Title	The role of phonological recoding in the reading acquisition of school children in Hong Kong
Other Contributor(s)	University of Hong Kong
Author(s)	Ng, Kwok-lam, Bonnie
Citation	
Issued Date	2005
URL	http://hdl.handle.net/10722/56189
Rights	Creative Commons: Attribution 3.0 Hong Kong License

The role of phonological recoding in the reading acquisition of school children in Hong Kong

Ng Kwok Lam Bonnie

A dissertation submitted in partial fulfillment of the requirements for the Bachelor of Science (Speech and Hearing Sciences), The University of Hong Kong, May 6, 2005.

Abstract

The study investigated the role of phonological recoding in reading acquisition through the examination of the difference between Cantonese colloquial form (CCF) and standard written form (SWF) during early primary school years (grade 1 to grade 3). Thirty-two subjects at each grade were selected randomly in a Hong Kong primary school. The subjects were required to complete a word-picture matching and a reading aloud task. Stimuli were two-character words controlled at low frequency for each grade, with different levels of difference between CCF and SWF. The results showed that the possibility of using phonological information from phonological recoding in accessing the semantic lexicon has posed a significant effect on reading acquisition. Phonological recoding grants an advantage on reading acquisition.

Introduction

Reading acquisition involves the connection of printed words to its semantic representation. It is widely asserted that there are two routes linking the orthographic form of words to its semantics (Coltheart, 1978; Foss, 1988; Zhou, 1997). A direct route goes from print to semantics, and an indirect route from print, through phonological representation of the word, to the semantic representation. Phonological recoding refers to the process which phonological information is extracted from the access to orthographic form of words (Share, 1995). This recoding strategy appears to be making use of the indirect route.

Before children acquire written words, they already have acquired the meanings of words from speech in daily life through interaction with other people. A connection between phonological representation of words and its semantic representation has already established in the children's language system. Once the children enter school and learn written words, the component of orthographic representation of words is added into the children's language system. In other words, learning to read is a process through which the connections from this orthographic component to the phonological and semantic representation are established. Through phonological recoding, the newly encountered orthographic form of a word can be translated into its phonological form which can be mapped onto the corresponding semantic information of the word . This process facilitates the acquisition of the new printed words. Phonological recoding is done through the indirect route while the process through the direct route is simply extracting the semantic information of the word directly from its orthographic representation.

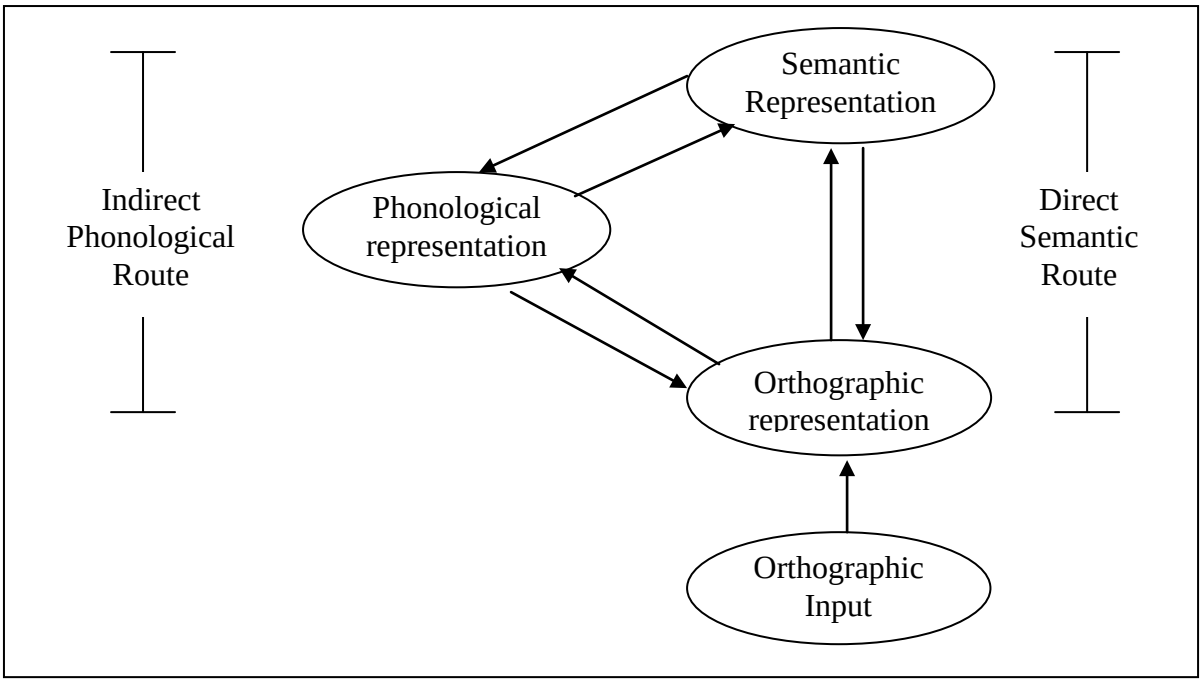


Figure 1. The direct and indirect route in reading acquisition.

Share (1995) has proposed a self-teaching hypothesis for the reading acquisition through phonological recoding. The hypothesis proposed that 'phonological recoding function as a self-teaching mechanism enabling the learner to independently develop both word-specific and general orthographic knowledge'. Share (1995) also mentioned that 'phonological recoding may be the principle means by which the learner attains word recognition proficiency'. He mentioned three key features of the self-teaching mechanism: First of all, the developmental role of phonological recoding is item-based rather than stage-based. The frequency of the word, in which the child has been exposed to and identified with success, has determined the process of word recognition. Children will depend more on phonological recoding when identifying new or low frequency words. Secondly, 'self-teaching is early onset; beginning reading is beginning self-teaching' (Share & Stanovich, 1995). They mentioned that early self-teaching depends on letter-sound knowledge, some minimal phonological sensitivity, and the ability to utilize contextual information to determine exact word pronunciations on the basis of partial encodings. The last feature is that, the self-teaching mechanism involves phonological and orthographic component in the

process. Share (1995) pointed that the phonological component is the primary source of individual differences in reading acquisition. It is the ability to use knowledge of spelling-sound relationships to identify unfamiliar words, which represents the sine qua non of reading acquisition. On the other hand, the orthographic component is the secondary source of individual differences in reading acquisition. It is the ability to store and retrieve word-specific orthographic information.

Share (1999) has later carried out a direct test of his self-teaching hypothesis on grade two students. Homophonic pseudowords was developed containing pairs of homophonic pseudowords in each of the categories, such as animals and musical instruments. The pairs of pseudowords were presented to the subjects in ten short texts. Three days after the reading of texts, the subjects were required to perform orthographic choice, naming, and spelling of the target words three days after text reading. In the orthographic choice experiment, the subjects were presented with four alternate spellings of the target word. The spellings included the target, a homophonic spelling, a visually similar spelling, and a letter transposed spelling. The subjects were required to choose the target spelling. In the naming task, the subjects were required to read of words which include the target spellings and their homophonic partners. The last task was spelling. The subjects were required to spell out the target spelling. The results of the three experiments showed that most of the subjects' orthographic choices shared the same spelling with the child's own mispronunciation. That is, subjects tended to prefer orthographic forms based on sound rather than sight. Share (1999) concluded that the process of print-to-sound translation is the primary factor responsible for orthographic learning and that not only phonological recoding alone determines orthographic learning, but the volume of exposure to print is also a key factor for reading acquisition.

Share (1995, 1999) supported for the notion that phonological recoding is important in reading acquisition, and the stress on the importance of the indirect route in the process

was shared by other researchers (Fleming, 1993; Rubenstein, Lewis, & Rubenstein, 1971). For example, Luo (1996) utilized a semantic discrimination task in the study. A pair of semantically related words (e.g. 'lion' and 'wolf') was presented with a distractor. There were two types of distractors, one is homophones (e.g. 'bare', homophone of 'bear') of words that were semantically related to the target (e.g. lion), and the orther one was visual controls of the words (e.g. 'bean', visual control of 'bear'). The subjects were asked to find out the word which is semantically related to the target. It was found that significantly more errors were made to choose the homophone, instead of the visual control. The author concluded that the result showed a strong phonological recoding effect on the reading in English and it supported the phonological recoding hypothesis.

Other researchers challenged Share's (1999) idea. Beringer (1995) claimed that since pseudoword reading taps the rule-governed in contrast to word-specific mechanism (Carr and Pollatsek, 1985, as quoted by Beringer, 1995), the use of pseudoword in testing the hypothesis might pose a bias towards the supporting the importance of phonological recoding. Other researchers did not agree with the importance of the indirect route over the direct semantic route. They supported the saying that the two routes are of equal importance in reading acquisition. Kimura and Bryant (1983) found evidence from their study that preschoolers acquired orthographic knowledge independently of phonological knowledge, and that the English-speaking children would utilize the direct route in reading task and the indirect route in spelling task. Carr and Pollatsek (1985), quoted by Perfetti & Tan (1998), mentioned that the direct access from print to the semantic representation and the indirect access route operated in parallel fashion.

The role of phonological recoding in the reading acquisition in Chinese is also controversial. Some researchers found that the direct semantic route is more important in reading acquisition (Chen & Peng, 1994; Leck, Weekes & Chen, 1995). Zhou's (1997) study

demonstrated this through using a lexical decision task and a naming task. Both two-character words and single-character words were used as stimuli in the experiments. Test stimuli are divided into the target, semantic prime, phonemic prime, and control stimuli. The result from the lexical decision experiment showed that the phonological component is not activated (or only activated to a limited degree), whereas the direct semantic activation is apparent. In the reading aloud task, activation of the phonological component was found. The author believed that the activation of phonological component was brought by the activation of semantic component. The results lent support to the relative importance of the direct semantic route in reading acquisition when compared with the phonological activation.

Moreover, Anderson, Li, Ku, Shu and Wu (2003) have demonstrated a parallel operation of the indirect phonological route and the direct semantic route. The subjects were required to complete a reading task (by writing pin-yin, an alphabetic script representing the Mandarin phonology) and a comprehension task so as to find out if the ability in retrieving the phonological code is in anyway affecting the ability in accessing the semantic representation. The result showed that Cantonese-speaking children (with Mandarin as a second language) are less able than Mandarin-speaking children to use phonetic information for reading, which means a weaker phonological recoding ability for the Mandarin representation. In the comprehension task, Cantonese-speaking children showed similar or even better result than the Mandarin-speaking children. The authors concluded that the direct semantic route and the indirect phonological route operate independently, which means, phonological recoding ability did not affect the performance in the retrieval of semantic information.

In contrast, Perfetti and Zhang (1991) demonstrated the effect of phonological recoding on reading acquisition in their study. In the priming experiment, subjects were allowed to expose to a prime for 180 ms (sufficient for identification of the prime character)

and then immediately replaced by a target character, which was to be named as quickly as possible. The prime characters included a phonemic prime (homophones to the target), a graphic prime, a semantic prime and a control prime. The result showed a clear priming effect for the phonemic primes, which had a significantly stronger effect than the effect of the semantic prime. Perfetti and Zhang (1991) concluded that phonological shape of a word is automatically activated as the word is accessed from an orthographic input. Their results lent support to the claim that phonological recoding is more important for reading acquisition and stressed the significance of the indirect route in Chinese reading acquisition.

Supporting Perfetti and Zhang's (1991) notion, Tan, Hoosain & Peng (1995) used a backward-masking procedure in examining the phonological processing in reading. With longer exposure durations for the target and the mask (60 ms and 40 ms respectively), phonological mask was found to be the most significant for the facilitation of word identification.

Different from alphabetic script like English, Chinese is considered to be logographic. Phonological representation of the words cannot be recoded at phonemic level from the print; rather, it is recoded at syllabic level. For example, in English, the word 'car' can be decoded as /kar/, in which the letter 'c', 'a' and 'r' correspond to the phoneme /k/, /a/ and /r/ respectively. However, in Chinese, the word 車 /$ts^h\varepsilon_1$/ (car) does not have any component that is corresponding to the initial consonant /ts^h-/ or the vowel /ε/, and neither the tone. The whole character is responsible for the phonological representation at syllabic level as /$ts^h\varepsilon_1$/. Therefore, the phonological recoding strategies may be different from English, and its role in reading acquisition may be different.

Most Chinese characters involve both semantic and phonetic radicals and these characters are called phonetic-semantic compound characters. These sub-character units are responsible for conducting different information of the characters. The semantic radical

carries information about the semantic category of the character and the phonetic compound carries phonological information of the character. For example, in the character 味 (taste) /mei$_6$/, 口 (mouth) is the semantic radical, telling that this character means something about the mouth; 未 /mei$_6$/ is the phonetic radical, providing information about the phonological representation of the character. Taft, Liu, and Zhu (1999) stated that characters with the same semantic radical can be highly related to each other semantically and thus a clear meaning for the common radical can be extracted. Leung & Lee (2002) said that readers would make use of the phonetic radical in phonetic-semantic compounds to get phonological information in Chinese. Thus, both phonological and semantic information can be directly extracted by accessing to the orthographic form of the characters in Chinese. The relative importance of the direct and indirect route may be different from those found in English studies.

Cantonese is a dialect of Chinese in which the colloquial forms of some of the words are different from the corresponding standard written forms. This difference between Cantonese colloquial form (CCF) and standard written form (SWF) has provided a ground for testing the role of phonological recoding in reading acquisition in Chinese.

Considering only two-character words, there are three kinds of relationships between CCF and SWF: First, words in colloquial Cantonese is identical to its representation in written form (CCF=SWF). For example, the phonological representations of both characters of the word 蜻蜓 /ts^{h}iŋ1/ /tiŋ4/ (dragonfly) are the same in its CCF and SWF. Second, the words are partially different, with one of the characters (either the first or the second character) being different, when their CCF and SWF are compared (CCF≠SWF$_P$). For example, the word 'desk' in SWF is 書桌 /sy$_1$/ /ts^{h}œk$_8$/ while its CCF is 書枱 /sy$_1$ t^{h}ɔi$_2$/. (desk) In this example, the difference lies in the second syllable (/ts^{h}ɛk$_8$/ compared with /t^{h}ɔi$_2$/). The third type of words has their CCF completely different from its SWF

(CCF≠SWF_T). For example, the word ‘refrigerator’ in SWF is 冰箱 /piŋ$_1$/ /sœŋ$_1$/ while that in CCF is 雪櫃 /syt$_8$ kwɐi$_6$/. These three types of word were used in this study as stimuli.

In the CCF=SWF type, the phonological representation of the words are the same in CCF and SWF in the phonological lexicon. After successful phonological recoding, the phonological code can be mapped with what is already stored in the phonological lexicon. The link to semantics can then be accessed through this indirect phonological route, in addition to the direct semantic route.

The CCF≠SWF_T type is the main focus in this study. The phonological representation of the words in CCF and SWF are different in the phonological lexicon. Before children goes to school, they have acquired the phonological code in CCF which map onto the corresponding semantic representation of an object name. After children goes to school, they will be exposed to orthographical print in SWF form and the corresponding pronunciation will be decoded. In CCF≠SWF_T type, the phonological code in SWF is different from what was already acquired in phonological lexicon (in CCF). Then, even if the phonological recoding is successful in SWF, mapping in the phonological lexicon is impossible. Hence, the corresponding semantic representation cannot be accessed through the indirect route. Therefore, the self-teaching mechanism achieved by phonological recoding cannot be carried out in this type of words. Semantic information can only be accessed through the direct semantic route.

The situation in CCF≠SWF_P type lies between the CCF=SWF type and the CCF≠SWF_T type. The phonological code in one of the characters can be mapped from its SWF to its CCF. The self-teaching process can only be achieved in one of the characters. Semantic information through the indirect phonological route cannot be fully accessed as in CCF=SWF type, but the direct route can still be used.

If the self-teaching hypothesis of phonological recoding (Share, 1995) is correct, it implies that the acquisition of the CCF=SWF type would be better than that in CCF≠SWF_P, and the acquisition in CCF≠SWF_P would be better than in CCF≠SWF_T. This would show that the use of phonological recoding would give advantages to the children in reading acquisition. In contrast, if the self-teaching hypothesis is erroneous, the performance in all the three types of words would be similar. This implies that the direct semantic route is the main route which would be taken in processing words.

As reading acquisition includes the acquisition of the words' phonological, orthographic and semantic representations, two experiments were used: word-picture matching task, and reading aloud task. With the two tasked administered, besides the acquisition of the words' phonological and semantic representations across the word types can be testified, the administration of these two tests can solve the methodological problems encountered by previous researchers.

In previous research, the use of pseudowords (Share, 1999) has been challenged to have bias towards the phonological route. In this study, two tests were adopted. The matching task is biased towards the direct semantic route and the reading aloud task is biased towards the indirect phonological route. With the administration of both of the tests, the methodological problem can be solved. If the results from the two tests were different (the matching task supports the semantic route, but the reading task supports the phonological route), it was expected that the result was test-oriented and no implication can be made. However, if the tests results from the two tests were the same, it was expected that the result can be used to confirm with the hypothesis.

Developmental trend of the role of phonological recoding in the reading acquisition of school children was also investigated in this study. Share (1995) proposed that phonological recoding is item-based, but not stage-based. In his direct test of the hypothesis (Share, 1999),

only second-graders was recruited as subjects. It was expected in this study that if his hypothesis is correct, the pattern of performance of the three grades in different types of words should be the same. However, if the hypothesis is incorrect, the pattern of performance of the three grades in different type of words would be different.

Method

Participants

A total of 126 children, aged 6;01 to 9;11, studying in grade one to three, from a Hong Kong primary school using Cantonese as medium of instruction, participated in the study. They were screened by the Raven Standard Progressive Matrices (Raven, 1986) and the reading part of the Hong Kong Test of Specific Learning Difficulties in Reading and Writing (Ho, Chan, & Education Department, HKSAR Government, 2000) to ensure that they have normal non-language intelligence and reading ability in Cantonese (Table 1).

Table 1.

Background Cognitive and Reading Characteristics of the study's participants

Grade	No. of subjects	Age	Raven Progressive Matrices	Chinese Word Reading Test
		Range	Mean Score	Mean Score
Grade 1	37	6;01 – 7;00	114.34	40.31
Grade 2	44	7;00 – 8;02	115.63	94.97
Grade 3	35	8;00 – 9;11	111	108.75

All subjects are from Cantonese-speaking families and they studied in kindergarten using Cantonese as medium of instruction. Children whose home language was not Cantonese, and those who did not use Cantonese as medium of instruction in Chinese lessons were excluded in this study. The target primary school has a higher-than-average academic

result in Hong Kong. Thirty children were screened out of the study. Ninety-six children (thirty-two from each grade) have taken the tests of the study.

Materials

Stimuli were chosen from the Hong Kong Corpus of Primary School Characters (Leung & Lee, 2002). The corpus includes all two-character words in Hong Kong Primary School Chinese and General Studies text books and work books. The accumulative frequency of occurrence of each word in each grade was counted in the corpus and divided into three categories: high frequency, mid frequency and low frequency. Words at the lowest 30% frequency of the total number of words were regarded as low frequency words and were chosen as stimuli in this study.

There were three types of stimuli, the CCF=SWF type, CCF≠SWF_P type and the CCF≠SWF_T type. Ten stimuli for each type in each grade were selected. That is, thirty stimuli for each grade were prepared. The stimuli for each grade were different. It was because the stimuli needed to be low frequency words for each grade, according to the accumulative frequency across grades.

The stimuli were presented to the subjects in a A4-sized booklet. Each target word, font size 48, using Biau Kai font (標楷體), was printed at the top middle part of the page. Below the stimulus word were four pictures - a target picture, a phonological distractor, a semantic distractor, and an orthographical distractor. They were printed in a 2 x 2 table, with the height of 7 cm each, in randomized order (see Appendix I).

The phonological distractors shared the same initial consonant with the target word in SWF and the orthographical distractors shared one of the logographemes in the target word.

Procedure

The experiment was conducted on a one-to-one basis. Each stimulus was presented to the subjects one by one by flipping the booklet. The subjects were then asked to choose one

from the four choices of pictures which best matched with the word presented on the top of the page. The subjects were not allowed to read aloud the words during the matching task. After the word-picture matching task, the subjects were asked to read aloud all the target words again. The reading aloud task was always done after the matching task (see Appendix II). This was to avoid encouraging the subjects in accessing the indirect phonological route before reaching the semantics in the matching task. The process during the reading part was audio-taped using MD recorders or MP3 recorders.

In the word-picture matching task, the examiner circled the answer pointed by the subject on a recording sheet (see Appendix III to V). In the reading task, the examiner wrote '1' for correct response and '0' for incorrect response and no response. For characters which were read incorrectly, the examiner transcribed the productions in orthographic forms or in IPA symbols.

Pilot test was carried out a week before the experiment. A total of six children (two from each grade) were involved in the pilot test (one from each grade were from the target school and the rest were from other schools in Hong Kong). It was found that some of the pictures were not able to represent the target words. It was confirmed by the fact that the children were not able to identify the picture even when the target words were phonologically presented. Those pictures identified were changed so as to improve the accuracy of the test.

Measurement

The scoring of the tests was done by the following procedures: In the word-picture matching task, the subjects were awarded a mark for each correct match. No mark was given to incorrect trials. For the reading part, the subjects was awarded a mark for each correct when the two characters of the target word were read aloud correctly. No mark was given if either one or both of the characters were incorrect, or when there was no response. The

productions of the subjects were audio-taped and orthographically transcribed. Maximum score for each type of words in each grade was 10.

Design

A repeated measures, 3 x 3, two way analysis of variance (ANOVA) was carried out to analyze the data obtained from both of the printed word picture matching and the read aloud tasks. There were one between-subjects factor (three levels of grade: grades 1 (G1), grade 2 (G2) and grade 3 (G3)) and one within-subjects factor (three levels of word types: the three different types of word CCF=SWF, CCF≠SWF_P and CCF≠SWF_T).

Results

In the word-picture matching task, significant main effect on word types ($F(2,186) = 79.284$, $p < 0.001$) and grade were found ($F(2,93)=55.265$, $p<0.001$). Post hoc Tukey HSD test was carried out to find out the what contributes to the significant main effects. In the word type main effect, it was found that the accuracy for the CCF=SWF type was significantly higher than that for the CCF≠SWF_P type ($p<0.05$); and the accuracy for the CCF≠SWF_P type was significantly higher than the CCF≠SWF_T type ($p<0.001$). In the grade main effect, post hoc Tukey HSD test showed that the score by G1 subjects was significantly lower than that in G2 ($p<0.001$), but the difference between G2 and G3 subjects was not significant.

Significant interaction effect between grade and word type was found ($F(4,186) = 13.201$, $p<0.001$). Post hoc Tukey HSD test showed that, for G1 subjects, the accuracy for the CCF=SWF type was not significantly different from that of CCF≠SWF_P type, but the accuracy for the CCF≠SWF_P word type was significantly higher than that of the CCF≠SWF_T type ($p<0.001$). Different from G1 subjects, the accuracy of the CCF=SWF type of G2 subjects was significantly higher than that of CCF≠SWF_P type ($p<0.001$), whereas, the accuracy for CCF≠SWF_P type and the CCF≠SWF_T type of G2 subjects was similar. Similar

to G1 subject, the accuracy for the CCF=SWF type of G3 subjects was not significantly higher from that of CCF≠SWF_P type of word and the accuracy for the CCF≠SWF_P type was significantly higher than the CCF≠SWF_T type ($p<0.005$) (Figure 2).

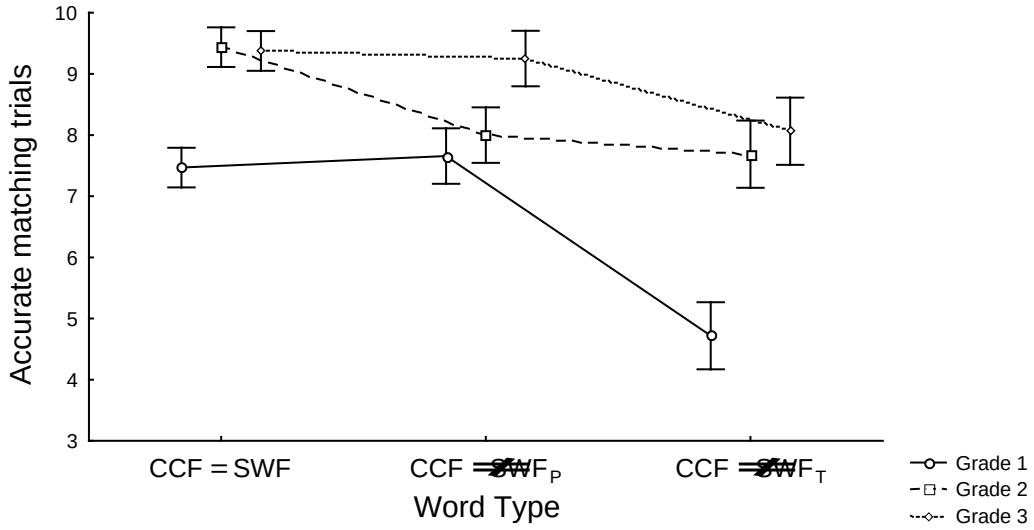


Figure 2. Interaction effect between grade and word type in matching task

. Similar to the word-picture matching task, a significant main effect of word type ($F(2,186) = 103.22$, $p<0.001$) (Figure 4) and a significant grade effect were found ($F(2,93)=26.635$, $p<0.001$) in the reading aloud task. Post hoc Tukey HSD test was carried out to identify what contribute to the significant effects. Results indicated that the accuracy of the CCF=SWF type was significantly higher than that for the CCF≠SWF_P type ($p<0.001$); and the accuracy for the CCF≠SWF_P type was significantly higher than the CCF≠SWF_T type ($p<0.001$). The Post hoc Tukey HSD test also showed that G1 subjects are found to show significantly lower accuracy than G2 subjects ($p<0.001$), and G2 subjects were found to show significantly lower accuracy than G3 subjects ($p<0.05$).

A significant interaction effect between grade and word type was found ($F(4,186) = 10.464$, $p<0.001$) in the reading task. Post hoc Tukey HSD test showed that, in G1, the accuracy of reading the CCF=SWF type of words was not significantly higher than that in CCF≠SWF_P word type, but the accuracy in CCF≠SWF_P word type was significantly higher

than that in the CCF≠SWF_T type ($p<0.001$). For G2, the accuracy in reading the CCF=SWF type of words was significantly higher than that in CCF≠SWF_P type ($p<0.001$); however, this performance was not significant higher than the CCF≠SWF_T type. For G3, the accuracy in reading aloud the CCF=SWF type of words was not significantly higher than that of the CCF≠SWF_P type, but it was significantly higher than the accuracy in reading words in the CCF≠SWF_T type ($p<0.001$) (Figure 3).

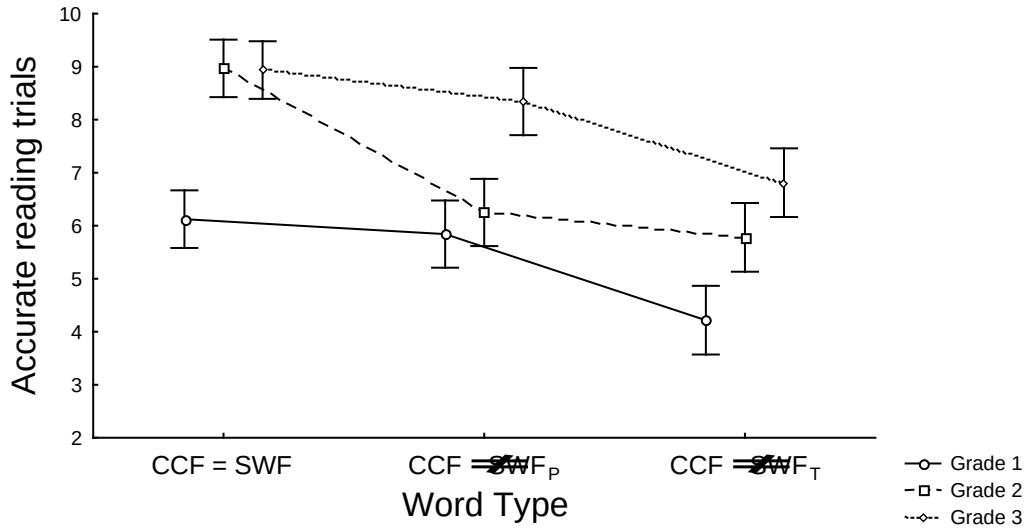


Figure 3. Interaction effect between grade and word type in reading aloud task

Discussion

The result from the printed word picture matching task showed that the performance on CCF=SWF word type was better than the other two word types, suggesting that the phonological recoding has a positive impact on reading ability. This might lend support to the notion that phonological recoding acts as a self-teaching mechanism and promotes reading acquisition. Since the phonological code of the print is the same as what is already acquired in the phonological lexicon from daily conversation, once the subjects decoded words in the CCF=SWF type, the phonological code can be directly mapped to the corresponding entry in the phonological lexicon. With this direct mapping, this type of words has the best opportunity in transferring phonological information to the semantic lexicon. The

indirect phonological route can then be activated together with the direct semantic route. This might explain why the highest accuracy of the matching task was found in the CCF=SWF word type.

In the CCF≠SWF_P type, the level of possible phonological code transfer has been reduced by half. One of the characters in this type of target stimuli is different when its CCF and SWF are compared. Consequently, the phonological code retrieved from print can only be mapped onto one of the characters represented by the phonological code in the phonological lexicon. Since the indirect phonological route can only be activated for one of the characters, its effectiveness in reaching the semantic lexicon is reduced. With this reduced activation of the indirect route and the activation in the direct route, the accuracy in the matching task is lacking behind the CCF=SWF type.

In the CCF≠SWF_T type, even though phonological recoding successfully changed the orthographic information into phonological code, the mapping of the phonological code retrieved from print to the corresponding phonological lexicon is impossible. This is because the two phonological codes are totally different. In this way, the indirect phonological route is not activated. The direct semantic route becomes the only route which is responsible for the retrieval of semantic information from print. This has contributed to the lowest accuracy of this type of words in the matching task.

The significant effect from the word type in the matching task has clearly showed that phonological recoding has played an important role in reading acquisition. When less information from phonological recoding are able to be transferred to the semantic lexicon, the accuracy in retrieving the correct semantics representation falls. This was evident by the best performance in the CCF=SWF type, followed by the CCF≠SWF_P type, and the CCF≠SWF_T type being the worst.

This finding is consistent with the saying by Perfetti and Zhang (1991). They asserted that phonological process is automatically activated as the word is accessed from a graphic input, and phonological processes support comprehension in reading Chinese. The results of the current study confirms the illustration of Perfetti and Zhang (1991). The more phonological information can be transferred to the semantic lexicon, the more accurate the semantic information can be retrieved.

In the reading task, the result has shown the same pattern of performance in the three types of word across grades. This result has further supported the Perfetti and Zhang (1991)'s idea. As mentioned, reading acquisition includes the acquisition of the words' phonological, orthographic and semantic representations. The highest accuracy found in the CCF=SWF type in both the matching and reading tasks reveals that phonological recoding has posed advantage on reading acquisition.

Although it was found from the main effect that phonological recoding plays an important role in reading acquisition, some limitations were found in the error analysis of the two tasks.

In the matching task, there were three distractors presented as pictures with the target. They are the semantic distractor, the phonological distractor, and the orthographical distractor. According to the summary (Table 2), a large portion of errors fell into the semantic type in different word type across grades. Obviously, the subjects tended to be distracted semantically than phonologically. Another example of error might suggest that the effect of the semantic activation on semantic retrieval is influential. The target word 盜竊 (/tou$_6$/ /sit$_8$/, stealing) was presented with a phonological distractor of 倒水 (/tou$_2$/ /sœy$_2$/, pouring water), a semantic distractor of 打劫 (/da$_2$/ /kip$_8$/, robbery), and an orthographic distractor of 木盆 (/muk$_9$/ /p^{h}un$_4$/, wooden tub, with the same radical '皿'). When the subject was unable to retrieve the accurate semantic representation of "stealing", the effect of the activation of the

direct semantic route would lead the subject to choose 打劫 (/da$_2$/ /kip$_8$/, robbery), instead of the phonological distractor 倒水 (/tou$_2$/ /sœy$_2$/, pouring water).

Table 2

Total Numbers of different types of error in different word type in each grade of subjects in matching task

Grade	Error Type	Word Type			
		CCF=SWF	CCF≠SWF$_P$	CCF≠SWF$_T$	Total
G1	Phonological	22	11	40	73
	Semantics	59	37	80	176
	Orthographic	9	28	51	88
G2	Phonological	0	4	4	8
	Semantics	15	51	56	122
	Orthographic	3	5	15	23
G3	Phonological	1	0	3	4
	Semantics	18	24	57	99
	Orthographic	1	0	2	3

In the reading task, semantic errors were found to be dominating other types of errors, including phonological and orthographic errors. In the semantic errors, some of them were semantically related words. For example, 毀壞 /wɐi$_2$/ /wai$_6$/ was read as 破壞 /p^{h}ɔ$_3$/ /wai$_6$/ (both means “to destroy”); 看病 /hɔn$_3$/ /pɛŋ$_6$/ (see a doctor) was read as 診病 /ts^{h}ɐn$_2$/ /pɛŋ$_6$/ (to make diagnosis). For others, the stimuli presented in SWF were read as its CCF. For example, 肥皂 /fei$_4$/ /tsou$_3$/ (soap) was read as 番梘 /fan$_1$/ /kan$_2$/; 沙發 /sa$_1$/ /fat$_8$/ (sofa) was read as 梳化 /sɔ$_1$/ /fa$_2$/. These semantic errors were the most frequently seen errors. Other

errors include orthographic errors and phonological errors. The second frequent type of error found was orthographic, such as 浴缸 /juk$_6$/ /kɔŋ$_1$/ (bath tub) was read as 彩虹 /ts^{h}ɔi$_2$/ /huŋ$_4$/ (rainbow), both words share the same radical '工'; and 參觀 /ts^{h}am$_1$/ /kun$_1$/ (to visit) was read as 遇見 /jy$_6$/ /kin$_3$/ (to meet accidentally), both share the same radical '見'. The type of error which appeared the rarest was phonological errors. For example, 牙縫 /ŋa$_4$/ /fuŋ$_4$/ (spaces between teeth) was read as 牙風 /ŋa$_4$/ /fuŋ$_1$/ (tooth, wind); and 附錢 /fu$_6$/ /ts^{h}in$_2$/ (to pay money) was read as 苦錢 /fu$_2$/ /ts^{h}in$_2$/ (bitter, money). Tone error was spotted in these responses.

The dominating semantic errors in CCF≠SWF$_P$ type and CCF≠SWF$_T$ type confirmed that, phonological recoding is not the only route to reading acquisition. There is a choice for accessing the semantic route. Moreover, when information from phonological recoding is transferred to the semantic lexicon with limitation, the access to direct semantic route is preferred to the access to indirect phonological route. Furthermore, the result indicates that semantic information was used to confirm the acquisition of words. Although phonological recoding plays an important role in reading acquisition, the result from error analysis tells that phonological recoding is not a pre-requisite in reading acquisition. This disproves one of the features which Share (1995) proposed in the self-teaching hypothesis that phonological recoding is the sine-qua-non of reading acquisition.

As mentioned above, the test results from both of the tests were similar, showing that phonological recoding plays an important role in reading acquisition. This support for the notion that phonological recoding was not only found in the phonologically-biased task (reading aloud), but also the semantically-biased task (word-picture matching). This has solved the methodological problem raised by previous researchers.

Share (1995) proposed that phonological recoding is item-based, rather than stage-based. However, developmental trend of the role of phonological recoding in reading acquisition was traced in this study. The effect from phonological recoding was found across all the three grades. The acquisition of CCF=SWF type was found to be significantly better than the acquisition of the CCF≠SWF_T type. Although the phonological recoding was found to be important in all the three grades, the pattern of performance in the three types of word was different.

In G1, the role of phonological recoding in reading acquisition is the least important among the three grades. Weakest acquisition ability was found when phonological information brought by phonological recoding was totally unable to be transferred. With phonological information brought by phonological recoding of one of the characters is able to be mapped and accessed, the acquisition ability already enhanced. However, further increase in getting information from phonological recoding does not promote even stronger acquisition ability.

In G2, the role of phonological recoding becomes more important. Without a full transfer of phonological information from phonological recoding for both characters, the acquisition ability remains low. That is, more information from phonological recoding is required to promote a stronger ability in the acquisition of words.

In G3, a ceiling effect was suspected in the CCF=SWF type and CCF≠SWF_P type, since several subjects got full marks in these types in G3. This has caused similar performance between the two groups. Therefore, it is expected that significant difference would also be found between CCF=SWF type and CCF≠SWF_P type as it was in G2. If it is true that the differences between the three types are significant, the role of phonological recoding becomes the most important in this grade. Children in this grade are more sensitive to the availability of information from phonological recoding, and the reading acquisition

ability is more easily affected by it. With information of one more character from phonological recoding is provided, the reading acquisition ability would also be stronger accordingly.

Further Studies and Educational Implications

The important role of phonological recoding in reading acquisition was found in all the three grades. It is speculated that the effect may fade in higher grades. Further study may be needed to be administered on higher grade students to see if phonological recoding fades at higher developmental levels.

From the difference between CCF and SWF in Cantonese, it was found in this study that the acquisition of CCF=SWF type of words is easier than that of CCF≠SWF type of words. It is implied that in primary schools, teachers can put more emphasis on teaching the CCF≠SWF type of words so as to establish the link between the phonological lexicon and semantic lexicon of the SWF of words, and thus facilitate acquisition. Moreover, the study also implies that native Mandarin speakers may show advantage over native Cantonese speakers in reading acquisition. This is because there were more words which is in CCF≠SWF type in the Cantonese system than in the Mandarin system. Nevertheless, further studies are needed to confirm with the speculation.

Acknowledgment

I would like to express my deepest gratitude to my supervisor, Dr. Man Tak Leung for his invaluable advice and guidance, which has contributed much to the accomplishment of my study. Besides, I would like to thank Baptist Lui Ming Choi Primary School for kindly allowing my study to be carried out in the school. Thankfulness also goes to all the parents and subjects for their generous participation, and the examiners of the study who has certainly contributed to a smooth process during data collection.

References

Anderson, R. C., Li, W., Ku, Y.-M., Shu, H., & Wu, N. (2003). Use of partial information in learning to read Chinese characters. *Journal of Educational Psychology*, 95, 52-57.

Beringer, V. W. (1995). Has the phonological recoding model of reading disability led us astray? A critique of "cognitive process in early reading development". *Issues in Education*, 1, 1, 59-63.

Chen, Y., & Peng, D. (1994). A connectionist model of Chinese character recognition and naming. In H.-W. Chang, J.-T. Huang, C.-W. Hue, & O J. L. Tzeng (Eds.). *Advances in the Study of Chinese Language Processing.* Taipei: Department of Psychology, Taiwan University.

Coltheart, M. (1978). Lexical access in simple reading tasks. In G. Underwood (Ed.), *Strategies of information processing* (pp. 151-216). New York: Academic Press.

Fleming, K. K. (1993). Phonologically mediated priming in spoken and printed word recognition. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 19, 272-284.

Foss, D. J. (1988). Experimental psysholinguistics. *Annual Review of Psychology*, 39. 301-348.

Ho, C. S-H., Chan D. W-O. & Education Department, HKSAR Government. (2000*). The Hong Kong Test of Specific Learning Difficulties in Reading and Writing.* HK: E.D., HKSAR Govt.

Kimura, Y., & Bryant, P. (1983). Reading and writing in English and Japanese: A cross-cultural study of young children. *British Journal of Developmental Psychology*, 1: 143-154.

Leung, M.T. & Lee, A. (2002). The Hong Kong Corpus of Primary School Chinese. *The 9th Meeting of the International Clinical Phonetics and Linguistics Association.*

Luo, C. R. (1996). How is word meaning accessed in reading? Evidence from the phonologically mediated interference effect. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 22, 883-895

Perfetti, C. A., & Zhang, S. (1991). Phonological processes in reading Chinese characters. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 17, 633-643.

Perfetti, C. A., & Tan, L. H. (1998). Phonological codes as early sources of constraint in Chinese word identification: A review of current discoveries and theoretical accounts. *Reading and Writing: An Interdisciplinary Journal*, 10, 165-200.

Raven, J.C. (1986). *Hong Kong Supplement to Guide to the Standard Progressive Matrices*. H.K.: Education Department, H.K.

Rubenstein, H., Lewis, S. S., & Rubenstein, M. A. (1971). Evidence for phonemic recoding in visual word recognition. *Journal of Verbal Learning and Verbal Behaviour*, 10, 645-658.

Share, D. L. (1995). Phonological recoding and self-teaching: sine qua non of reading acquisition. *Cognition*, 55, 151-218.

Share, D. L. (1999). Phonological recoding and orthographic learning: a direct test of the self-teaching hypothesis. *Journal of Experimental Child Psychology*, 72, 95-129.

Share, D. L., & Stanovich, K. E. (1995). Cognitive processes in early reading development: accommodating individual differences into a model of acquisition. *Issues in Education*, 1, 1, 1-57.

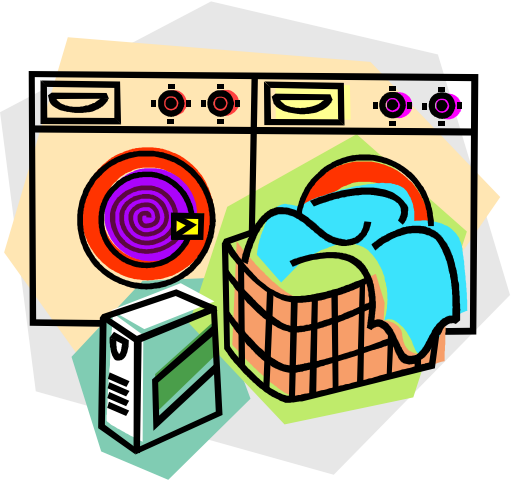
Taft, M., Liu, Y., & Zhu, X. (1999). Morphemic processing in reading Chinese. In J. Wang, A. W. Inhoff, & H.-C. Chen (Eds.). *Reading Chinese script: a cognitive analysis.* London: Lawrence Erlbaum Associates.

Tan, L. H., Hoosain, R., & Peng, D.-L. (1995). The role of early presemantic phonological code in Chinese character identification. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 21, 43-54.

Zhou, X. L. (1997). Yu Yi Ji Huo Zhong Yu Yin De You Xian Zuo Yong. In D. L. Peng, H. Shu, & X. Z. Chen (Eds.). *Han Yu Ren Zhi Yan Jiu*. Ji Nan: Shan Dong Jiao Yu Chu Ban She.

Appendix I
Presentation of stimuli

澆花

A 	B 
C 	D 

Appendix II

Instructions of the experiments

<u>指導語</u>

理解作業

- 翻開「T」頁
- 「呢度有一個詞語（指著「花兒」）同四幅圖畫（指著四幅圖）。裡面其中一幅圖畫係同個詞語一樣意思嘅。」
- 「呢度邊幅圖畫係同上面個詞語一樣意思㗎架?」(受测者指著答案 C)
- 「啱嘞，個字同幅圖係一樣意思喎！」
- 「之後每一頁我哋都係咁樣做，你睇清楚個詞語同四幅圖，再指個答案我睇就得㗎架喇！記住我哋做嘅時候唔講嘢㗎架喎！」

＊記緊不可讓受測者讀出目標詞語

閱讀作業

- 「呢度有啲詞語係同頭先嗰啲一樣嘅，你識嘅每個字都要盡量讀出嚟喎！你順住打橫慢慢讀（手指指示閱讀次序)就得㗎架喇！」

＊ *如受測者很快就說「唔識」，或不作聲，可請受測者「試吓啦」。若仍沒有答案，在答案紙上畫上０，說「唔緊要，我哋讀下一個」．*

評分方法

理解作業

- 於格上圈出答案
- 目標字共分三種：　　書面語＝口語

　　(＊)書面語＝口語（其中一字）

　　(ㄟ)書面語≠口語

- 可選答案中含有:

　目標字　　Target (T)

　語音扦擾字　Phonological distractor (P)

　字形扦擾字　Orthographic distractor (O)

　字義扦擾字　Semantic distractor (S)

閱讀作業

- 對的字寫１；錯的寫所說出的答案（文字或拼音)；沒答案的寫０

　如：　全對　　/單車/ → [單車]　　１１

　　一個字對　/單車/ → [汽車]　　汽１

　　/單車/ → [單 tsi_4]　　１/tsi_4/

　　/單車/ → [單---]　　１０

　　全錯　　/單車/ → [滑板]　　滑板

　　/單車/ → [------]　　００

＊錯的並不包括發音錯誤

Appendix III

G1 Record form

一年級詞語理解及閱讀作業
答案記錄紙

姓名: _____ ( ) 班別: _____

幼稚園: _____ 錄音帶編號: _____

	A	B	C	D	Read		A	B	C	D	Read
單車	A(T)	B(P)	C(S)	D(O)		數字	A(O)	B(T)	C(P)	D(S)	
*書桌	A(S)	B(O)	C(T)	D(P)		*採花	A(S)	B(O)	C(T)	D(P)	
^弄破	A(P)	B(S)	C(O)	D(T)		^肥皂	A(O)	B(T)	C(P)	D(S)	
蜻蜓	A(P)	B(S)	C(O)	D(T)		滑梯	A(O)	B(T)	C(P)	D(S)	
*買菜	A(O)	B(T)	C(P)	D(S)		*舒適	A(S)	B(O)	C(T)	D(P)	
^入睡	A(O)	B(T)	C(P)	D(S)		^談天	A(P)	B(S)	C(O)	D(T)	
熱鬧	A(P)	B(S)	C(O)	D(T)		參觀	A(T)	B(P)	C(S)	D(O)	
*手帕	A(T)	B(P)	C(S)	D(O)		*燒飯	A(P)	B(S)	C(O)	D(T)	
^合穿	A(T)	B(P)	C(S)	D(O)		^冰箱	A(T)	B(P)	C(S)	D(O)	
散步	A(O)	B(T)	C(P)	D(S)		浴缸	A(S)	B(O)	C(T)	D(P)	
*站好	A(P)	B(S)	C(O)	D(T)		*山洞	A(O)	B(T)	C(P)	D(S)	
^上班	A(S)	B(O)	C(T)	D(P)		^沙發	A(S)	B(O)	C(T)	D(P)	
網球	A(S)	B(O)	C(T)	D(P)		火柴	A(T)	B(P)	C(S)	D(O)	
*雨衣	A(P)	B(S)	C(O)	D(T)		*看病	A(T)	B(P)	C(S)	D(O)	
^毀壞	A(T)	B(P)	C(S)	D(O)		^勝利	A(O)	B(T)	C(P)	D(S)	

	Identical	*Partial	^Different	Total
Target (T)	/10	/10	/10	/30
Phonological (P)	/10	/10	/10	/30
Semantic (S)	/10	/10	/10	/30
Orthographic (O)	/10	/10	/10	/30
Reading	/10	/10	/10	/30

Appendix IV

G2 Record form

二年級詞語理解及閱讀作業
答案記錄紙

姓名: _____ ( ) 班別: _____

幼稚園: _____ 錄音帶編號: _____

	A	B	C	D	Read		A	B	C	D	Read
掃地	A(P)	B(S)	C(O)	D(T)		藥丸	A(T)	B(P)	C(S)	D(O)	
*亂丟	A(O)	B(T)	C(P)	D(S)		*盛水	A(S)	B(P)	C(O)	D(T)	
^吃光	A(O)	B(T)	C(P)	D(S)		^烹調	A(T)	B(P)	C(S)	D(O)	
蕃茄	A(T)	B(P)	C(S)	D(O)		綿羊	A(S)	B(O)	C(T)	D(P)	
*石階	A(S)	B(O)	C(T)	D(P)		*下棋	A(S)	B(O)	C(P)	D(T)	
^拔去	A(S)	B(O)	C(T)	D(P)		^塗污	A(O)	B(T)	C(P)	D(S)	
熨斗	A(O)	B(T)	C(P)	D(S)		日曆	A(T)	B(P)	C(S)	D(O)	
*抓頭	A(T)	B(P)	C(S)	D(O)		*吹滅	A(S)	B(O)	C(T)	D(P)	
^致電	A(S)	B(O)	C(T)	D(P)		^躺臥	A(P)	B(S)	C(O)	D(T)	
喇叭	A(P)	B(S)	C(O)	D(T)		屋邨	A(S)	B(O)	C(T)	D(P)	
*牙縫	A(T)	B(P)	C(S)	D(O)		*付錢	A(P)	B(S)	C(O)	D(T)	
^責罵	A(T)	B(P)	C(S)	D(O)		^鄰座	A(T)	B(P)	C(S)	D(O)	
敲門	A(O)	B(T)	C(P)	D(S)		筆盒	A(O)	B(T)	C(P)	D(S)	
*桌底	A(O)	B(T)	C(P)	D(S)		*瓶蓋	A(P)	B(S)	C(O)	D(T)	
^弄髒	A(P)	B(S)	C(O)	D(T)		^剩下	A(O)	B(T)	C(P)	D(S)	

	Identical	*Partial	^Different	Total
Target (T)	/10	/10	/10	/30
Phonological (P)	/10	/10	/10	/30
Semantic (S)	/10	/10	/10	/30
Orthographic (O)	/10	/10	/10	/30
Reading	/10	/10	/10	/30

Appendix V

G3 Record form

三年級詞語理解及閱讀作業
答案記錄紙

姓名: _____ ( ) 班別: _____

幼稚園: _____ 錄音帶編號: _____

	A	B	C	D	Read		A	B	C	D	Read
修理	A(P)	B(S)	C(O)	D(T)		傘兵	A(O)	B(T)	C(P)	D(S)	
*拐彎	A(O)	B(T)	C(P)	D(S)		*候車	A(T)	B(P)	C(S)	D(O)	
^唾液	A(O)	B(T)	C(P)	D(S)		^孕婦	A(S)	B(O)	C(T)	D(P)	
籃球	A(T)	B(P)	C(S)	D(O)		堤壩	A(T)	B(P)	C(S)	D(O)	
*出生	A(T)	B(P)	C(S)	D(O)		*漱口	A(O)	B(T)	C(P)	D(S)	
^欺負	A(O)	B(T)	C(P)	D(S)		^葡萄	A(S)	B(O)	C(T)	D(P)	
水喉	A(T)	B(P)	C(S)	D(O)		廁所	A(P)	B(S)	C(O)	D(T)	
*燈泡	A(T)	B(P)	C(S)	D(O)		*躲開	A(O)	B(T)	C(P)	D(S)	
^瞌睡	A(P)	B(S)	C(O)	D(T)		^襯衣	A(S)	B(O)	C(T)	D(P)	
晾乾	A(O)	B(T)	C(P)	D(S)		訪問	A(S)	B(O)	C(T)	D(P)	
*報章	A(S)	B(O)	C(T)	D(P)		*乞丐	A(P)	B(S)	C(O)	D(T)	
^盜竊	A(P)	B(S)	C(O)	D(T)		^入獄	A(T)	B(P)	C(S)	D(O)	
餐廳	A(O)	B(T)	C(P)	D(S)		蝌蚪	A(S)	B(O)	C(T)	D(P)	
*耕種	A(S)	B(O)	C(T)	D(P)		*澆花	A(P)	B(S)	C(O)	D(T)	
^結賬	A(S)	B(O)	C(T)	D(P)		^聊天	A(O)	B(T)	C(P)	D(S)	

	Identical	*Partial	^Different	Total
Target (T)	/10	/10	/10	/30
Phonological (P)	/10	/10	/10	/30
Semantic (S)	/10	/10	/10	/30
Orthographic (O)	/10	/10	/10	/30
Reading	/10	/10	/10	/30