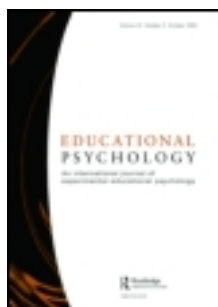


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Correlates of early reading comprehension skills: a componential analysis

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Correlates of early reading comprehension skills: a componential analysis

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This study had three main aims. First, we examined to what extent listening comprehension, vocabulary, grammatical skills and verbal short-term memory (VSTM) assessed prior to formal reading instruction explained individual differences in early reading comprehension levels. Second, we examined to what extent the three common component skills, namely vocabulary, grammar and VSTM explained the relationship between kindergarten listening comprehension and early reading comprehension levels. Third, we examined the relative contributions of word-reading and listening comprehension skills to early reading comprehension in Turkish. For this purpose, 56 Turkish-speaking children were followed from kindergarten (mean age = 67.7 months) into Grade 2 (mean age = 90.6 months). The relative role of kindergarten listening comprehension, vocabulary, VSTM and grammatical skills in later reading comprehension tended to vary across time, and they partly explained the relationship between listening comprehension and reading comprehension. Finally, as anticipated, listening comprehension, rather than word-reading, was found to play a more powerful role in children's reading comprehension levels even during the early primary grades. These results contradicted those reported in English and can be explained by the rapid development of accurate word-reading skills due to the consistency of the grapheme–phoneme relationships of the Turkish orthography.

Keywords: vocabulary; listening comprehension; reading comprehension; grammatical skills; verbal short-term memory; transparent orthography

Introduction

Listening comprehension inevitably precedes reading comprehension, and it can be considered an important precursor of early reading comprehension skills (Van den Broek et al., 2005). Currently, however, there is a paucity of longitudinal research that has specifically examined the role of preschool listening comprehension skills in early reading comprehension development. Although it is widely assumed that vocabulary, grammatical skills and verbal memory are the primary common component processes that explain the relationship between listening comprehension (linguistic comprehension) and reading comprehension (Gough & Tunmer, 1986; Hoover & Gough, 1990), we are not aware of any study that systematically examined these relationships. Hence, there is clearly a need for more research to clarify the underlying common component processes of listening comprehension

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and reading comprehension with far-reaching important implications for early identification of children who might be at risk of later reading comprehension difficulties. Along with linguistic comprehension, accurate word recognition is essential for reading comprehension (Gough & Tunmer, 1986; Hoover & Gough, 1990). In fact, the latter is a major factor that constrains children's early reading comprehension levels. This is evidenced by the strong predictive relationships between word recognition and reading comprehension skills during the early primary grades, which then, decline as word recognition accuracy levels increase with age (Catts, Hogan, & Adolf, 2005; Curtis, 1980; Gough, Hoover, & Peterson, 1996). However, most research in this area has been conducted in English, and it is not clear to what extent the observed pattern of findings in English can be extended to transparent orthographies with simpler and more consistent grapheme–phoneme relationships.

The simplicity of the grapheme–phoneme relationships in transparent orthographies facilitates the development of word recognition skills, and it is for this reason that high rates of word recognition accuracy are achieved within the first year of formal reading instruction in transparent orthographies (Seymour, Aro, & Erskine, 2003). The rapid development of word recognition skills may, in turn, mean that word-reading may not constrain children's early reading comprehension skills in transparent orthographies to the same extent as observed in English. Although a few studies in highly transparent orthographies, such as Turkish and Finnish, provided supporting evidence for this notion (e.g. Babayiğit & Stainthorp, 2011; Müller & Brady, 2001), so far the research evidence from transparent orthographies is highly limited and far from conclusive. Hence, it remains to be clarified to what extent word recognition is a reliable index of early reading comprehension levels in transparent orthographies. This study sought to address these issues and examined (1) to what extent listening comprehension skills, vocabulary, verbal short-term memory (VSTM) and grammatical skills assessed prior to formal reading instruction explain individual differences in early reading comprehension levels; (2) to what extent the three main component skills of vocabulary, grammar and VSTM explain the relationship between kindergarten listening comprehension and early reading comprehension; and (3) the relative contributions of word recognition and listening comprehension skills to early reading comprehension levels in the transparent orthography of Turkish.

Theoretical framework: taking the simple view of reading further

The simple view of reading framework conceptualises reading comprehension as a product of listening comprehension and decoding (Gough & Tunmer, 1986; Hoover & Gough, 1990). During the early stages of reading development, decoding skills (i.e. bottom-up processes) play a central role in children's reading comprehension levels. However, once children's word recognition proficiency develops with time and reaches a certain threshold, it ceases to constrain reading comprehension levels and, instead, top-down or higher level linguistic comprehension processes take precedence in explaining individual differences in reading comprehension levels (Hoover & Gough, 1990). Hence, as children's word-reading accuracy levels increase, whereas the effect of word recognition on reading comprehension levels decreases, that of listening comprehension becomes stronger (i.e. explains a larger amount of the variance in reading comprehension levels). The studies in English have provided substantial support for these developmental relationships

(e.g. Adlof, Catts, & Little, 2006; Francis, Fletcher, Catts, & Tomblin, 2005; Gough et al., 1996). Hence, the simple view of reading provides a framework for examining the changing roles of word recognition and listening comprehension skills in children's reading comprehension development.

Although the simple view of reading acknowledges that there are important differences in the processing demands of listening comprehension and reading comprehension, it also emphasises the similarities in their component processing skills, such as vocabulary, verbal memory and grammatical skills (Hoover & Gough, 1990). However, the paucity of longitudinal research on typically developing children means that it is not entirely clear to what extent verbal memory, vocabulary and grammatical skills can be considered the key common components that explain the relationship between listening and reading comprehension. Needless to say, this issue has particular implications for advancing our understanding of the causal antecedents of reading comprehension skills (see de Jong & van der Leij, 2002; Oakhill & Cain, 2007b).

Reading comprehension entails a wide range of cognitive–linguistic processes, including executive skills, motivation and metacognitive skills (e.g. inference making) and can be influenced by background knowledge and text characteristics (for reviews, see Guthrie & Wigfield, 2005; Nation, 2005; Oakhill & Cain, 2007a; Perfetti, Landi, & Oakhill, 2005). However, a focus on oral language processing and verbal memory skills can be considered a good starting point for examining the development of the early reading comprehension skills of young children who necessarily have limited metacognitive skills, background knowledge and experience with text reading.

Component skills: The roles of vocabulary, VSTM and grammatical skills in reading comprehension

Vocabulary, as an index of semantic knowledge, is clearly central to comprehension processes, and numerous studies have reported powerful longitudinal predictive relationships between vocabulary and reading comprehension (e.g. de Jong & van der Leij, 2002; Muter, Hulme, Snowling, & Stevenson, 2004; National Institute of Child Health and Development Early Child Care Research Network [NICHD], 2005; Roth, Speece, & Cooper, 2002; Torgesen, Wagner, Rashotte, Burgess, & Hecht, 1997). This is a complex and multifaceted relationship. Nonetheless, broadly, it can be conceptualised that vocabulary may impact upon reading comprehension directly through its effect on the semantic processing of text as well as indirectly through its facilitating effect on word recognition skills (e.g. see NICHD, 2005).

Grammar is a multi-dimensional construct that is concerned with the ordering of linguistic units to convey meaning (i.e. syntax) and the internal structure of linguistic units (i.e. morphology) (Carter & McCarthy, 2006). Within the context of this study, grammar will be used as a generic term that primarily entails morphological and syntactic processing skills. Grammatical processing skills can influence sentence comprehension and, thereby, text comprehension, through processes, such as syntactic parsing the syntactic parsing entails assigning syntactic functions to the constituent words of a sentence and thereby, constructing a structure tree with noun and verb phrases. The understanding of the meaning of words and the construction of a syntactic structure are central for sentence comprehension (Scott, 2004; Van Gompel & Pickering, 2007). As with vocabulary, grammar can also facilitate word

recognition skills and, thereby, reading comprehension (Bowey, 1986a; Cain, 2007; Carlisle, 1995; Willows & Ryan, 1986). Several longitudinal investigations have found grammatical skills to be a reliable predictor of subsequent reading comprehension levels even after controlling for vocabulary skills (e.g. Adlof, Catts, & Lee, 2010; Muter et al., 2004; NICHD, 2005). Likewise, significant weaknesses in grammatical skills have been found to be one of the distinguishing features of children who can read words accurately but have a specific difficulty with the comprehension of written text (Nation, Clarke, Marshall, & Durand, 2004). There is, however, a clear need for further longitudinal research on typical populations with a focus on the role of grammar in early reading comprehension development (for further discussion, see Scott, 2009).

Reading comprehension is a highly integrative process that clearly calls upon verbal working memory skills (Daneman & Merikle, 1996; Just & Carpenter, 1992; Kintsch, 1998). The commonly used complex verbal working memory tasks, such as listening span tasks, can be too difficult for children below the age of six years, as they require switching between processing and storage functions (Gathercole, Pickering, Ambridge, & Wearing, 2004; see also Daneman & Blennerhassett, 1984). For instance, in a listening span task, typically children are presented with a series of simple sentences (e.g. rabbits have wheels; the sky is blue) that they need to verify as true or false. They are then asked to recall the last word of each sentence in the same serial order of presentation (see Pickering & Gathercole, 2001). Therefore, studies on young children below the age of six years tend to focus on simple verbal working memory or VSTM, which entails passive storage of verbal information, such as serial recall of digits or words (Gathercole et al., 2004). Among older primary school children, complex verbal working memory tends to influence reading comprehension more than VSTM skills (Oakhill, Yuill, & Parkin, 1986; Pimperton & Nation, 2010; Stothard & Hulme, 1992; Yuill & Oakhill, 1991). However, for younger age groups in early primary grade levels, VSTM (simple verbal working memory) skills have also been found to influence both listening comprehension and reading comprehension levels (e.g. Dufva, Niemi, & Voeten, 2001; Näslund & Schneider, 1991). For example, in a study on Finnish-speaking preschoolers (mean age=6 years 9 months), Dufva et al. (2001) found that preschool VSTM skills influenced second-grade reading comprehension levels through its relationship with both listening comprehension and word-reading skills. Very similar results have been reported by Näslund and Schneider (1991) on a group of German-speaking kindergarten children (mean age=6.1 years). In a retrospective study in Finnish, Torppa et al. (2007) also noted that children who were identified to have reading comprehension difficulties at eight years of age had depressed scores on VSTM tasks (e.g. forward digit span) at 5.5 and 6.5 years.

One possible explanation as to why some studies have found VSTM to be linked to younger but not older primary school children's reading comprehension levels might be that for younger age groups, VSTM tasks are more demanding and therefore, may act as complex working memory tasks (i.e. assess both processing and storage of information) (Engle, Tuholski, Laughlin, & Conway, 1999). Hence, whereas younger children's more limited VSTM skills may constrain the comprehension processes, this may not be the case for older age groups who have larger VSTM spans, better attentional control skills, better long-term memory support and more knowledge of memory strategies for effective recall. The commonly used VSTM tasks, such as digit span tasks, also assess phonological skills, which are

important for accurate word-reading (Snowling, 2000). This might be another reason why both Näslund and Schneider (1991) and Dufva et al. (2001) found that preschool VSTM made indirect contributions to later reading comprehension levels through word-reading skills. Taken together, these findings suggest the importance of examining the role of VSTM skills in early reading comprehension development of younger primary school children.

There is a substantial amount of research evidence showing significant longitudinal relationships between oral language skills (i.e. listening comprehension and vocabulary) and later reading comprehension development (e.g. Catts, Adlof, & Weismer, 2006; Catts, Tomblin, Compton, & Bridges, 2012; Justice, Mashburn, & Petscher, 2011; Nation, Cocksey, Taylor, & Bishop, 2010; Storch & Whitehurst, 2002; Torppa et al., 2007). For instance, Nation et al. (2010) followed children from 5.5 years to 8 years of age and found that children who were identified to have reading comprehension difficulties (but had adequate word recognition skills) at the age of eight years, showed evidence of weaknesses in their listening comprehension, vocabulary and grammatical skills when these skills were assessed at earlier time periods. However, to our knowledge, no study examined to what extent VSTM, vocabulary and grammatical skills explained the relationship between listening comprehension and reading comprehension. Given the evidence for the continuity of comprehension skills (Van den Broek et al., 2005), as well as reports that listening comprehension may act as an early marker of later reading comprehension development (e.g. Justice et al., 2011), examining the common components of listening comprehension and reading comprehension is clearly an important step forward in the furtherance of our understanding of the antecedents of reading comprehension skills.

Relative contributions of word recognition and listening comprehension to reading comprehension levels: comparison of transparent and non-transparent orthographies

Several studies in highly transparent orthographies, such as Turkish and Finnish have found small and time-limited effects of word recognition skills on early reading comprehension levels (e.g. Dufva et al., 2001; Müller & Brady, 2001; Öney & Durgunoğlu, 1997). The difference between English and transparent orthographies was perhaps best illustrated by Müller and Brady (2001) who compared a group of 80 Finnish-speaking children with their English-speaking peers at Grade 1. The data for the English-speaking group came from an earlier study conducted by Stanovich, Cunningham, and Freeman (1984). In the Finnish-speaking group, after controlling for phonological skills and general intelligence, listening comprehension accounted for 10% of unique variance in Grade 1 reading comprehension, whereas word-reading fluency explained only 5% of unique variance. The opposite pattern of results was observed for the English-speaking group: word-reading proficiency was a more powerful predictor of reading comprehension levels than listening comprehension skills (Müller & Brady, 2001).

Likewise, Dufva et al. (2001) followed 222 Finnish-speaking preschool children into Grade 2 and found that listening comprehension skills assessed at preschool and Grade 1 were the most powerful longitudinal correlate of reading comprehension ($r_s = .65$ and $.74$, all $p_s < .001$, respectively). Moreover, listening comprehension was a significant unique predictor of reading comprehension over and above

verbal memory and word recognition skills. In contrast, the relationships between word-reading speed and reading comprehension at Grades 1 and 2 were much weaker in this study ($r_s = -.29$ and $-.36$, all $p_s < .05$, respectively).

Further corroborating findings came from a study on Turkish-speaking children at Grade 1 (mean age = 77.2 months) (Öney & Durgunoğlu, 1997). In that study, listening comprehension was by far the most powerful correlate of reading comprehension ($r = .87$, $p < .01$) and explained significant unique variance in reading comprehension over and above word recognition and syntactic skills.

However, these findings are not entirely unequivocal and at least two studies in Dutch, which also has a transparent orthography, found word-reading to play a more central role in reading comprehension levels even among older age groups. For instance, de Jong and van der Leij (2002) followed 141 Dutch-speaking children from Grade 1 (mean age = 7 years 2 months) to Grade 3 and found that Grade 1 word recognition explained a small but significant amount of further variance in Grade 3 reading comprehension levels over and above the autoregressive effect of Grade 1 reading comprehension. Similar results were reported by Droop and Verhoeven (2003), who tested Dutch-speaking children at Grade 3: word-reading skills assessed at the beginning of Grade 3 made a significant direct effect on Grade 3 reading comprehension assessed at the end of Grade 3, over and above the autoregressive effect of reading comprehension (assessed at the beginning of Grade 3), listening comprehension and oral language skills.

At this point, it is noteworthy that in our previous study with older Turkish-speaking children (mean ages ranged from 7.6 years to 10.3 years), we implemented a wide range of word-reading tasks and found small-to-moderate correlation coefficients between word-reading fluency and reading comprehension levels. In that study, the unique effect of word-reading fluency on reading comprehension became negligible, when vocabulary, verbal working memory, non-verbal reasoning and listening comprehension skills were included in the structural equation model (see Babayiğit & Stainthorp, 2011). Instead, we found listening comprehension to be the most powerful unique predictor of individual differences in reading comprehension levels after taking into account the effects of other predictor measures.

It is not entirely clear whether these seemingly contradictory findings are due to methodological differences, subtle differences in the degree of transparency of these writing systems or a combination of these factors. Therefore, further research is needed to examine to what extent word-reading proficiency constrains children's early reading comprehension levels and can be considered a reliable index of children's broader reading skills in transparent orthographies.

At this point, a distinction needs to be made between word-reading accuracy and word-reading fluency (for detailed discussions, see Fuchs, Fuchs, Hosp, & Jenkins, 2001; Kuhn & Stahl, 2003). Due to the rapid mastery of accurate word-reading skills, reading fluency is considered a more sensitive measure of individual differences in word-reading skills in transparent orthographies (Wimmer, 1996), and therefore, it is possible that word-reading fluency rather than word-reading accuracy may play a stronger role in reading comprehension. However, there are contradictory findings in relation to the role of reading fluency in reading comprehension (Adlof et al., 2006; Jenkins, Fuchs, van den Broeck, Espin, & Deno, 2003; Proctor, Carlo, August, & Snow, 2005), and it remains to be clarified to what extent word-reading fluency influences reading comprehension independent from word-reading accuracy skills (Paris, Carpenter, Paris, & Hamilton, 2005). It is beyond the scope

of the present study to examine these issues in detail. However, suffice it to say that in the case of highly transparent orthographies, such as Turkish and Finnish, the reported weak relationships between word-reading skills and reading comprehension came from studies that have assessed word-reading accuracy as well as word-reading fluency skills (see Babayiğit & Stainthorp, 2011; Dufva et al., 2001; Öney & Durgunoğlu, 1997; Müller & Brady, 2001).

Summary of aims and predictions

There were three main aims of the present study. First, we sought to examine the extent to which listening comprehension, VSTM, vocabulary and grammatical skills assessed at kindergarten and prior to the onset of formal reading instruction would make significant contributions to later reading comprehension levels at Grades 1 and 2. Given the previous research evidence, we expected that kindergarten measures of oral language and VSTM skills would explain significant variance in later reading comprehension levels.

Second, we aimed to build on the existing research evidence by examining the extent to which the three common component skills (i.e. VSTM, vocabulary and grammatical skills) explained the relationship between kindergarten listening comprehension and later reading comprehension levels. The paucity of research impedes precise predictions. Nonetheless, if these three common component skills explain the relationship between kindergarten listening comprehension and later reading comprehension, then the influence of listening comprehension on later reading comprehension was expected to become negligible (i.e. non-significant) when these component skills were taken into account.

Finally, we set out to examine the relative contributions of word-reading and listening comprehension skills to early reading comprehension levels in a highly transparent orthography. Following the previous findings from Turkish (Öney & Durgunoğlu, 1997) and other highly transparent writing systems, such as Finnish (Dufva et al., 2001), we anticipated that the influence of listening comprehension on reading comprehension would be stronger than that of word-reading across all testing periods.

Method

Participants

Fifty-six (27 females, 29 males) Turkish-speaking children were recruited from two public kindergartens in Northern Cyprus where Turkish is the only official language. Children were randomly selected with the constraining conditions that they should be monolingual speakers of Turkish with no formally diagnosed speech, language or neurological disorders. At the time of the study, kindergarten was part of the preschool system that children typically attended when they turned five years of age. Children were followed from kindergarten through Grade 2 and tested at the end of kindergarten, Grades 1 and 2. Children's mean age was 67.65 months (ranged from 64 to 76 months, $SD=3.63$) in kindergarten, 79.11 at Grade 1 (ranged from 76 to 88 months, $SD=3.56$) and 90.61 (ranged from 87 to 99 months, $SD=3.36$) at Grade 2. At the time of the study, in kindergarten, teachers followed the national curriculum that included activities to develop children's vocabulary,

broader oral language skills and print awareness (e.g. listening to stories). Children were taught how to write the letters of the alphabet as part of pre-writing activities but they were not taught the letter names, the grapheme–phoneme relationships or how to read words. Therefore, most children could not read words in kindergarten, and they had very limited alphabet knowledge (Babayiğit & Stainthorp, 2007). A set of screening measures of early word recognition skills and alphabet knowledge confirmed that children in this study could not read words and had very limited knowledge of grapheme–phoneme relationships. Finally, the formal reading instruction in Northern Cyprus involves a mixture of phonics and whole word methods and begins at Grade 1 (Babayiğit & Konedralı, 2009; Babayiğit & Stainthorp, 2007).

The sample size reduced to 54 at Grade 1 and 48 at Grade 2: Eight children failed to complete the study due to either illness or families moving. The reported results were based on children with complete data. The sample reflected a wide range of socio-economic backgrounds. The parental occupational levels were 21% house worker/unemployed, 13% partially manual, 10% skilled manual, 38% non-manual skilled, 13% self-employed and 6% professional. The highest attained educational levels of the parents were 22% primary school, 8% secondary school, 57% high school, 11% undergraduate and 4% post-graduate.

Materials and procedures

The children were tested individually at their school at the end of each grade level (i.e. the spring term of kindergarten, Grades 1 and 2). Each testing wave lasted for about four weeks. Standardised tests of reading, listening comprehension and grammatical skills were not available in Turkish at the time of testing. Hence, these tasks have been developed by the first author, who is a native speaker of Turkish. The tasks were piloted on eight children from the same age groups to ensure there were no ceiling and floor effects. All testing was conducted by the first author. The measures of non-verbal reasoning, VSTM, vocabulary, grammar and listening comprehension were implemented in kindergarten. At Grades 1 and 2, children were presented with the same reading and listening comprehension tasks. (Recall that children could not read words in kindergarten).

Non-verbal reasoning

There is some evidence that children with reading comprehension difficulties may show weaknesses in non-verbal reasoning skills (Catts et al., 2012; Nation, Clarke, & Snowling, 2002). In this study, Raven's Coloured Progressive Matrices (Raven, Raven, & Court, 1998) was used as a control measure for general non-verbal reasoning skills in kindergarten. The reported internal reliability indices of this test exceed .90 (Raven et al., 1998). Standard testing procedures were followed.

Vocabulary

The vocabulary subscale from the Turkish version of the Wechsler Intelligence Scale for Children-Revised (WISC-R) (Savaşır & Şahin, 1995) was used as a measure of expressive vocabulary skills. The reported internal consistency of the scores

on this subset exceeds .90 (Savaşır & Şahin, 1995). Standard testing and scoring procedures as outlined in the test manual were implemented.

It is notable that the WISC-R has been standardised in Turkey and on children aged between 68 and 75 months (Savaşır & Şahin, 1995). In this study, the age of the students in kindergarten was slightly younger (ranged from 64 to 76 months) but relatively comparable with the standardisation sample. Unfortunately, at the time of testing, this was the only standardised vocabulary test in Turkish that could be used. For these reasons, we reported the results based on raw scores rather than standard scores.

Verbal short-term memory (VSTM)

The forward digit span subtest from the WISC-R (Savaşır & Şahin, 1995) and a word span test developed by the first author were used to assess VSTM skills. The word span task followed the same procedure as the forward digit span subtest. There were seven sets of fourteen trials in each test. In this study, the split-half internal consistency was .90 for word span and .94 for digit span. The final composite VSTM score was the sum of the digit span and word span scores.

Grammatical skills

This task was partly adapted from Bowey (1986a, 1986b) and aimed to assess children's morphological and syntactic processing skills. Sentences with inflectional suffixation or word-order errors were read aloud with a normal prosody. The task was to repeat the sentence after undertaking the necessary correction. In order to reduce the memory load of this task, the experimenter repeated the sentences when required (up to three repetitions were allowed). Five practice trials with feedback were given at the beginning of each task in order to ensure that children understood the task. There were 12 test trials in total and one point was awarded for any grammatically acceptable answer (see Appendix). The Cronbach's alpha coefficient of this task was .72.

Listening comprehension

This task was based on the listening comprehension subset of the Wechsler Oral Language Dimensions (Wechsler, 1996) (for further information, see Babayiğit & Stainthorp, 2011). It was implemented at all three testing occasions: kindergarten, Grades 1 and 2.

Short narrative passages between one and four sentences in length (10–36 Turkish words) were read aloud once with a normal prosody and then followed by oral comprehension questions. There were five different passages and 12 comprehension questions. Children were instructed that they would have only one opportunity to listen to the passages. The questions required both inference making and the extraction of literal information from the sentence or passage. One point was given for each correct answer. The Cronbach's alpha coefficients at kindergarten, Grades 1 and 2 were .67, .72 and .68, respectively. The observed strong correlations between the listening comprehension measures across the three testing times suggested that there was relatively high stability in children's listening comprehension levels from kindergarten to the end of Grade 2 (Table 2). Finally, the observed large correlation coefficients between reading

comprehension and listening comprehension measures provided support for the concurrent validity of these measures (Table 2).

Reading

Children read two narrative passages aloud. One passage was composed of 31 words and the other of 70 words. There were 15 questions designed to tap verbatim memory of text as well as inference making skills. One of these passages was adapted from Oakhill's (1984) Tim and the Biscuit Tin story. Pilot tests confirmed that the questions could not be answered without having read the passages (see Keenan & Betjemann, 2006). The passages were taken away before the presentation of the questions. The scores on the two passages were combined to obtain an overall index of word-reading accuracy rate, word-reading fluency and reading comprehension skills. Hence, the percentage of accurately read words across the two passages was used as an index of word-reading accuracy rate. The reading time of the two passages was also noted, which then enabled to obtain a measure of reading fluency, scored in terms of the total number of words read accurately in one minute. The reading sessions were tape-recorded for cross-validation.

The alpha coefficient internal consistency of the reading comprehension scores was .75 at Grade 1 and .74 at Grade 2. The correlation coefficient between the two consecutive measures of reading comprehension at Grades 1 and 2 was large, $r = .67$, $p < .001$. There was also evidence for high stability in word-reading fluency scores from Grades 1 to 2, $r = .82$, $p < .001$. The restricted variance in the word-reading accuracy scores seems to be the most likely explanation for the non-significant correlation coefficient between the Grades 1 and 2 word-reading accuracy measures (Table 2).

Results

Preliminary data analysis

Table 1 provides a summary of the measures, testing times and descriptive statistics. In line with previous findings from Turkish as well as other transparent orthographies (e.g. Öney & Durgunoğlu, 1997; Seymour et al., 2003), word-reading accuracy scores were at ceiling levels (mean percentage of accurately read words = 94% at Grade 1 and 97% at Grade 2) and showed significant negative skews at both testing times ($z_{\text{Grade 1}} = 9.47$ and $z_{\text{Grade 2}} = 4.37$, $ps < .001$). Several recommended transformation procedures (e.g. logarithm 10, see Tabachnick & Fidell, 2001) were implemented but all failed to improve the distribution of the word-reading accuracy scores. However, as there was some variability in the scores, specifically at Grade 1, it was decided to retain the word-reading accuracy measure in the analysis (Table 1). Further screening of data did not reveal any significant deviations from normality. There was one outlying low score on Grade 2 word-reading accuracy, which was changed to the next lowest score. With the exception of non-verbal reasoning ($r = .31$, $p = .025$), age did not significantly correlate with any of the measures. Therefore, age-adjusted non-verbal reasoning scores were included in the subsequent analyses.

Table 1. Measures, testing occasions and descriptive statistics.

Measures/potential range	Kindergarten (N=56) (Mean age = 67.8 months)		Grade 1 (N=54) (Mean age = 79.1 months)		Grade 2 (N=48) (Mean age = 90.6 months)	
	Mean (SD)	Actual range	Mean (SD)	Actual range	Mean (SD)	Actual range
1. Raven/36 ^a	13.70 (3.40)	8–25				
2. Vocabulary/68	9.17 (4.48)	2–25				
3. VSTM/28	4.56 (1.97)	1–10				
4. Grammatical skills/12	3.15 (2.18)	0–8				
5. Listening comprehension/12	4.20 (2.01)	1–9	6.02 (2.48)	1–12	7.78 (2.19)	3–12
6. Reading fluency ^b /na			29.52 (11.89)	6–56	51.13 (16.03)	28–87
7. Reading accuracy/100 ^c			94.10 (7.64)	58–100	97.31 (2.44)	88–100
8. Reading comprehension/15			5.56 (3.29)	0–12	8.94 (3.24)	2–15

Note: na = not applicable; VSTM = verbal short-term memory.

^aRaven's coloured progressive matrices.

^bScored as the number of correct words read per minute.

^cScored as the percentage of accurately read words.

Table 2. Correlations between the measures.

	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Raven – K	–												
2. VSTM – K	.32*	–											
3. Vocabulary – K	.15	.27*	–										
4. Grammatical skills – K	.38**	.26*	.39**	–									
5. Listening comprehension – K	.26*	.23	.19	.37**	–								
6. Listening comprehension – G1	.28*	.43**	.50***	.44***	.58***	–							
7. Reading accuracy – G1	.18	.25	.02	.34*	–.09	.11	–						
8. Reading fluency – G1	.14	.54***	.17	.21	.08	.10	.58***	–					
9. Reading comprehension – G1	.36*	.44***	.28*	.44***	.52***	.47***	.33*	.31*	–				
10. Listening comprehension – G2	.25	.28*	.26	.51***	.59***	.62***	.06	–.12	.51***	–			
11. Reading accuracy – G2	–.23	–.26	.43**	–.19	–.28	–.38**	.19	.20	–.13	–.14	–		
12. Reading fluency – G2	.07	.36*	.10	.05	–.07	–.09	.33*	.82***	–.06	–.14	–.29	–	
13. Reading comprehension – G2	.31*	.37**	.41**	.34*	.40**	.52***	.08	–.07	.67***	.59***	–.18	–.17	–

Note: Raven = Raven's coloured progressive matrices; VSTM = verbal short-term memory; K = Kindergarten; G1 = Grade 1; G2 = Grade 2.
 * $p < .05$. ** $p < .01$. *** $p < .001$.

Table 3. Hierarchical multiple regression analysis: kindergarten predictors of reading comprehension levels assessed at Grades 1 and 2.

Kindergarten Measures	Grade 1 – reading comprehension		Grade 2 – reading comprehension	
	ΔR^2	β	ΔR^2	β
Step 1	.33**		.27**	
Raven		.13		.16
Vocabulary		.04		.29*
VSTM		.32*		.21
Grammatical skills		.27*		.08
Step 2	.11**		.05	
Listening comprehension		.37**		.24
R^2 (Adjusted)	.44 (.37)**		.31 (.22)**	

Note: Raven = Raven's Coloured Progressive Matrices; VSTM = verbal short-term memory; β = standardised beta coefficient.

* $p < .05$. ** $p < .01$. *** $p < .001$.

Correlations between the measures

Table 2 shows the inter-correlations between the measures across the three testing times. The strength of the relationships of the three component processing skills with the reading comprehension levels varied depending on the testing period. Nonetheless, listening comprehension was the most powerful and consistent correlate of reading comprehension across all testing periods. The concurrent correlation coefficients between Grade 1 reading comprehension and word-reading measures (i.e. word-reading accuracy and fluency) were moderate and significant. However, these relationships became non-significant when they were tested at Grade 2. The longitudinal correlation coefficients between Grade 1 word-reading and Grade 2 reading comprehension were also very small and non-significant.

Kindergarten predictors of reading comprehension

Using a series of hierarchical multiple regression analyses, we examined (a) to what extent the kindergarten measures of vocabulary, grammar, VSTM and listening comprehension skills explained individual differences in Grades 1 and 2 reading comprehension levels and (b) to what extent the relationship between kindergarten listening comprehension and early reading comprehension levels could be explained by the three common component skills (i.e. vocabulary, VSTM and grammatical skills). In order to address these two questions, the three component skills, along with non-verbal reasoning, were entered into the regression model at Step 1 and listening comprehension was entered into the model at Step 2. Table 3 shows the summary of the results.

The overall model accounted for 44% of the variance in Grade 1 and 31% of the variance in Grade 2 reading comprehension levels, $F(5, 48) = 6.42$ and $F(5, 42) = 3.36$, $ps < .01$, respectively. The strength of the relationships between the individual kindergarten predictor measures and reading comprehension levels tended to vary across the two developmental periods. Whereas kindergarten VSTM, listening comprehension and grammatical skills were all statistically significant unique

predictors of Grade 1 reading comprehension, vocabulary was the only significant unique predictor of Grade 2 reading comprehension.

When the effects of non-verbal reasoning and the three component skills (i.e. vocabulary, VSTM and grammatical skills) were statistically accounted for, kindergarten listening comprehension remained as a significant predictor and explained further unique variance in Grade 1 reading comprehension level, $\Delta R^2 = .11$, $F(1, 48) = 8.33$, $p = .006$, 95% CI [.12, .86]. It is noteworthy that when the kindergarten listening comprehension was entered into the regression model alone at Step 1, it explained a larger amount of the variance in Grade 1 reading comprehension performance, $R^2 = .28$, $F(1, 52) = 17.73$, $p < .001$, 95% CI [.29, .82]. These findings suggested that the relationship between kindergarten listening comprehension and Grade 1 reading comprehension was partially explained by the three component skills.

In contrast, the component skills fully explained the relationship between kindergarten listening comprehension and Grade 2 reading comprehension. When listening comprehension was entered into the regression model at Step 1, it was a significant predictor and explained a moderate amount of the variance in Grade 2 reading comprehension, $R^2 = .16$, $F(1, 46) = 8.44$, $p = .006$, 95% CI [.13, .71]. However, the unique contribution of listening comprehension to the Grade 2 reading comprehension variance became smaller and non-significant when individual differences in non-verbal reasoning and the three component skills were statistically accounted for, $\Delta R^2 = .05$, $F(1, 42) = 2.52$, $p = .121$, 95% CI [-.07, .57].

Finally, in order to further inform our evaluation of the component processes of language comprehension, we examined the total variance the three component skills explained in listening comprehension levels. For this purpose, a series of simultaneous multiple regression analyses were conducted with non-verbal reasoning, vocabulary, VSTM and grammatical skills as the predictor measures of listening comprehension levels assessed at the three testing points (i.e. kindergarten, Grades 1 and 2). The overall model accounted for small-to-moderate amounts of the variance in listening comprehension performance. The total R^2 was .18 ($F[4, 51] = 2.60$, $p = .048$) for kindergarten listening comprehension, .39 ($F[4, 49] = 7.11$, $p < .001$) for Grade 1 listening comprehension, and .27 ($F[4, 43] = 3.45$, $p = .017$) for Grade 2 listening comprehension levels. One possible reason why the concurrent relationships in kindergarten were weaker than longitudinal relationships might be the restricted range of listening comprehension scores in kindergarten. Nonetheless, it is noteworthy that the overall predictive power of the kindergarten measures was comparable across the listening comprehension and reading comprehension levels at Grades 1 and 2: The total R^2 was .33 for Grade 1 and .27 for Grade 2 reading comprehension levels (Table 3).

The relative contributions of word-reading and listening comprehension to Grades 1 and 2 reading comprehension levels

We then examined the relative role of word-reading accuracy and listening comprehension in early reading comprehension levels. As word-reading accuracy tended to be more strongly related to reading comprehension than word-reading fluency (Table 2), only word-reading accuracy was included in the regression model.

Table 4 shows the summary of the simultaneous multiple regression analyses, examining the concurrent relationships between the predictor measures (i.e. word-reading accuracy and listening comprehension) and reading comprehension

Table 4. Multiple regression analysis examining the relative contributions of word recognition and listening comprehension skills to early reading comprehension levels: concurrent relationships.

Measures ^a	Grade 1 – reading comprehension			Grade 2 – reading comprehension		
	β	$t(51)$	95% CI	β	$t(45)$	95% CI
Reading accuracy	.28	2.21*	[.02, .51]	-.17	-1.40	[-.49, .09]
Listening comprehension	.45	3.55***	[.18, .67]	.59	4.88***	[.35, .84]
R^2 (Adjusted)	.30 (.27)			.38 (.35)		

Note: ^a=For Grade 1 reading comprehension, the Grade 1 reading accuracy and listening comprehension were the predictor measures. Likewise, for the Grade 2 reading comprehension, the Grade 2 reading accuracy and listening comprehension were the predictor measures. β =standardised beta coefficient. CI=confidence interval.

* $p < .05$. ** $p < .01$. *** $p < .001$.

measures assessed at Grades 1 and 2. The overall model was significant at both Grades 1 and 2, ($F[2, 51]=9.66$ and $F[2, 45]=12.92$, $ps < .001$, respectively). At Grade 1, both word-reading accuracy and listening comprehension were significant unique predictors of reading comprehension. At Grade 2, however, listening comprehension was the only significant unique predictor and word-reading accuracy failed to explain significant variance in reading comprehension.

Next, the longitudinal relationships between Grades 1 and 2 measures were examined. For this purpose, Grade 1 reading comprehension was entered into the regression model at Step 1 to control for autoregressive effect. As Table 5 indicated, Grade 1 listening comprehension explained a small but significant amount of further variance in Grade 2 reading comprehension over and above the autoregressive measure (Model 1, Table 5). In contrast, Grade 1 word-reading accuracy failed to predict Grade 2 reading comprehension when the autoregressive effect of the Grade 1 reading comprehension was taken into account (Model 2, Table 5). However, the influence of Grade 1 listening comprehension on Grade 2 reading comprehension became marginally significant when word-reading accuracy was also statistically accounted for ($\Delta R^2 = .04$, $\beta = .24$, $p = .071$). The overall model was significant and explained a large amount of the variance in Grade 2 reading comprehension levels, $F(3, 44) = 14.71$, $p < .001$.

Discussion

Broadly, the findings from this study indicated that listening comprehension along with vocabulary, grammar and VSTM skills assessed prior to formal reading instruction could be a reliable indicator of children's early reading comprehension performance. The results also provided evidence that vocabulary, grammar and VSTM are common component skills that partially explained the relationship between kindergarten listening comprehension and later reading comprehension. Finally, in line with the previous research in Turkish, children's word-reading accuracy rates were very high in this study. For this reason, and as anticipated, listening comprehension, rather than word-reading accuracy, was found to play a more significant role in early reading comprehension in Turkish.

Table 5. Hierarchical multiple regression analysis examining the relative contributions of word-reading and listening comprehension skills to early reading comprehension levels: longitudinal relationships.

Grade 1 measures	Grade 2 – reading comprehension	
	ΔR^2	β
Step 1		
Reading comprehension (autoregressor)	.46***	.61***
Model 1		
Step 2		
Listening comprehension	.06*	.24
Step 3		
Reading accuracy	.01	-.13
Model 2		
Step 2		
Reading accuracy	.03	
Step 3		
Listening comprehension	.04	
Total R^2 (adjusted)	.53 (.50)	

Note: β = standardised beta coefficient when all the predictor variables were included in the regression model.

* $p < .05$. ** $p < .01$. *** $p < .001$.

Kindergarten predictors of reading comprehension

The strength of the relationships of individual kindergarten measures and later reading comprehension levels tended to vary across time. Whereas kindergarten listening comprehension, VSTM and grammatical skills were unique predictors of Grade 1 reading comprehension levels, vocabulary was the only unique predictor of Grade 2 reading comprehension. However, it is noteworthy that all four kindergarten measures correlated significantly with reading comprehension at both grade levels and the effect sizes were mostly within the moderate-to-large range (Table 2). The observed significant influence of kindergarten VSTM and listening comprehension on later reading comprehension certainly echoed the findings of Dufva et al. (2001) in Finnish, and Näslund and Schneider (1991) in German. Likewise, the unique effect of grammatical skills on Grade 1 reading comprehension and that of vocabulary on Grade 2 reading comprehension correspond to previous research findings (Adlof et al., 2010; Babayiğit & Stainthorp, 2011; Müller & Brady, 2001). The finding that different component processes played differential roles across the two testing periods is not uncommon in developmental research (e.g. see Adlof et al., 2010; Perfetti et al., 2005) and further signified the importance of developing our understanding of the evolving roles of different component skills along the trajectory of children's reading development. Finally, it is notable that the correlation coefficients between kindergarten VSTM and word-reading accuracy measures were non-significant at both grade levels. Therefore, in this study, there was no evidence to suggest that the effect of VSTM on later reading comprehension might have been indirect through the word recognition skills.

With respect to the question of the extent to which the three component skills (i.e. vocabulary, grammar and VSTM) explained the relationship between listening comprehension and reading comprehension, once again the findings varied across

the two testing periods. When the testing period from kindergarten to Grade 1 was examined, the component skills partly explained the relationship between kindergarten listening comprehension and Grade 1 reading comprehension: kindergarten listening comprehension explained a further 11% of the variance in Grade 1 reading comprehension over and above the three component skills. However, in the subsequent testing period from kindergarten to Grade 2, the three component skills almost completely explained the relationship between listening comprehension and reading comprehension: kindergarten listening comprehension explained 5% of further variance in Grade 2 reading comprehension levels, which was non-significant. However, this finding should be interpreted with some caution due to the modest sample size of this study. With a larger sample size and therefore, higher statistical power, a 5% increment in explained variance might well have been significant. Nonetheless, together the results indicated that the component skills accounted for a sizable amount of the relationship between kindergarten listening comprehension and reading comprehension.

Relative contributions of word-reading and listening comprehension to reading comprehension levels

The finding that word-reading accuracy rate had a small and highly transient effect on early reading comprehension levels corroborated the previous reports in Turkish (Babayiğit & Stainthorp, 2011; Öney & Durgunoğlu, 1997) and Finnish (Dufva et al., 2001; Müller & Brady, 2001) and provided further evidence that among typical populations, listening comprehension, rather than word-reading accuracy, tends to provide a more reliable index of children's early reading comprehension levels in a highly transparent orthography. It is important to note that the results remained the same even when reading fluency, which is a more reliable measure of word-reading skills in transparent orthographies and did not suffer from the problem of restricted variance, was included in the multiple regression analyses.

The results were clearly in line with the simple view of reading, which postulates that, as decoding accuracy rate increases over time, linguistic comprehension takes the precedence in explaining individual differences in reading comprehension levels and that there is a shift in the predictive powers of word-reading accuracy and listening comprehension (Gough et al., 1996). In the case of the highly transparent orthography of Turkish, due to the rapid development of word-reading skills, children seem to reach this threshold at a much earlier age and the suggested shift in the predictive roles of word-reading and listening comprehension was observed during the first two years of formal reading instruction. This was also evident from the results reported in Table 4, which showed that, whereas the effect of word-reading accuracy declined from Grades 1 to 2, of listening comprehension increased.

Limitations and further research

Overall findings should be evaluated in the light of several important caveats. First, the reported findings may not generalise to other measures or samples. The nature of the text comprehension tasks, for instance, can influence the observed pattern of relationships (Cutting & Scarborough, 2006; Keenan, Betjemann, & Olson, 2008). It is also not entirely clear whether the words in the reading passages might have

been easy in this study contributing to the observed restricted variance and thereby weaker relationships between word-reading and reading comprehension skills. Therefore, further investigations need to confirm the findings of this study with a wider range of reading comprehension measures at differing levels of complexity.

Second, the kindergarten measures of VSTM, vocabulary and grammar explained small-to-moderate amounts of variance in reading comprehension and listening comprehension levels. Given that a substantial amount of the variance remained unexplained in these analyses, future research with a wider range of cognitive–linguistic measures is needed to shed further light on the early markers of language comprehension as well as the common component skills of listening comprehension and reading comprehension.

Finally, transparent orthographies differ in terms of their level of grapheme–phoneme consistency, which may in turn influence the relative ease with which word-reading skills develop across the transparent orthographies (Seymour et al., 2003). We are not aware of a study that has systematically compared the level of transparency of Turkish and Dutch. However, based on previous research (e.g. Babayiğit & Stainthorp, 2007; Seymour et al., 2003), one may speculate that Turkish (as with Finnish) is more transparent than Dutch. This might explain why word recognition skills were found to play a more central role in early reading comprehension in Dutch (e.g. de Jong & van der Leij, 2002). To clarify this issue, cross-linguistic research on orthographies with varying levels of transparency is needed where these relationships can be systematically examined and compared using comparable measures of reading and listening comprehension. Only then would it be possible to evaluate with more precision the extent to which the timing of the developmental shift in the predictive influence of word-reading and listening comprehension skills may vary as a function of orthographic transparency.

Educational implications

The observed strong continuity in children's language comprehension skills from kindergarten to Grade 2 further signified the importance of an integrated approach to the study of listening and reading comprehension skills. Both reading and listening comprehension problems indicate subtle if not obvious oral language problems (see Leonard, 2009b; Nation et al., 2004) that need to be addressed as early as possible and as an integrated whole. Hence, research on the cognitive–linguistic components of language comprehension is vital for identification of early markers of both listening and reading comprehension difficulties and, thereby, provide the opportunity for parents and teachers to address comprehension problems even before the onset of formal reading instruction.

The findings also have important implications for furthering our understanding of early antecedents of reading comprehension difficulties. In English-speaking populations, it is estimated that about 10% of primary school-aged children have poor reading comprehension skills despite adequate word recognition skills (Nation & Snowling, 1997; Yuill & Oakhill, 1991). Following from this and given the relative ease with which word-level reading skills develop in a transparent orthography, it might be suggested that children with reading comprehension problems might be more likely to display this particular profile of poor readers in transparent orthogra-

phies (i.e. reading comprehension difficulties with adequate word recognition skills) (see also Torppa et al., 2007).

There are also clear theoretical and educational implications for developing our understanding of what specific aspects of oral language skills (e.g. grammatical structures) play a key role in language comprehension and to what extent these may differ across languages. The latter is particularly important given the evidence that the profile of children's oral language difficulties may differ as a function of the characteristics of the input language (Leonard, 2009a; Leonard, Sabbadini, Leonard, & Volterra, 1987).

Conclusions

In sum, the findings from this study revealed that listening comprehension skills assessed at kindergarten and before the onset of formal reading instruction can be considered an important precursor of later reading comprehension skills and that there is a strong continuity between the development of listening and reading comprehension levels.

Hence, the findings highlighted the importance of an integrated approach to the assessment of listening and reading comprehension skills and their common component skills for furthering our understanding of the antecedents of reading comprehension skills. Finally, in a highly transparent orthography, where word-reading accuracy rates reach ceiling levels within the first two years of formal reading instruction, listening comprehension, rather than word-reading skills, seems to play the most powerful role in children's early reading comprehension levels.

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Appendix. Grammatical skills

1. Inaccurate inflectional suffix Ev-im-e boyadım.	Accurate inflectional suffix Ev-im-i boyadım.
House – 1st person possessive – dative painted.	House – 1st person possessive – accusative painted. (I painted my house.)
2. Inaccurate word order Gibi kar beyazdır.	Accurate word order Kar gibi beyazdır. (It is white as snow).
