

The Characteristics of Reading-related Skills in Poor Comprehenders, Poor Readers and Normal Readers in Hangul

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Abstract We assessed reading-related skills in children with reading comprehension difficulties (“Poor comprehenders”), word decoding difficulties (“Poor decoders”) and normal readers, matched for age and nonverbal IQ. The reading-related skill tests used in our study are phonological processing, visual processing test, and receptive vocabulary test. The authors argue that children who had difficulty in reading comprehension had lower scores only on the phonological short-term memory test compared with normal readers, although their performance on receptive vocabulary and visual processing tests are comparable to normal readers. The results of our study revealed that poor decoders had lower scores on the phonological processing, visual processing, and receptive vocabulary tests.

Key Words : Reading comprehension difficulties, Poor Readers, Reading disability, Support policy for reading disabilities

요약 지금까지의 읽기장애 연구에서는 문자언어 음독의 정확성과 속도 즉 해독(음독)능력에 어려움을 가진 난독증(dyslexia)을 대상으로 한 연구에 초점이 맞추어져 있었으나 최근의 보고에 따르면 음독능력에는 어려움을 가지지 않음에도 불구하고 특수하게 읽기 이해력만이 저하되는 특정 읽기이해부진아동의 사례가 보고되고 있다. 이에 본 연구에서는 음독능력은 저하되지 않으나 읽기 이해력만이 특수하게 저하되는 읽기이해부진 아동과, 음독능력과 읽기 이해력 모두 저하되는 읽기부진 아동의 특징을 비교검토 하였다. 그 결과 읽기부진아동이 음운인식 과제와 음운 작업기억 과제 모두에서 유의하게 낮은 수행을 보인 반면 특정 읽기이해부진아동 집단의 경우 음운 작업기억의 유의한 저하만이 나타나는 것을 확인할 수 있었다. 본 연구결과를 토대로 읽기 이해력 장애아동의 특성에 대한 시사점을 논하였다.

주제어 : 읽기이해력 저하군, 읽기 부진, 읽기장애, 읽기장애 정책 및 교육 지원

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1. Introduction

Traditionally reading was determined to consist of two components, word decoding and reading comprehension. Positive relationships between these two components have been established by many previous studies[1,2,3]. Researchers have found that reading comprehension success or failure can be determined by the ability of decoding skills [3,4]. However, research on reading development has focused mostly on the acquisition of word decoding skills while development of reading comprehension has been relatively neglected[5]. Researchers have found that there are some children who have difficulty in reading comprehension, but not in word decoding skills [6]. Catts and his colleague (2006) mentioned that, 'these children, often referred to as poor comprehenders, have significant deficits in reading comprehension despite normal or near-normal abilities in word reading (decoding)'.

Cain and his colleagues (2004) argued that our knowledge of the unique contribution of reading-related skills to two components of reading—word decoding and reading comprehension—is limited because the majority of studies in this field have focused on word decoding and or a single component of reading-related skills[7]. For Korean Hangul, a few research studies have focused on the poor comprehenders who have significant deficits in only reading comprehension. It is insufficient to understand poor comprehenders, because the work in this field has focused on dyslexics and or intervention studies [8]. Thus, in this paper, we clarify the characteristics of poor comprehenders between poor decoders and normal readers in Korean.

Developmental and individual differences in phonological processing are believed to be causally related to the normal acquisition of beginning reading skills. Reading-related phonological processing typically consists of phonological awareness—one's awareness and access to the sound structure of one's language—, phonological short-term memory—coding information

in a sound-based representation system—, and naming speed—retrieval of phonological codes from a long-term store[9]. In many orthographic systems, phonological awareness is an important predictor for reading and spelling[10,11,12,13]. The relationship between phonological awareness and decoding skill has been observed among both normal and poor readers across the orthographic systems [14,15,16,18]. On the other hand, Catts et al.(2006) argued that poor comprehenders identified had concurrent deficits in language comprehension but normal phonological processing abilities[6]. This results raise doubt about different roles of phonological awareness in reading comprehension. Naming speed has been also generally acknowledged as an important correlate of decoding skill [19,20]. Many studies from transparent orthographies (orthographically consistent language) such as German, Italian, or Dutch, show that naming speed measured by Rapid Automatized Naming (RAN) performance seems to be a better parameter for discriminating between normal readers and children with decoding difficulties [21,22,23]. As for research on Hangul which is an orthographically consistent language, many studies have suggested that naming speed is important for reading Hangul[18,24]. Furthermore, Wolf and Bowers (1999) proposed the double-deficit hypothesis whereby those readers with a double deficit have the most severe reading impairment, whereas readers with only a phonological deficit have moderate reading impairment, and those with only a naming speed deficit show the least reading impairment[25]. The positive relation between phonological short-term memory and reading comprehension skill has been found in previous studies. De Beni and his colleague(1998) found that the poor comprehenders had significantly lower performance in the listening span test. They suggested that phonological memory has a crucial role in reading comprehension. Cain et al. (2004) examined the relations between phonological short-term memory (sentence-span and digit working memory) and reading comprehension

skills in children aged 8, 9, and 11 years. They argued that phonological working memory capacity explains unique variance in reading comprehension between the ages of 8-11 years.

Many studies have investigated the role of visual skills on reading acquisition [26,27]. A 3-year longitudinal study from Italy showed that visual spatial attention in preschoolers predicted reading acquisition [26]. A few studies have examined the role of visual processing on reading acquisition of alpha-syllabic languages such as Hangul. However, similar to findings of Hangul reading studies, results from studies on the relationship between visual cognition and reading are inconsistent [28,29]. Kim and Davis (2004) found no relationship between visual cognition and decoding ability among Korean readers in Grade 5. In contrast to these previous studies on Hangul, Cho and Ji (2001) reported that compared to age-matched controls, poor Grade 3 Korean readers showed either phonological or visual perceptual deficits, or both.

Recently, researchers have focused attention on the possible role of vocabulary in the development of reading and spelling [2,30]. In Hangul a previous study reported that compared to average- and high-reading level groups, the group with a low-reading level showed significantly lower scores on the receptive vocabulary test [18]. Ouellette (2006) suggested that receptive vocabulary is a unique predictor of word reading accuracy in Grade 4. Tunmer and Chapman (2012) found that receptive vocabulary directly influenced future reading comprehension and indirectly influenced future decoding and word recognition in a 3-year longitudinal study [32]. Catts et al.(2006) also argued that poor comprehenders had concurrent deficits in receptive vocabulary although they have normal abilities in phonological processing.

The Korean writing system, Hangul is 'alpha-syllabic' [33]. The relationship of the conversion between grapheme to phoneme is consistent in Hangul [12]. However, the Hangul writing system has a nonlinear spatial layout.

Hangul syllable block characters are separated; there is a clear syllable boundary[34].

Considering the findings described above, we clarify the characteristics of reading-related skills in children with reading comprehension difficulties, word decoding difficulties, and normal readers in Korean Hangul. The reading-related skill tests used in our study are the phonological awareness test (syllable and phoneme deletion tests), phonological short-term memory test, naming speed test, visual cognition test and receptive vocabulary test.

2. Method

2.1 Participants

A total 285 children were enrolled in our study (Grade 1: n = 112, Grade 2: n = 173). All participants were native speakers of Korean in Daegu Metropolitan City, South Korea. All of the children attended the same school serving of Education curriculum. Data from children with Raven's Coloured Progressive Matrices (RCPM; a nonverbal intelligence test) scores below -1.5 times the SD of the mean score and from a child who did not participate in all the tasks were excluded. In addition, from these children, we selected 3 groups (Poor Comprehenders, Poor Decoders, Normal Readers) according to scores of reading comprehension and word decoding tests. Poor comprehenders were matched for chronological age, decoding ability and nonverbal intelligence with normal children and matched for chronological age and nonverbal intelligence with poor readers.

The "Poor Comprehenders" scored lower than -1SD only in normalized reading comprehension test's score (n=14). The "Poor Decoders" scored lower than -1SD in both normalized reading comprehension and word decoding tests' scores (n=19). The "Normal Readers" scored higher than -1SD in both normalized reading comprehension and word decoding tests' scores (n=20).

Informed consent was obtained from the headmasters, curriculum coordinators, classroom teachers, and children. This study was approved by the ethics committee of the University of Tsukuba (Graduate School of Comprehensive Human Sciences).

〈Table 1〉 Profile of Participants

Groups	N(Male, Female)	Months (range)
Poor readers	19(13,6)	
Grade 1	11(6,5)	78.4(76-80)
Grade 2	8(7,1)	93.4(87-98)
Poor comprehenders	14(9,5)	
Grade 1	5(2,3)	79.7(75-82)
Grade 2	9(7,2)	92.8(89-99)
Normal readers	20(7, 13)	
Grade 1	10(3, 7)	80.4(76-87)
Grade 2	10(4, 6)	93.2(87-99)

2.2 Test and Materials

2.1.1 Nonverbal Intelligence test

Raven Colored Progressive Matrices (RCPM) served as a nonverbal intelligence test [35]. RCPM consists of 36 items grouped into 3 sets, each set containing 12 items which are ordered in increasing difficulty. For each of the 36 items, a colored pattern with 1 part missing was presented, and the participant was asked to select the missing part out of 6 options. Each child's score was the total number correct of 3 sets.

2.1.2 Reading comprehension test

Basic Academic Skills Assessment (BASA) - Reading subtest of reading comprehension was administered to children as a reading comprehension test [36]. BASA is normalized reading test used in South Korea for the purpose of basic academic skills assessment that was administered on the children as a reading comprehension test in our study. The children were presented with paragraphs printed on A4 size paper and asked to select and circle 1 word from 3 words which is most suitable for paragraph.

2.1.3 Decoding test

The word reading aloud task included 23 word stimuli, each consisting of 2 to 4 syllables (CV or CVC structures) in Korean (11 2-syllable, 6 3-syllable, 6 4-syllable). In word reading, selected words were drawn from those in the study of Seo and Kim (1999) on the frequency of written words in Korean primary textbook[37]. The word reading task contains 4 high-frequency words and 19 low-frequency words. As mentioned above Hangeul letters consistently represent sounds with a one-to-one correspondence and are combined in a limited number of patterns [38].

2.1.4 Phonological Short-term Memory test

Nonword repetition test was served as a phonological short-term memory test (1 practice run and 7 trials). The children were required to complete nonword repetition tasks with stimuli composed of 4 to 10 syllables (CV or CVC structures). The children were asked to listen to each nonword carefully and then to repeat the nonword. Each stimuli are ordered in increasing length of syllables.

2.1.5 Phonological Awareness test

Syllable deletion and phoneme onset deletion tests were served as a phonological awareness test. 1) Syllable deletion: In two practice runs and five trials, the children were asked to delete the first, middle, or final syllable from each three-syllable stimulus item and to answer orally. For example, the tester would say 'What sound would be left if the middle sound is taken away from the /pa.gu.ni/(a basket)?'. The correct answer would be '/pa.ni/'. Feedback was given only in practice runs and if children failed all of practice trials the task ended. This task had an internal consistency reliability of .77. 2) Phoneme onset deletion: In two practice runs and five trials, children were asked to delete the initial phoneme from the syllable stimulus item and to answer orally. For example, the tester would say 'What sound would be left if the first sound

is taken away from the /to/(a stone)?'. The correct answer would be '/ol/'. Feedback was given only in practice runs and if children failed all of practice trials the task ended. This task had an internal consistency reliability of .90.

2.1.6 Rey-Osterrieth Complex Figure test

The Rey-Osterrieth Complex Figure Test (ROCFT) with copy drawing, immediate recall, and delayed recall was used in order to assess visual information processing abilities. The ROCFT has been used for the assessment of visuoconstructional drawing ability and visual memory [39]. The children were asked to copy a complex figure (copy drawing). After they had completed their drawing, they were asked to reproduce the figure without looking at the complex figure stimulus (immediate recall). After 30 minutes, they were asked to reproduce the figure again (delayed recall). The maximum score of ROCFT copy drawing, immediate recall, and delayed recall was 36.

2.1.7 Naming Speed test

The children were administered RAN (Rapid Automatized Naming) tasks, which were originally developed by previous study in Japan [40]. These tasks required the children to name the drawings of objects and digits in each row that were shown on A4 size paper as quickly as possible. The children were given 3 trials of RAN tasks, and the averaged time duration of these 3 trials was used in our analyses. This task had a test-retest reliability of .73.

2.1.8 Receptive Vocabulary test

The receptive vocabulary subtest from the Receptive and Express Vocabulary Test (REVT), a normalized test given in South Korea[41] was administered to the children as a receptive vocabulary test. The children were asked to select one picture from four pictures and circle the number of the answer on the previously distributed form.

2.3 Procedure

These tasks were administered in random order to children in the June and July of their first- and second-grade year. Testing took place in one individual sessions and one group session within a 2-month period. Individual session (Decoding test, Phonologica short-term memory test, Phonological awareness test, Naming speed test) lasted approximately 20 minutes, and the group session lasted at most 35 to 45 minutes. When the schools were willing to participate, oral and written informed consent was obtained from the curriculum coordinators and classroom teachers. And children were asked for permission orally.

3. Results

The scores (mean ± SD) of each reading group's score are presented in Table 2. The Table 2 shows the mean and standard deviation of the number of correctly answered items in each task and the required time (second) in the RAN task.

〈Table 2〉 Test Performance among Three groups

Grades	Poor Decoders		Poor Comprehenders		Normal Readers	
	1st	2nd	1st	2nd	1st	2nd
Reading comprehension	2.6 (1.9)	6.9 (1.5)	3.2 (0.8)	7.3 (1.5)	10.7 (1.6)	16.1 (3.8)
Decoding(23)	3.9 (1.0)	7.3 (1.0)	8.0 (1.6)	11.2 (1.6)	8.6 (1.6)	12.1 (2.0)
Nonword repetition(7)	2.0 (0.6)	2.4 (1.3)	1.4 (0.9)	2.1 (0.8)	2.8 (0.6)	3.0 (1.6)
Syllable del.(5) ¹⁾	2.5 (2.1)	3.9 (1.9)	1.6 (1.5)	4.6 (0.7)	4.6 (0.5)	4.8 (0.4)
Phoneme del.(5) ²⁾	0.1 (0.3)	1.0 (1.8)	0.8 (0.8)	2.1 (1.8)	1.5 (1.7)	3.5 (2.3)
ROCFT C.(36) ³⁾	13.3 (9.1)	26.3 (7.5)	20.7 (8.0)	32.1 (1.6)	22.5 (11.4)	29.2 (4.8)
ROCFT I.(36) ⁴⁾	5.5 (4.4)	16.8 (8.1)	5.5 (3.1)	14.5 (8.2)	9.4 (5.1)	14.5 (8.6)
ROCFT D.(36) ⁵⁾	4.1 (3.9)	16.4 (9.3)	5.5 (4.1)	16.4 (6.7)	9.0 (4.3)	14.1 (9.7)
RAN(sec.)	21.7 (4.2)	17.0 (2.7)	17.4 (1.2)	14.3 (2.4)	17.4 (3.6)	14.3 (2.2)
Receptive vocabulary(24)	6.5 (3.9)	11.3 (2.4)	9.6 (1.5)	10.9 (2.1)	10.7 (1.6)	11.4 (2.7)

Our purpose of this study was to clarify the characteristics of reading-related skills in children with reading comprehension difficulties (Poor comprehenders), word decoding difficulties (Poor decoders), and normal readers in Korean Hangul. To evaluate these views, ANOVA were conducted. Z-scores of each grade of the all tests were used in this study due to each reading groups composed not only Grade 1 but also Grade 2. Z-scores of three reading groups were compared separately using one-way ANOVA tests. The group differences were assessed using a Tukey's post hoc test if the ANOVA was significant. Table 3 shows the z-scores of each reading groups and Table 4 shows the results of the ANOVA.

〈Table 3〉 Z-score of Reading Groups and Correlation Coefficient between Reading Comprehension and Other Measures' Scores

Measures	Poor Decoders	Poor Comprehenders	Normal Readers	Correlation coefficient
Reading comprehension	-.144	-1.31	.38	-
Decoding	-1.26	.19	.45	.562**
Nonword repetition	-.26	-.48	.41	.199
Syllable del.	-.70	-.44	.44	.485**
Phoneme del.	-.78	-.27	.22	.462**
ROCFT C.	-.71	.35	.07	.108
ROCFT I.	-.04	-.10	.13	.137
ROCFT D.	-.22	.06	.08	.166
RANf	.96	-.14	-.11	-.279*
Receptive vocabulary	-.64	-.12	.20	.404**

*p<.05, **p<.01

A significant effect was observed on the nonword repetition test ($F(2,193) = 3.841$); a Tukey's post hoc test indicated significant differences between the poor

1)Syllable del.= Syllable deletion

2)Phoneme del.=Phoneme deletion

3)ROCFT C.=ROCFT Copy drawing

4)ROCFT I.=ROCFT Immediate recall

5)ROCFT D.=ROCFT Delayed recall

decoders/poor comprehenders and normal readers ($p<.01$). A significant effect was also observed on the syllable deletion test ($F(2,193) = 6.912$), phoneme onset deletion test ($F(2,193) = 4.855$), and receptive vocabulary test ($F(2,193) = 3.555$); a Tukey's post hoc test indicated significant differences between the poor decoders and normal readers ($p<.01, p<.01, p<.05$ each).

A significant effect was observed on the Rapid Automatized Naming (RAN) test ($F(2,193) = 7.092$), and a Tukey's post hoc test indicated significant differences between the poor decoders and poor comprehenders/normal readers ($p<.01$). A significant effect was observed on the Rey-Osterrieth Complex Figure Test (ROCFT) copy drawing ($F(2,193) = 5.239$); a Tukey's post hoc test indicate significant differences between the poor decoders and poor comprehenders ($p<.05$).

〈Table 4〉 The Result of ANOVA

Measures	One-way ANOVA	
	F(2,193)	Post hoc comparison
Nonword repetition	3.841**	G1<G3, G2<G3
Syllable deletion	6.912**	G1<G3
Phoneme deletion	4.855**	G1<G3
ROCFT Copy drawing	5.239*	G1<G2
ROCFT Immediate recall	0.270	
ROCFT Delayed recall	0.535	
RAN	7.092**	G1< G2, G1<G3
Receptive vocabulary	3.555*	G1<G3

*p<.05, **p<.01, G1=poor decoders, G2=poor comprehenders, G3=normal readers

4. Discussion

The results of this study confirmed that the poor decoders showed worse performance in terms of Rapid Automatized Naming (RAN), nonword repetition, syllable deletion, phoneme onset deletion, and receptive vocabulary compared with normal readers. The results obtained here suggest that the phonological processing

deficits observed in poor decoders are in agreement with the results of the reading studies in Hangul [15,18]. Furthermore, the results of our study confirmed that poor decoders have significantly worse performance compared with normal readers in terms of receptive vocabulary. From this result, we assume that Korean readers can read aloud accurately by activating lexical processing, to use the knowledge of the phonological lexicon (receptive vocabulary), when they read Hangul[18].

In the present study, children who had difficulty in reading comprehension had lower scores on the nonword repetition test compared with normal readers, although the performance of poor comprehenders is comparable to normal readers on receptive vocabulary. Therefore, phonological short-term memory seems to be an important ability for reading comprehension. The present outcome with regard to phonological short-term memory is also in line with a previous study in alphabetic orthography [7,42]. Cain and his colleagues (2004) showed that the phonological short-term memory task (sentence-span task) was highly correlated with reading comprehension. They argued that the measures of processing capacity (working memory) explained unique variance in reading comprehension ability. Kendeou et al. (2009) mentioned that 'successful reading comprehension requires the continual integration of incoming information into the evolving discourse representation in readers' memory[42]. Integrating new information during reading results in the updating of the emerging discourse representation.' The progress of integration and inference are important to read the text, and working memory serves as a buffer for the most recently read propositions in a text, enabling their integration to establish coherency and hold information retrieved from long-term memory[7]. On the other hand, in the results of our study, poor comprehenders did not have significantly lower scores on the Rey -Osterrieth Complex Figure Test (ROCFT) immediate recall and delayed recall tests which were used as visual short-term memory measures. Nation et al., investigated the role of

working memory measures in distinguishing between the performance of poor and good comprehenders in English. They mentioned that poor comprehenders are more disadvantaged in complex span tasks than good comprehenders only when tasks involve verbal material[44]. In contrast, the performance of poor comprehenders is comparable to that of good comprehenders on visuo-spatial complex span tasks. We are of the opinion that a nonword repetition test may be a crucial marker of reading comprehension difficulties in Korean readers. While some previous studies have shown that poor comprehenders have deficits in receptive vocabulary and semantic processing[31,44], the poor comprehenders in our study also had lower scores in receptive vocabulary than normal readers, but did not show a statistically significant difference.

Furthermore, in comparison with poor comprehenders, poor decoders were confirmed as having significantly worse performance in the ROCFT copy drawing and RAN test. The ROCFT copy drawing test has been used for the assessment of visuo-perceptual, visuo-spatial, and visuo-constructional drawing ability. Thus, these two types of poor reading groups might be marked by visual processing skills and naming speed.

Therefore, there should be a study on educational policy that support the different types of reading disabilities. To date, little is known about the difficult to access the digitization information in reading disabilities and poor readers. Therefore, it is necessary to consider the educational support of reading disabilities in connection with engineering and information technology.

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