

[博士論文概要]

Accuracy and fluency on Kanji writing in children
with typical development and developmental dyslexia

(典型発達児および発達性読み書き障害のある児童における

漢字書取の正確性と流暢性について)

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Doctoral program in Kansei Behavioral and Brain Sciences,

Graduate School of Comprehensive Human Sciences,

University of Tsukuba

Mio Yokoi

I. INTRODUCTION

The term “dyslexia” is widely used as a shortened version of “specific developmental dyslexia,” which includes individuals who have an unexpected difficulty in learning symbol codes at a level appropriate for their intellectual ability (Montgomery, 2007). Reading difficulty is accompanied by difficulty with written expression in dyslexia as learning how to spell characters is challenging without first knowing how to pronounce them (Uno, 2016). However, compared with studies on reading difficulty, little research has been conducted on writing impairments. Although there has been an increase in the use of nonwritten methods of expression (e.g., keyboard typing), children are still often required to handwrite characters in school, making handwriting an important skill that could be directly related to academic evaluation during school and afterward.

Several reports are available concerning the evaluation of factors that could be related to writing performance, such as word attributes (word-level effects), cognitive abilities and fine motor skills (cognitive-level effects). For word-level effects, some studies have examined the effects of certain word attributes (e.g., the imageability of words or number of strokes) on handwriting performance (Imura et al., 2011; Akashi et al., 2014). For cognitive-level effects, several hypotheses have been proposed for the cause of dyslexia in Japanese individuals, such as “phonological deficits” (Oishi and Saito, 1999; Inoue et al., 2012), “visual cognitive deficits”

(Uno et al., 1995; Uno et al., 1996), and a combination of the two deficits (Uno et al., 2002). Uno (2018) asserted that deficiencies in visual cognition and automatization, in addition to phonological ability, are closely related to developmental dyslexia in Japanese individuals. As for the relationship between writing difficulty and fine motor skills, a few studies have investigated fine motor skills in CWD (Children with Dyslexia). Cheng-Lai et al. (2013) reported that approximately 10% of CWD exhibited slow writing speeds. A second study indicated that, while CWD pause more often, they do not exhibit slow writing speeds (Sumner et al., 2013). However, this association remains controversial, and further investigation is required.

The purpose of this study was to investigate word-level and cognitive-level effects on performance in writing to dictation of one Kanji character as measured by accuracy and fluency (i.e., latency, and duration). Latency refers to the time before the onset of writing the character, and duration refers to the time taken to write the character. This study did not focus solely on accuracy because, even if children can write characters accurately, when the writing process is too slow, it becomes less useful as a method of expression. While investigating the effects of word attributes on writing performance, writing frequency may be an important factor since repeated copying is one of the most common ways to learn new Kanji characters for Japanese-speaking children. However, there is no objective standard for writing frequency in Japanese. Therefore, research concerning writing frequency was conducted with teachers at elementary schools in

Study 1 to be used as a baseline.

II. STUDY 1

Research concerning writing frequency was conducted with teachers at elementary schools in Study 1. Sixteen teachers with at least 5 years of experience teaching at an elementary school participated in a survey questionnaire. Participants were asked to rate the frequency at which elementary school pupils write the 160 Kanji characters to be learned by grade 2 and the 200 Kanji characters to be learned by grade 3, on a 7-point scale (1 = very rarely; 7 = very frequently). To examine the validity of the values of writing frequency, examination of all pairs of the attributes, including writing frequency, were surveyed as well as 4 conventional attributes of correlation that demonstrated statistically significant, moderate correlation between writing frequency and the number of neighbors, frequency on textbooks and the number of neighbors, and writing frequency and frequency on textbooks. These results were consistent between second-grade Kanji characters and third-grade Kanji characters. The results revealed that a larger number of neighbors for a certain Kanji character indicate that the character is used for more words, and that there is a tendency of elementary school pupils to read and write a certain Kanji with the same frequency. Given the not-so-high correlation, it is possible that some Kanji characters frequently read in a textbook are rarely written, and vice versa. Kanji-reading frequency and

Kanji-writing frequency can be considered different measures, and writing frequency is a meaningful variable, as are conventional measures.

III. STUDY 2

Study 2 explored the following five points: 1) examination of developmental changes of writing performance in TD (Typical Development) and CWD groups; 2) investigation of word-level effects on writing performance; 3) investigation of cognitive-level effects on writing performance; 4) enquiry into whether reading ability is related to the acquisition of writing skills since reading and writing both involve orthographic representation, but how they relate to each other is unknown; and 5) comparison of the performance of writing to dictation and the cognitive abilities between the TD and CWD groups.

The TD group was made up of 48 elementary school student participants from grades 3 to 6 (18 boys and 30 girls). The CWD group was made up of 27 children (21 boys and 6 girls) who were recruited from grade 3 in elementary school up through grade 9 in junior high school. Tests of literacy, cognitive ability, and fine motor skills were administered all to participants. The writing to dictation task included 50 single-kanji words to be learned by grade 2 and 13 single-kanji words to be learned by grade 3. As these tests were conducted, accuracy, latency, duration, and duration/stroke number were analyzed. For word attributes, four variables were examined: writing frequency (the mean score in Study 1), number of strokes, imageability in the NTT

database (Sakuma et al., 2008), and frequency on textbooks. For the reading aloud task, Standardized Test for Assessing the Reading and Writing (STRAW-R) was conducted. To test cognitive ability, the Raven's Colored Progressive Matrices Test was conducted as an intelligence task. A Rey–Osterrieth Complex Figure Test (ROCFT) was used as a visual cognitive task. To assess phonological skills, nonword repetition task and word repetition in reverse order task were conducted. To test vocabulary, a component of the Standardized Comprehension Test of Abstract Words (SCTAW) was used. To evaluate fine motor skills, peg-moving task and peg-upending tasks from IPU test (Tsuboi et al., 2009) were utilized.

As a result, evaluation of the developmental changes for writing to dictation performance in the TD group found that accuracy in grade 6 is significantly higher than that of grade 3. In addition, latency and duration become significantly shorter when students reach grade 4. The results of this study are largely consistent with Kandel's report (2015) stating that dysfluency of writing movement decreased from age 8 to 9 and stabilized at approximately age 10. In the CWD group, the results did not show a consistent tendency of developmental change. The results of word-level effects on the performance of writing to dictation task indicated that writing frequency and imageability significantly affected accuracy and latency, and number of strokes predicted duration in the TD group. On the other hand, in the CWD group, writing frequency and number of strokes significantly predicted all dependent variables, and imageability

significantly predicted accuracy and latency of writing to dictation task. Here, writing accuracy and latency in the CWD group were significantly affected not only by writing frequency and imageability, but also number of strokes. Because the CWD group achieved significantly lower performances in visual cognitive tasks among the cognitive tasks, it is possible that visual cognition weakness in CWD is associated with a negative effect due to the number of strokes in a character. These results suggest that a different approach to teaching Kanji characters to CWD, other than just repeated copying, is necessary. In terms of the cognitive-level effects, phonological processing skills affected accuracy in the TD group. In addition, in the CWD group, vocabulary affected accuracy while phonological processing skills affected latency in the writing to dictation task. When children take the writing to dictation test, they need to segment the phonology, extract the part that corresponds to the Kanji, and retrieve the shape of the character. It is suggested that these processes require phonological skills. In terms of fine motor skills, the results of peg-moving tasks significantly predicted all of the parameters in the TD group. However, this might be due to a broad standard deviation. Conversely, there was no effect of fine motor skills on any dependent variables in the CWD group. Therefore, fine motor skills are not a significant predictor of performance in the writing to dictation task, specifically in the CWD group. It was not possible to confirm with this study design, but in terms of incidence of mistakes due to low legibility or self-corrections of handwriting, it is very possible that fine motor skills affect writing performance.

Concerning the relationship between writing to dictation performance and reading Kanji words aloud, since the model with two direct and indirect routes affected writing performance, the direct effects of phonological skills and the indirect effects of phonological skills and vocabulary on writing performance via ability to read aloud were suggested. Lastly, in comparing writing to dictation performance between the TD and CWD groups, the accuracy of TD group was significantly higher, and latency was significantly shorter than the CWD group. These results confirmed that children in the TD group could write Kanji characters more correctly and immediately than those in the CWD group even after excluding the effect of grade. In comparing cognitive task performance between groups, the results show that CWD's performance in ROCFT copying, word repetition in reverse order, and the peg-moving task were significantly lower than that of the TD group supporting the hypothesis that visual cognition, phonological skills, and fine motor skills with dominant hands can influence Kanji character writing skills.

V. CONCLUSIONS

This study evaluated the accuracy and fluency of writing to dictation of one Kanji character and the effects of word-level and cognitive-level factors on TD and CWD groups. This was the first attempt to evaluate the fluency of writing to dictation with Kanji characters and investigate the effects of word attributes, particularly the writing frequency of each character.

Study 1 revealed that writing frequency is a meaningful variable, as are imageability and frequency on textbooks. In study 2, for word-level effects, the importance of writing frequency and imageability are highlighted. In addition to these two variables, the number of strokes was also important to the CWD group. This result indicated that CWD need another possible technique which involves introducing new Kanji characters by the number of strokes instead of randomly, so that CWD children can learn with less difficulty. With respect to the cognitive-level effects on writing performance, phonological skills predicted writing accuracy for the TD group, and writing latency for the CWD group. In the CWD group, vocabulary predicted the accuracy of writing. These results suggest that it is important to ensure that children can read a Kanji character and know its meaning before they learn how to actually write it. A partial effect of fine-motor skills on writing performance was observed in the TD group only. However, this study did not produce clear conclusions that can explain this result. Overall, the results from this study suggest that the factors that affect writing performance in the TD and CWD groups are different, and different treatments would be needed for CWD students.