners and first graders, respectively.

Figure 2 shows results for skilled and less skilled word readers in first grade. For either group, listening comprehension was not uniquely related to text reading fluency after accounting for word reading fluency, most likely due to the reduced sample size.

Research Question 3: Is text reading fluency uniquely related to reading comprehension after accounting for listening comprehension and word reading fluency?

In kindergarten, text reading fluency ($\gamma = .53$, $p = .003$) and listening comprehension ($\gamma = .20$, $p = .005$) were both uniquely related to reading comprehension but word reading fluency was not ($\gamma = .30$, $p = .08$) (see Figure 1A). In first grade, listening comprehension was strongly related ($\gamma = .90$, $p < .001$) whereas word reading fluency ($\gamma = .21$, $p = .13$) and text reading fluency ($\gamma = -.20$, $p = .17$) were not uniquely related to reading comprehension. Total amount of variance explained in reading comprehension was .84 and 85 for kindergartners and first graders, respectively. As shown in Figures 2A and 2B, the patterns of relations were essentially the same for skilled and less skilled word readers in first grade.

Discussion

The goal of the present study was to examine developmental relationships among listening comprehension, word reading fluency, text reading fluency, and reading comprehension in a relatively transparent orthography, using data from Korean-speaking children. Overall, the findings suggest that text reading fluency is an additional component skill of reading comprehension (Breznitz, 2006; Fuchs et al., 2001; Jenkins et al., 2003; Wolf, 2001) acting as a ‘bridge’ between word reading and reading comprehension (Chard et al., 2006). Importantly, however, the nature of these relationships is developmental, depending on the child’s reading level.

In the present study, text reading fluency was a dissociable construct from word reading fluency, convergent with previous studies with English-speaking children (Author et al.,

2011, 2012). Note that we used the same words in the word reading fluency and text reading fluency tasks, and thus, controlled for differences in words in word vs. text reading fluency tasks (Jenkins et al., 2003). In addition, text reading fluency was not only predicted by children's word reading fluency, but also by listening comprehension over and above word reading fluency. This unique relation of listening comprehension occurred after children reached a certain level of word reading proficiency, first graders in the present study. A similar pattern of findings was found for English-speaking children such that listening comprehension was not uniquely related to text reading fluency for average word readers in first grade (Author et al., 2011), but was for more advanced readers such as skilled readers in first grade (Author et al., 2011) and average and skilled readers in second grade (Author et al., 2012). These results indicate that while context-free word reading skill is the foundation of text reading fluency (Ehri, 2002; NICHD, 2000), text reading fluency captures individual differences in listening comprehension/meaning construction to some extent once children develop sufficient word reading proficiency (Author et al., 2012; Samuels, 2006; Wolf & Katzir-Cohen, 2001), which is why text reading fluency is strongly related to reading comprehension (Jenkins et al., 2003).

The present study also expands our knowledge about the relationship of text reading fluency to reading comprehension and suggests that the mediating role of text reading fluency is developmental and nuanced. It is developmental in that the nature of relationship changed as a function of children's reading skills. Text reading fluency completely mediated the relationship of word reading fluency and reading comprehension for kindergartners such that text reading fluency was, but word reading fluency was not, uniquely related to reading comprehension after accounting for listening comprehension. In first grade, however, neither text reading fluency nor word reading fluency was uniquely related to reading comprehension whereas listening comprehension largely explained variation in reading comprehension. A highly similar picture was reported for English-speaking children. Text reading fluency did not mediate for children at the beginning stage of reading (i.e., first graders) but partially mediated for more advanced readers (skilled readers in second grade; Author, 2012). Thus, these findings from English-speaking children and Korean-speaking children suggest that the hypothesized 'bridging" role of text reading fluency (Chard et al., 2006; Kuhn et al., 2010; Pikulski & Chard, 2005; Raskinski, 2004) is not static but changes as a function of children's reading skill. During the initial phase of reading, individual differences in word reading skills explain a large amount of variation in reading comprehension. With further development, text reading fluency mediates the relationship between word reading and reading comprehension (perhaps from a partial mediation to a complete mediation), followed by a phase in which listening comprehension largely explains variation in children's reading comprehension. The developmentally changing role of word reading and language comprehension has been hypothesized by the simple view of reading (Hoover & Gough, 1990) – the relationship of listening comprehension to reading comprehension becomes stronger whereas the relationship of word reading to reading comprehension becomes weaker from beginning to later stage of reading development. Similar patterns of relationships have been reported for English-speaking children (Adlof et al., 2006; Hoover & Gough, 1990; Francis et al., 2006; Storch & Whitehurst, 2002) such that the relative importance of word reading and listening comprehension change for beginning

readers versus advanced readers. For instance, the correlation between word reading fluency and reading comprehension latent variables decreased from .90 to .77 from grade one to four, and the correlation between listening comprehension and reading comprehension increased from .70 to .90 from grade one to four for English-speaking children (Author et al., 2012b). A similar pattern was also reported by Adlof and her colleagues (2006). This pattern of relationships was also found in the present study such that word reading fluency was strongly and uniquely related to reading comprehension for kindergartners (i.e., $r = .88$), but only moderately related for first graders ($r = .54$). In contrast, listening comprehension was moderately related to reading comprehension ($r = .55$) for kindergartners but very strongly related for first graders ($r = .91$). To sum up, the present study confirms a developmentally changing nature of the relationships of word reading and listening comprehension to reading comprehension, but also demonstrates that another skill, text reading fluency, might be another important necessary component of reading comprehension and its relationship changes as children's reading skills develop.

The present study also suggests that the developmental relationship of text reading fluency to reading comprehension is more nuanced than previously thought in that the pattern of mediation differs for word reading versus listening comprehension. Note that the mediating role of text reading fluency has been only hypothesized in relation to word reading, but not to listening comprehension (Chard et al., 2006; Pikulski & Chard, 2005; Raskinski, 2004). However, given that text reading fluency captures children's language comprehension in addition to word reading fluency, its mediating role should include both word reading and listening comprehension. The present study revealed that text reading fluency does not completely mediate, but only partially mediates the relationship between listening comprehension and reading comprehension across different developmental levels of reading skills. That is, when text reading fluency was uniquely related to reading comprehension over and above word reading fluency and listening comprehension, listening comprehension remained statistically significantly related to reading comprehension for both kindergartners and first graders in the present study. This was also the case for English-speaking children in first and second grades (Author et al., 2011, 2012). Therefore, the present study indicates that the mediating role of text reading fluency should include listening comprehension, and its mediating role for the relationship between listening comprehension and reading comprehension appears partial.

It is interesting that the unique relationship of text reading fluency to reading comprehension found for kindergartners in the present study is similar to that for skilled first graders in English (Author et al., 2011). This is likely to be attributed to the transparency of the Korean orthography as well as educational context in Korea. Studies have shown that word reading acquisition is easier and faster in a transparent orthography (Seymour, Aro, & Erskine, 2003). In addition, typically many Korean children start receiving literacy instruction in prekindergarten (or age 4; Author, 2011). Given the relatively transparent nature of the Korean orthography, even after a year of literacy instruction, the nature of relations for kindergartners in Korean appear to be similar to that found for English-speaking first graders in the U.S. It is clear that kindergartners in the present study have sufficient basic literacy

skills as evidenced by the fact that the majority were able to perform text reading fluency and reading comprehension tasks.

A few limitations of the present study should be noted. The results for Korean-speaking children were from cross-sectional sample of children in different developmental phases. A future longitudinal study following children from beginning to later phases of reading is needed to replicate these findings, and to inform developmental patterns of relations from beginning to advanced stage of reading in a transparent orthography. In addition, the present study included only oral mode of text reading fluency. Given the importance of silent reading and lack of our knowledge of silent reading (Author et al., 2011; Hiebert & Reutzel, 2010; Klauda & Gutherie, 2008), it will be important to examine developmental relations of both oral and silent reading fluency in future studies. Finally, although use of a latent variable approach mitigated the impact of low reliabilities in some measures, higher reliabilities would have been ideal.

Overall, the present study was an initial step toward expanding our understanding about developmental nature of relations for component skills of reading comprehension using data from a relatively transparent orthography. The present study showed that relations among component skills of reading comprehension were not static, but dynamic (Author, 2011, 2012). Future cross linguistic longitudinal studies would be informative in revealing any similarities and differences in the developmental relations.

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Figure 1A: Kindergarten

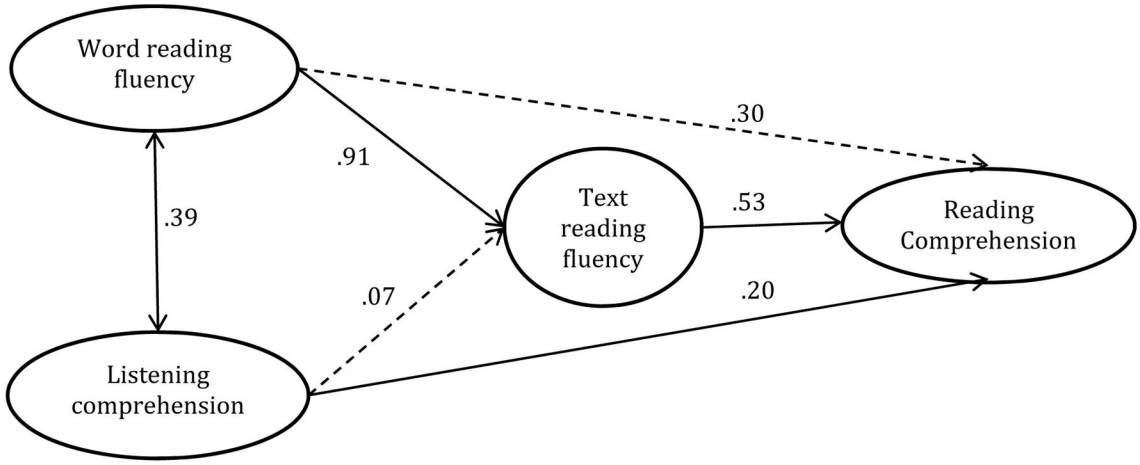

Figure 1B: First grade

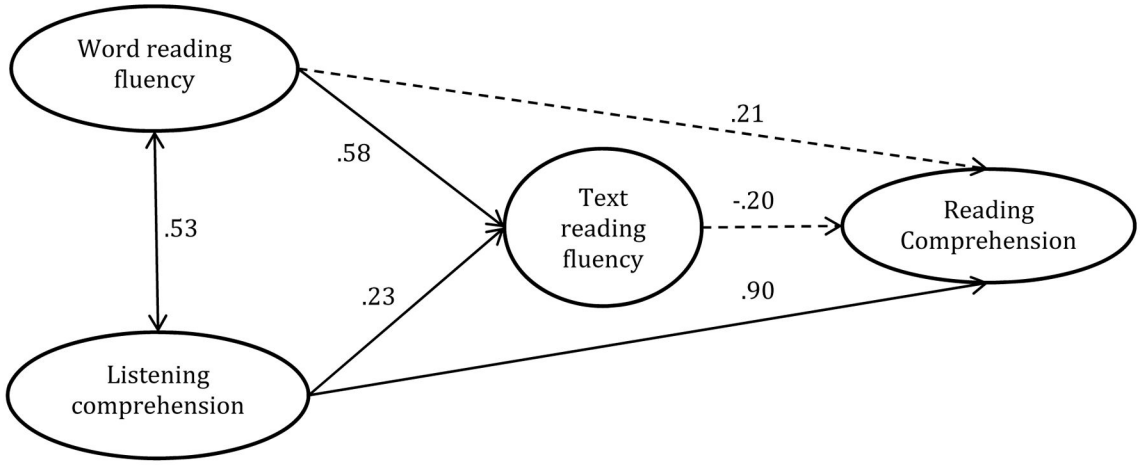

Figure 1.

Standardized structural regression weights among listening comprehension, word reading fluency, text reading fluency, and reading comprehension for Korean kindergarteners (1a) and less skilled first graders (1b).

Figure 2A: First grade skilled word readers

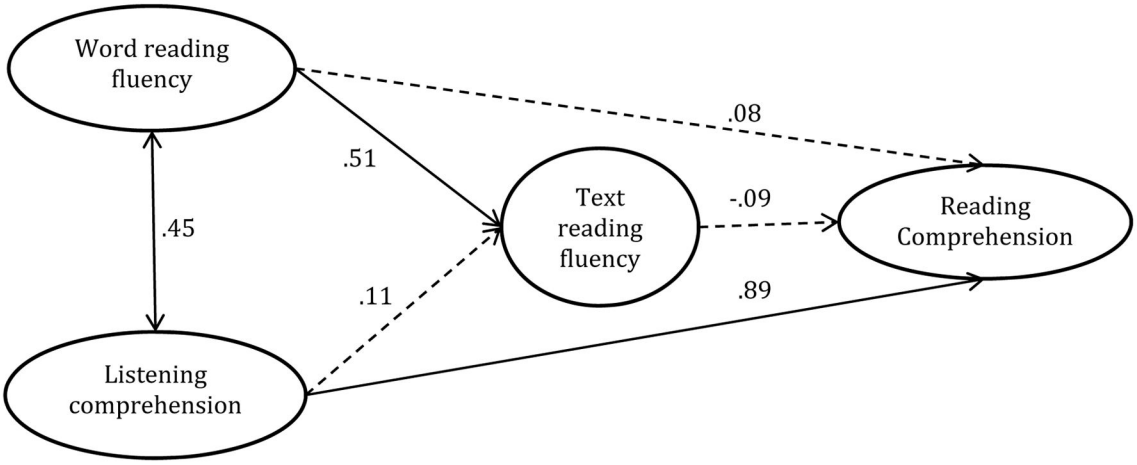

Figure 2B: First grade less skilled word readers

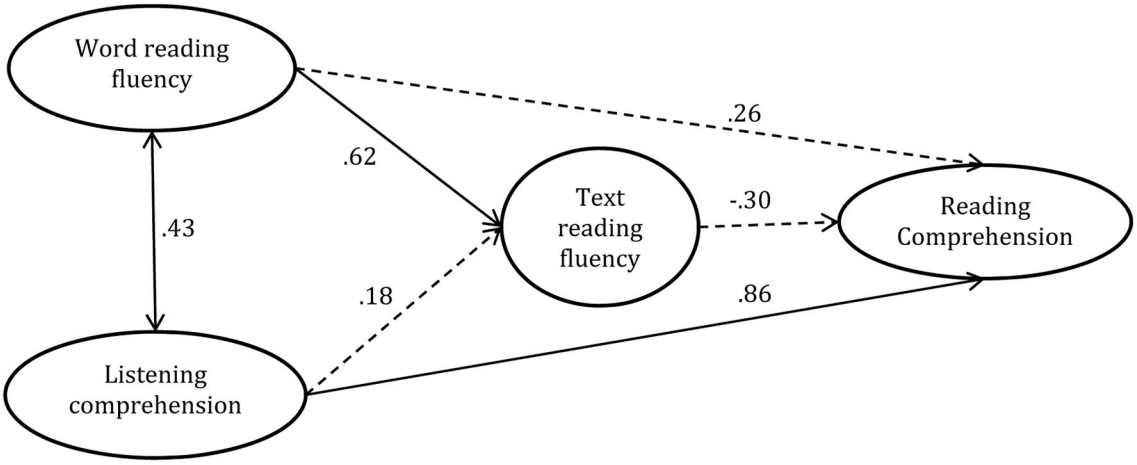

Figure 2.

Standardized structural regression weights among listening comprehension, word reading fluency, text reading fluency, and reading comprehension for Korean first grade skilled word readers (2a) and less skilled word readers (2b).

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Table 1

Descriptive statistics

	Kindergarten (N = 98)		First grade (entire sample N = 170)		First grade skilled readers (n = 95)		First grade less skilled readers (n = 75)	
	Mean (SD)	**Min - Max**	**Mean (SD)**	**Min - Max**	**Mean (SD)**	**Min - Max**	**Mean (SD)**	**Min - Max**
Listening comprehension								
Task 1	19.19 (3.78)	8 – 28	25.06 (3.60)	10 – 33	25.96 (2.94)	20–33	23.93 (4.04)	10–33
Task 2	13.53 (3.70)	4 – 21	16.04 (2.45)	4 – 19	16.51 (2.06)	11–19	15.45 (2.76)	4–19
Word reading accuracy								
Word identification	22.12 (10.15)	0 – 34	30.20 (3.18)	14 – 34	32.37 (1.06)	31–34	27.45 (2.84)	14–30
Pseudoword reading	21.12 (11.21)	0 – 38	31.15 (5.93)	5 – 40	34.12 (3.74)	22–40	27.40 (6.08)	5–38
Word reading fluency								
TRF passage 1 words	24.05 (13.23)	0 – 55	39.84 (11.40)	10 – 60	43.65 (10.24)	19–60	35.01 (11.03)	10–57
TRF passage 2 words	21.44 (12.80)	0 – 48	38.70 (11.81)	8 – 60	42.34 (10.18)	22–60	34.09 (12.18)	8–59
TRF passage 3 words	23.15 (13.19)	0 – 49	38.37 (11.49)	11 – 60	41.96 (10.22)	17–60	33.76 (11.46)	11–60
Text reading fluency								
TRF Passage 1	91.33 (50.67)	0 – 194	147.14 (44.51)	44 – 281	162.52 (39.30)	54–260	127.67 (43.31)	44–281
TRF Passage 2	86.65 (46.45)	0 – 203	149.58 (43.86)	53 – 281	166.39 (39.99)	88–281	128.29 (39.23)	53–212
TRF Passage 3	88.83 (47.11)	0 – 201	151.28 (41.51)	53 – 251	164.75 (38.21)	90–251	134.23 (39.41)	53–211
Reading comprehension								
RC Passage 1	2.40 (1.58)	0 – 5	3.88 (1.14)	0 – 5	4.15 (.95)	1–5	3.55 (1.28)	0–5
RC Passage 2	2.74 (1.11)	0 – 6	4.84 (1.50)	0 – 6	5.23 (1.19)	0–6	4.33 (1.70)	0–6
Cloze task	9.94 (5.39)	0 – 19	16.43 (3.08)	6 – 21	17.39 (2.68)	6–21	15.21 (3.14)	7–21

TRF = Text Reading Fluency: number of syllables read correctly in 40 sec; RC = Reading Comprehension

Table 2

Correlations between observed variables for Korean-speaking first grade sample (N = 170) and kindergarten sample (N = 98)

	1	2	3	4	5	6	7	8	9	10	11	12	23
1. Listen Comp task 1	---	.48	.30	.30	.33	.36	.31	.39	.36	.34	.32	.48	.38
2. Listen Comp task 2	.39	---	.22	.22	.18	.16^{+}	.17^{+}	.25	.26	.23	.20	.39	.34
3. Word identification	.26	.28	---	.94	.87	.83	.85	.85	.86	.84	.77	.76	.84
4. Nonword reading	.24	.25	.73	---	.84	.82	.83	.83	.84	.82	.77	.76	.81
5. Word reading fluency 1	.36	.30	.46	.36	---	.95	.94	.89	.89	.88	.75	.74	.78
6. Word reading fluency 2	.31	.29	.43	.32	.91	---	.96	.90	.91	.90	.79	.74	.76
7. Word reading fluency 3	.29	.26	.43	.37	.87	.87	---	.90	.90	.90	.71	.75	.77
8. TRF Passage 1	.31	.22	.44	.25	.59	.56	.62	---	.95	.94	.69	.76	.81
9. TRF Passage 2	.36	.18	.46	.31	.60	.58	.61	.75	---	.97	.69	.76	.82
10. TRF Passage 3	.37	.22	.41	.28	.55	.57	.56	.75	.79	---	.67	.76	.81
11. RC – Passage 1	.26	.35	.35	.36	.21	.17	.18	.11^{+}	.17	.05^{+}	---	.69	.70
12. RC – Passage 2	.44	.51	.42	.44	.43	.42	.40	.24	.33	.24	.53	---	.81
13. RC – Cloze task	.43	.35	.46	.47	.43	.45	.40	.33	.43	.41	.39	.51	---

Note: Coefficients below diagonal are for first graders; above diagonal are for kindergarteners.

$^{+}p > .05$

Listen Comp = Listening Comprehension; Word reading F = Word reading fluency; TRF = Text reading fluency; RC = Reading Comprehension

Table 3

Standardized loadings and residuals (kindergarten and first grade entire samples, and skilled and less skilled word readers in first grade).

	Kindergarten entire sample		First grade entire sample		First grade skilled word readers		First grade less skilled word readers	
	Loading (SE)	**Residuals (SE)**	**Loading (SE)**	**Residuals (SE)**	**Loading (SE)**	**Residuals (SE)**	**Loading (SE)**	**Residuals (SE)**
Listening comprehension								
Task 1	.87 (.09)	.25 (.16)	.67 (.06)	.55 (.09)	.52 (.10)	.73 (.10)	.61 (.09)	.63 (.11)
Task 2	.49 (.06)	.76 (.06)	.55 (.06)	.70 (.07)	.53 (.10)	.72 (.11)	.65 (.09)	.58 (.12)
Word reading fluency								
TRF Passage 1 words	.96 (.01)	.07 (.02)	.95 (.01)	.10 (.02)	.93 (.02)	.14 (.04)	.96 (.01)	.09 (.03)
TRF Passage 2 words	.98 (.01)	.03 (.01)	.95 (.01)	.10 (.02)	.93 (.02)	.13 (.04)	.96 (.01)	.08 (.03)
TRF Passage 3 words	.97 (.01)	.06 (.01)	.92 (.01)	.16 (.03)	.88 (.03)	.23 (.05)	.93 (.02)	.14 (.03)
Text reading fluency								
Passage 1	.96 (.01)	.08 (.02)	.85 (.02)	.28 (.04)	.82 (.04)	.33 (.06)	.85 (.03)	.27 (.06)
Passage 2	.99 (.004)	.02 (.01)	.88 (.02)	.23 (.04)	.81 (.04)	.34 (.06)	.95 (.02)	.10 (.04)
Passage 3	.98 (.01)	.05 (.01)	.89 (.02)	.20 (.04)	.85 (.04)	.27 (.06)	.85 (.03)	.28 (.06)
Reading comprehension								
RC Passage 1	.76 (.04)	.42 (.06)	.63 (.04)	.60 (.06)	.51 (.07)	.75 (.07)	.61 (.06)	.63 (.08)
RC Passage 2	.87 (.03)	.24 (.05)	.79 (.04)	.37 (.06)	.77 (.07)	.41 (.10)	1.00 (.00)	.00
Cloze task	.91 (.02)	.16 (.04)	.68 (.05)	.55 (.07)	.53 (.07)	.72 (.07)	.61 (.06)	.63 (.08)

TRF = Text reading fluency; RC = Reading comprehension

Note: All the loadings were statistically significant at .001 level.

Table 4

Correlations between latent variables (kindergarten sample N = 98; first grade sample N = 170)

	1	2	3
Kindergarten entire sample			
1. Listening comprehension	---		
2. Word reading fluency	.39	---	
3. Text reading fluency	.43	.94	---
4. Reading comprehension	.55	.88	.90
First grade entire sample			
1. Listening comprehension	---		
2. Word reading fluency	.53	---	
3. Text reading fluency	.53	.70	---
4. Reading comprehension	.91	.54	.43
First grade skilled word readers			
1. Listening comprehension	---		
2. Word reading fluency	.45	---	
3. Text reading fluency	.35	.56	---
4. Reading comprehension	.89	.43	.26
First grade less skilled word readers			
1. Listening comprehension	---		
2. Word reading fluency	.43	---	
3. Text reading fluency	.45	.70	---
4. Reading comprehension	.84	.42	.27

All coefficients are statistically significant at .05 level.