Acceleration of Chunked Reading:
Perspective From Differences of EFL Reading Proficiency

Natsumi TANAKA
Graduate School, University of Tsukuba

Abstract

The current study investigated phrase-level (chunk) processing fluency, using accelerated chunk reading task which manipulates the presentation time of chunks. Another purpose of this study was to examine whether the accelerated chunk reading promotes learners’ reading comprehension and fluency. There are plenty of reports in literature on speed of word, sentence, and passage-level processing, but none on fluency of chunk-level processing in context. This study involved 43 Japanese EFL learners reading passages in three different speed conditions: fast, normal, and slow paces; and recalling these contents. Fast-paced condition in the reading task was assumed as a fluent reading, thus learners who comprehend text well in this condition are supposed to process chunks fluently. A hypothesis represented that chunk-processing fluency relates to reading proficiency. Findings support this hypothesis: There were differences of chunk-processing fluency between proficiency levels in the accelerated reading. Results does not reveal a significant improvement by accelerated chunk reading as expected from previous studies, but the reading efficiency, one of indices of reading fluency, in fast reading condition was superior to the other conditions in both proficiency levels (upper and lower). These results suggest that this reading method is effective for EFL reading fluency without any special instruction in chunking.

1. Introduction

1.1 Background of this study

Recently, importance of reading fluency is getting more attention in the field of foreign language education in Japan. Though the term fluency is also generally used for skills such as speaking and writing, the development of reading fluency can have clear practical and motivational benefits for a language learner (Nation, 2009). Fluent reading is one of the prominent characteristics of proficient reader, and it contributes towards allotment of cognitive resources for additional texts or tasks. Thus, it becomes goals of elementary education for native speakers (L1) of English (Kuhn & Stahl, 2003; Schwanenflugel et al., 2006). However, many learners of English as a foreign language (EFL) cannot comprehend texts fluently, even if they possess adequate grammatical or lexical knowledge to understand. Therefore, the reading speed of the EFL learners
is only less than one half or third of L1 readers (Grabe, 2009), and it could be possible that they are poor at integration of meaning of words into higher level. The present study is focused on reading fluency process, especially phrase-level fluency.

1.2 Cognitive processes of fluent reading

Fluent reading depends on a set of complex cognitive processes. Researchers have defined fluency in many different ways: Reading fluency is “the ability to read rapidly with ease and accuracy” (Grabe, 2009) and “freedom from word-identification problems that might hinder comprehension in silent reading” (Harris & Hodges, 1995). In addition, “Fluency combines accuracy, automaticity, and oral reading prosody, which, taken together, facilitate the reader’s construction of meaning” (Kuhn, Schwanenflugel, Meisinger, Levy, & Rasinski, 2010). Reading fluency involves three major elements: accuracy, speed (rate), and automaticity (e.g., Kuhn et al., 2010; Kuhn & Stahl, 2003; Schwanenflugel et al., 2006). Understanding of prosodic structure is needed only in oral reading; this is out of the scope of the present study. The cognition of reading speed is different from automaticity with regard to readers’ control: Readers can control their own reading speed, but cannot control their automaticity (Grabe, 2009; Samuels, 2002; Nation, 2009).

The reason why readers need speed to comprehend texts relates to the process of working memory (WM) in their minds. WM is considered to be a kind of short-term memory, which decodes information including language, while stores the information temporarily (Baddeley, 2000). The WM stores the processed information for only one or two seconds without activation by mental rehearsal (Baddeley, 2000; Daneman & Carpenter, 1980). If learners spend too much time to decode, the stored information will fade from WM. In contrast, when readers process contents of text rapidly, they can retain more information in a rehearsal.

Automaticity attributes to the effective use of cognitive resources. The roles of WM in reading are twofold: decode and store language information immediately as mentioned above. Furthermore, reading requires learners to process both at lower and higher-levels, and these processing also compete with cognitive resources. The lower-level processing is essential for comprehension, which involves three steps (e.g., Grabe, 2009; Grabe & Stoller, 2011): Readers recognize each word first (lexical access), next they decode using grammatical information (syntactic parsing), and finally build clause-level meaning from word meaning and grammatical information (semantic proposition formation). On the other hand, higher-level processing (e.g., using strategies or readers’ background knowledge, and make inferences) is not always required for comprehension, but it supports to enhance quality of comprehension, or text representation. However, readers’ available cognitive resource (i.e., working memory capacity) is limited. In order to succeed in these complex processes with limited cognitive resources, readers need to minimize their cognitive resources allotted for lower-level processing, and concentrate on higher-level processing. The automaticity, one of the important components of fluency resolves this problem, as it is needless to spend resources during lower-level processing (Samuels, 2002).
Therefore, factors influencing the rapid process such as speed and automaticity are quite important components in successive reading, in addition to accuracy.

1.3 Measurements of Fluent Reading

The fluent reading also involves some strategic and flexible processes, which change reading speed according to reading purposes (Carver, 1992; Grabe & Stoller, 2011). Carver suggested five types of reading: scanning, skimming, rauding, learning or memorizing. L1 college students’ average reading rate of scanning and skimming is above 450 words per minute (wpm) and the average rate of the slowest process, memorizing is 138 wpm. Rauding is considered to be the best speed for comprehension, which is also called optimal reading rate. Learners could comprehend more than 75% of text information with that rate (Carver, 1992; Nation, 2009). Sometimes learners read fast with a little comprehension instead of careful reading (Nation, 2009). Thus, the index of reading efficiency has been recommended for measuring readers’ appropriate silent-reading rate with adequate comprehension (e.g., Geva, Wade-Woolley, & Shany, 1997). The measurement is done by multiplying the learners’ reading time with proportion of comprehension.

In contrast to self-paced reading speed, Breznitz and her colleagues’ study investigated the reading fluency of L1 learners to read texts silently and orally, with controlled reading speed (Breznitz, Demarco, Shammi, & Hakerem, 1994; Breznitz & Share, 1992). Participants of their studies were instructed to read passages at a little faster rate (e.g., 120% rate) than their own reading paces. The results indicated that the fast-paced reading (accelerated reading) contributes to the promotion of reading comprehension consistently even when learners were young or adolescent (e.g., Breznitz et al., 1994). These studies suggest that the accelerated reading improves comprehension because a faster reading rate increases the units available in WM, and accelerated reading lowers vulnerability to distraction. Therefore, making fluent reading situation for learners is also one of effective way to observe process to achieve fluent reading.

The components of reading fluency have generally been investigated in terms of speed of word, sentence or whole passage-level processing. In case of L1 readers, reading comprehension relates to fluency of word, syntactic unit such as phrase and sentence levels, and whole passage level (Klauda & Gurthrie, 2008). In another study on EFL readers, similar results were obtained; word recognition and sentence verification speeds were associated with reading comprehension (van Gelderen, et al., 2004). However, Fender (2003) suggested Japanese EFL readers have some difficulties in integration of word-level information into higher-level information such as phrase level, even if they can recognize each word individually. Therefore, as well as word or sentence level, phrase-level processing (i.e., semantic proposition formation) should be investigated to ascertain the process of EFL readers’ fluent reading.

1.4 Chunking processes of L1 and EFL learners

Readers mentally parse texts into processing units, chunks. There are individual differences in
size of chunk unit, such as word, clause, phrase, or sentence level. Several L1 studies on chunking process investigated individual differences of processing units, using eye-voice span test, which measured readers’ eye movements preceding voice in oral reading, after materials disappeared (Rode, 1974). It revealed that L1 readers could recognize the syntactic units such as noun or verb phrases. Other studies targeted Japanese EFL readers to investigate these chunking-related phenomena. Kadota, Yoshida, and Yoshida (1999) tested their participants with passages which were divided into different units (i.e., word, clause, or phrase). They examined the effect of units on reading comprehension and speed, and they found that both reading time and comprehension of text faced interference from word-unit presentation, while both were maintained in clause- or phrase-unit. They concluded that Japanese EFL learners processed reading unit such as clause- or phrase-unit, or perhaps larger unit. Other studies also reconfirm these results (Hijikata, 2012; Yamashita & Ichikawa, 2010), and Hijikata mentioned that the processing unit might be extended to sentence unit. It has also been observed that comprehension and reading times of more proficient learners with large chunking-unit suffer from smaller unit presentation such as word level (Hijikata, 2012; Yamashita & Ichikawa, 2010).

As reviewed above, many studies have been carried out to find out the reading unit processed by a learner, and some of these studies which focused on reading fluency had argued mainly reading time of whole passage. However, these studies did not give much attention on the fluency of a learner to decode syntactic unit such as phrases, or chunks.

1.5 Purpose, Hypothesis and Research Questions of the Present Study

The importance of reading fluency of both L1 and EFL learners have been investigated earlier (Grabe & Stoller, 2011; Klauda & Guthrie, 2008; Kuhn & Stahl, 2003; Nation, 2009; van Gelderen et al., 2004). In addition, the size of chunking unit processed during reading has also been explored in L1 and EFL learners (Hijikata, 2012; Kadota et al., 1999; Rode, 1974; Yamashita & Ichikawa, 2010); however, processing speed of phrase-level is also worthy to focus as well as chunking span, in order to investigate fluent reading process of EFL learners. The main purpose of the present study was to investigate chunk processing fluency of different proficient learners.

Nevertheless, there are some difficulties in measuring chunk processing fluency. The chunk processing fluency could not be measured in list of chunks such as word recognition speed or sentence verification speed, because the reading time of contents are affected by with or without contexts (Jenkins, Fuchs, van den Broek, Espin, & Deno, 2003). Thus, the chunk processing fluency should be investigated in context. However, the studies which measured self-paced reading time in chunked reading with contexts pointed out the negative effect of the number of times of key pressing. Because participants pressed a key many times to read at their own paces, and the number of times of key pressing (i.e., the number of chunks) could possibly affect the reading time and speed (Kadota, et al, 1999; Yamashita & Ichikawa, 2010). Another problem is that reading rate is easily susceptible to reading purposes (Carver, 1992). Thus, learners’ reading speed
or comprehension is changeable according to their reading style or strategy without any control.

To measure learners’ chunk processing fluency, this study proposed a reading task which controlled speed of chunk-by-chunk presentation: accelerated chunk reading. The task was based on the following two methods: reading of chunking units in segmented texts (Hijikata, 2012; Kadota et al., 1999; Yamashita & Ichikawa, 2010) and accelerated reading (Breznitz et al., 1994; Breznitz & Share, 1992). In accord with previous methods, the reading task in this study regarded a phrase-level unit as a chunk, and it presented one phrase (i.e., chunk) at a time. When learners comprehend texts presented in a given speed well, it means that they can process chunks at a rate of presentation. Accordingly, the experimental study set at three types of presentation speed: one in accelerated reading condition (fast), and two others in controlled conditions (normal and slow). In particular, when a learner comprehends texts well in the fast condition, it suggests that the learner achieves fluent reading. Though this reading method cannot reveal learners’ processing to parse texts into individual units, it makes possible to observe readers’ time and speed to decode, and integrate the phrase-level chunks into whole text representation. The additional purpose of the study was, in the educational point of view, to examine effects of the accelerated chunk reading on reading comprehension and fluency.

Hypothesis was proposed to examine the effects of presentation speed of chunks on EFL reading comprehension in light of differences between reading proficiency levels, and the research questions focused on effects of accelerated chunk reading on comprehension and fluency. Throughout the whole study, the main focus was on the fast conditions, as the condition was accelerated chunk reading, which regarded as a fluent-reading situation. Accordingly, this study proposed following a hypothesis (H) and research questions (RQs):

H: Chunk-processing fluency is one of the determinants of EFL reading proficiency.

RQ1: Does the accelerated chunk reading promote reading accuracy (recall performance) of EFL readers at different proficient levels?

RQ2: Does the accelerated chunk reading promote reading fluency (reading efficiency) of EFL readers at different proficient levels?

Hypothesis will be supported when differences in each reading proficiency occur because of not accuracy but speed and automaticity; when high proficient readers comprehend better than low proficient readers in fluent reading situation (the fast condition), simultaneously comprehension of low-proficient learners is superior or equivalent to high-proficient learners’ comprehension in the normal and/or slow conditions. The RQ1 will be positively answered if the effects of L1 accelerated reading (Breznitz & Share, 1992) are applicable to EFL reading. Breznitz did not mention effects of accelerated reading on fluency (RQ2), but the learners’ fluency will improve as a result, if the reading comprehension increases in accelerated reading.

211
2. Methods

2.1 Pilot Study

2.1.1 Overview of pilot study

The objectives behind performing a pilot study before the experimental study were as follows: (a) to choose and revise materials and (b) to determine presentation time of chunks.

Nine Japanese undergraduates and graduates, who received formal education in English for at least six years, participated in this pilot study. To accomplish the above mentioned purposes, the three types of tasks were administered: reading task, free written recall task, and text evaluation task. For these tasks, reading passages and questionnaires were prepared. The reading materials for the pilot and experimental studies were four expository passages from a previously reported study (Hijikata, 2012). The length of these four passages was relatively short, around 100 words in length (an exemplary passage is shown in Appendix A). Following Hijikata’s indices (2012), these passages were divided into phrase-based chunks including one-word chunks to ten-word chunks. Since the experimental design required three reading speed conditions, this pilot study was aimed to choose three passages of equal readability. In order to ensure homogeneity of the passages, questionnaires on participants’ perceived difficulty and topic familiarity were also prepared for each passage with a 7-point Likert scale (1 = extremely easy, unfamiliar; 7 = extremely difficult, familiar). These methods followed the guidelines by Yamashita and Ichikawa (2010).

Overall procedure consisted of two sessions: (a) reading and recalling passages, and (b) rereading passage for evaluation. In the first session, the participants read each passage and recalled the contents. Before beginning the tasks, the experimenter instructed them to read as fast as possible, and try to comprehend the contents at the same time so that they can answer the detailed-comprehension questions after reading. This instruction was given to identify learners’ purpose of reading as memorizing (Carver, 1992). They read the passages on the screen of the computer. The text was presented with just one chunk on each page, which prevented the participants from going back to read previous chunk. The next chunk appeared when the participants pressed a key after they finished reading the previous chunk. Thus, they could read the text at their own paces. The reading time (milliseconds: msec) of each chunk was measured by SuperLab 4.5. When they finished reading a passage, they were asked to write down what they remembered about the passage in Japanese on the answer sheet. These procedures were repeated for all four passages. The order of passage to read was counterbalanced. This study used recall task as a comprehension question, because Yamashita and Ichikawa (2010) obtained ceiling effect with multiple comprehension questions. After all passages were read and recalled, participants performed two kinds of tasks in the second session: (a) evaluation of the perceived difficulty and topic familiarity, and (b) confirmation of unknown words. On the experimental booklet, the passages, previously read by participants appeared again. After rereading each passage, the participants answered questionnaires on the perceived difficulty of passage and topic familiarity.
Finally, they checked any unknown words in the four passages. The whole sessions took about an hour.

Based on the division of idea units (IUs) in Hijikata (2012), which followed Ikeno (1996), recall protocols were scored. Nine recall protocols (25%) of all data were randomly selected and scored by two raters separately (the inter-rater agreement = 95.16%). The percentages of IUs which were reproduced two thirds of text information in the learners’ protocols were counted. The disagreements in scoring were discussed by the two raters and they decided the criteria. The remaining data were scored by one rater on the basis of the criteria.

2.1.2 Results of pilot study
(a) Reading materials

Reading materials for the experimental study were chosen on the basis of recall performance, perceived difficulty and topic familiarity scores. Unfortunately, equal-scored three passages were not found among the four passages. Thus, two participants in the pilot study read additional five passages again, and finally three equivalent passages were prepared. Unknown words which several participants pointed out and infrequent words (below level 5 in JACET 8000) were paraphrased with easier words. A L1 reader checked these revised passages. These revised passages were used as reading materials for the experimental study as shown in Appendix B.

(b) Presentation speed

Each number-word chunk was extracted from every passage used in the pilot study. Reading times of these chunks were then averaged. For example, the average reading time of in fact (two-word chunk) was calculated by taking average of reading times of all two-word chunks among four reading passages, so that the effects of text factor counterbalanced. The results of averaged reading time were shown in Figure 1 (in detail, see Appendix C). This averaged time was regarded as standard of EFL readers in the experimental study. Finally, the presentation time in the experimental study was determined from the approximation of averaged reading time.

2.2 Methods of the Experimental Study
2.2.1 Participants

A total of 44 Japanese EFL undergraduates participated in the experimental study. They majored in many different fields. The range of the participants was from first-year to fourth-year
students who had learned English for at least six years. Data of one student who had been in English-speaking countries more than 10 months was excluded from following analyses. Thus, the final number of participants was 43. They were recruited on a paid volunteer basis. None of them had participated in the pilot study.

2.2.2 Materials

There were three types of materials: the reading passages, questionnaire and reading proficiency test. Three reading passages used in the experimental study were chosen based on the results of the pilot study. The questionnaire on the perceived reading speed was prepared to examine the appropriateness of presented speed for participants (see Appendix D). For reading proficiency test, six reading passages were prepared from Society for Testing English Proficiency’s Eiken Tests (from Pre-1 grade to Pre-2 grade texts). Each reading passage had five multiple-choice questions, and there were 30 items in total.

2.2.3 Procedure

In the experimental study, two test sessions were conducted individually: (a) reading and recalling text session (Session 1), and (b) reading proficiency test session (Session 2). In Session 1, participants read three passages at different speeds: fast, normal and slow paced. They were asked to read the texts displayed on the center of a computer screen in chunk-by-chunk style. They were also told that they should read carefully to comprehend the contexts, as in the pilot study. Under the Normal condition, each chunk was presented at the rate calculated in the pilot study (see Figure 1 and Appendix C). Chunks on the Fast condition were accelerated to 65%, resulted in 100 wpm. Chunks on Slow condition were slowed to 150%, or 40 wpm. These percentages were adopted from Breznitz’s studies (1992; 1994). After reading each passage, the participants wrote out what they had remembered about the passage. They were also evaluated on how fast they perceived the presented speed with questionnaire. Finally, in Session 2, the participants performed the reading proficiency test within 30 minutes. The whole procedure took about an hour.

The chunk-by-chunk reading style might be criticized, because the presentation of chunk segmentation affects readers’ comprehension (Hijikata, 2012; Yamashita & Ichikawa, 2010). However, one must note that the effect of chunking unit presented in this study was ignorable compared to presentation conditions, as all participants read the presented chunk at three speed conditions.

2.2.4 Scoring and Data Analyses

The way to score recall task in the experimental study was the same as the pilot study. These scores were transformed into proportion (%), as the number of IUs was different among passages. Based on this proportion of recall task, reading efficiency score was calculated from the following formula: the score of recall performance (%) × presented reading time (wpm).
To confirm the hypothesis and answer the research question, the following two analyses were conducted: analysis of the recall protocols for hypothesis and RQ1, and reading efficiency for RQ2. All analyses are two-factor mixed analysis of variance (3 × 2 mixed ANOVA) to estimate effects of presentation speed and reading proficiency level on each variable. Presentation speed (Fast, Normal, and Slow) was the independent of within-participant, while the reading proficiency level (Upper and Lower) was the variable of between-participant. In all analyses, p values less than 0.05 were considered statistically significant.

3. Results and Discussion

Table 1 shows the descriptive statistics of reading proficiency test. Prior to the main analyses, as preliminary analysis, one-way ANOVA was carried out to confirm the differences in reading proficiency between the Upper and the Lower groups. The result confirmed that score of the Upper group was significantly higher than the Lower group \(F(1, 41) = 64.53, p < .001, \eta^2 = .611\). The reliability of reading proficiency test was also enough (Cronbach's \( \alpha = .72 \)).

| Table 1 Descriptive Statistics of Reading Proficiency Test |
|-----------------|---------|-------|-------|-------|-------------------|
| \(n\)           | \(M\)   | \(Min\) | \(Max\) | \(SD\) | 95% CI            |
| Upper           | 21      | 19.38  | 18.00  | 25.00  | 1.94              | [18.50, 20.26] |
| Lower           | 22      | 13.68  | 6.00   | 17.00  | 2.64              | [12.51, 14.85] |
| Total           | 43      | 16.47  | 6.00   | 25.00  | 3.69              | [15.33, 17.60] |

*Note. Maximum possible score = 30. Cutoff point between the Upper and the Lower groups was 18.*

3.1 Chunk Processing Fluency in Accelerated Chunk Reading (Hypothesis)

The means with standard deviation of the recall tests' performance is demonstrated in Table 2 and Figure 2. To examine Hypothesis, a 3 (Presentation speed: Fast, Normal and Slow) × 2 (Reading proficiency: Upper and Lower) mixed ANOVA was carried out on the recall performance. A significant interaction between presentation time and reading proficiency was found out \(F(1, 41) = 4.65, p = .037, \eta^2 = .102\). Then, the subsequent analyses showed that there was significant simple main effect of presentation time: In the Fast and the Slow conditions, the Upper group significantly comprehended better than the Lower group, \(F(1, 41) = 11.45, p = .002, \eta^2 = .214\); \(F(1, 41) = 8.51, p = .006, \eta^2 = .172\); but there were no differences between reading proficiency level at the Normal condition, \(F(1, 41) = 0.15, p = .699, \eta^2 = .004\). No significant differences were found in reading speed conditions for both the Upper group, \(F(1, 41) = 0.08, p = .774, \eta^2 = .000\), and the Lower group, \(F(1, 41) = 0.09, p = .760, \eta^2 = .000\).

In the Fast-paced reading, the Upper group comprehended better than the Lower group, which meant that the high-proficient learners can process chunks fluently. These findings agree with the previous studies (Kuhn et al., 2010; Kuhn & Stahl, 2003; Schwanenflugel et al., 2006).
Table 2 Means with Standard Deviation of Recall Performance (%)

<table>
<thead>
<tr>
<th></th>
<th>Fast condition</th>
<th>Normal condition</th>
<th>Slow condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>M</td>
<td>SD</td>
<td>M</td>
</tr>
<tr>
<td>Upper</td>
<td>21</td>
<td>50.33</td>
<td>22.08</td>
</tr>
<tr>
<td>Lower</td>
<td>22</td>
<td>29.45</td>
<td>18.86</td>
</tr>
<tr>
<td>Total</td>
<td>43</td>
<td>39.65</td>
<td>22.84</td>
</tr>
</tbody>
</table>

The high-proficient learners can process word or chunk recognition smoothly, as their lower-level processing is quite automatic and fast (Grabe, 2009), thus, they are regarded as fluent readers. In contrast, low-proficient learners did not comprehend within a limited time at the Fast reading. However, they achieved the same comprehension as the Upper group in the Normal condition, indicating that they were poor at processing chunks or combining into sentence representation quickly, even if they possess accurate knowledge about each word or grammar.

Hypothesis assumes that in fluent condition, the differences between reading proficiency levels come out. The result of simple main effect of reading proficiency supports this hypothesis: It revealed significant differences in proficiency at the Fast condition, but insignificant at the Normal condition. Therefore, fluent chunk processing (i.e., phrase-level fluency) relates to EFL reading proficiency.

In the Slow paced reading, comprehension of the Upper group was also higher than the Lower group. The Slow condition might be considered to give positive effects to the low-proficient learners whose speed or automaticity of word recognition and chunk integration is under development. This phenomenon could be accounted by the function of rehearsal in WM. Too slow reading has negative effects on learners, because it disturbs rehearse to process in WM (Nation, 2009). However, the high-proficient learners can process word or chunk recognition smoothly, because their lower-level processing is quite automatic and rapid (Grabe, 2009). They can rehearse each presented chunk repeatedly within presentation time, and integrate these chunks into the text representation. Thus, they can recall contents of text, even when the rate of chunks is too slow compared to their reading rate. On the other hand, Lower group’s lower-level processing was so slow that the text information which they once stored in their WM might fade out.

At the Normal condition, there was no significant difference between the Upper and Lower groups, which was contrast to the Fast and Slow conditions. The Normal condition contributes to the interaction between reading proficiency levels and speed conditions: The Upper group’s comprehension decreased and Lower group’s comprehension increased in comparison with the other speed conditions. The reason why the Normal condition made no differences between proficient levels is probably in learners’ perception or differences between presented reading time.

Figure 2. Results of recall performance.
and their optimal reading rate. If the presented speed matches reading speed, learners could read passage comfortably, and their comprehension would increase. The next session discussed the results and effects of questionnaire on perceived speed.

3.2 Perception of Speed During Accelerated and Manipulated Speed Reading

Table 3 shows the descriptive statistics of questionnaire on perceived reading speed. Note that the scores in Table 3 represent responses of questionnaire (1 = speed of presentation was felt to be fast, 4 = normal, and 7 = slow). These results suggested that the Upper group perceived Fast speed condition as most proximate to their own reading speed, or optimal reading rate (4 in questionnaire). In contrast, the most comfortable speed for the Lower group was Normal condition, although these results were not based on the statistical analysis (see Figure 3).

<table>
<thead>
<tr>
<th></th>
<th>Fast</th>
<th>Normal</th>
<th>Slow</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
<td>M</td>
</tr>
<tr>
<td>Upper</td>
<td>21</td>
<td>3.90</td>
<td>1.14</td>
</tr>
<tr>
<td>Lower</td>
<td>22</td>
<td>3.36</td>
<td>1.26</td>
</tr>
<tr>
<td>Total</td>
<td>43</td>
<td>3.28</td>
<td>1.22</td>
</tr>
</tbody>
</table>

Note. Smaller score shows that participants perceived the presented speed as faster. When participants perceive that presented reading speed is the most optimal, the score becomes close to 4. Maximum possible score = 7.

The interaction of reading comprehension in the Normal condition came from the progress of the Lower group’s performance because of their optimal reading rate. The reason for the high-proficient learners’ decreasing performance is same as the low proficient learners: Too slow presentation speed compared to their reading rate. Here, the contradiction occurred: The high-proficient learners’ comprehension found to improve a little in the Slow condition, though the significant differences between presentation speed were not found out. It suggests that the Slow condition plays the role like poses between chunks that gives enough or even exceeding time to rehearse in WM, promoting comprehension of high-proficient learners.

3.3 Effects of Accelerated Chunk Reading on Comprehension (Accuracy) (RQ1)

There were insignificant differences between speed conditions in comprehension. Breznitz and her colleagues observed that the accelerated presentation of text increased readers’ comprehension (Breznitz et al., 1994; Breznitz & Share, 1992), but the current study did not agree with these previous studies. The plausible reasons could be the differences in methods and targeted language. The reading speed in this study was the same regardless of learners’ optimal reading rate, while Breznitz manipulated learners’ own reading rates in her fast reading condition.
Therefore, different results are likely to obtain, when the Fast condition is set based on a little faster than self-paced reading speed of learners. More importantly, this study targets Japanese EFL learners instead of L1 readers. One of the advantages of accelerated reading was improvement of units available in WM, but EFL learners seem not to benefit from that, because their WM capacity is more limited than that of L1 learners (Grabe, 2009; Grabe & Stoller, 2011; Nation, 2009).

The insignificant result of main effect of presented speed was unexpected, though, in other words, the recall performance was maintained while the presented speed became high. In consequence, the readers’ fluency would increase, since reading fluency consists of both accuracy and speed. Accordingly, RQ2 investigated the effects of the accelerated chunk presentation on reading fluency using reading efficiency as an index of reading fluency (Geva et al., 1997).

### 3.4 Effects of Accelerated Chunk Reading on Reading Efficiency (Fluency) (RQ2)

Table 4 shows the means with standard deviation of reading efficiency. This study utilized reading efficiency differently from other researches. One of the different points is that the scores of reading efficiency at the three speed conditions were naturally different because of the presentation speed. Thus, the presentation speed was maximum score of reading efficiency. Another point is that unlike proportion of multiple comprehension tasks used in some previous studies reported in literature, this study used the recall performance proportion as an index of accuracy, which resulted in lower scores than other studies. Thus, the results of reading efficiency reported here should be regarded only as a guide.

A 3 x 2 two-way mixed ANOVA was again carried out on reading efficiency, which found out the interaction between reading proficiency and presented speed, F(2, 82) = 5.33, p = .007, \( \eta^2 = .115 \). Accordingly, subsequence tests were performed to identify the simple main effect of speed condition and proficiency. The main effects of speed condition in both upper and low proficiency levels were significant, F(2, 82) = 26.34, p < .001, \( \eta^2 = .225 \); F(2, 82) = 6.91, p = .002, \( \eta^2 = .059 \), respectively (also see Figure 4). Further, the multiple comparisons revealed that the following results: In the Upper group, the score of Fast conditions was higher than the Normal (p < .001) and Slow conditions (p < .001), while there were no differences between the Normal and Slow conditions (p = .189); and scores of the Lower group in the Fast and Normal conditions were higher than the Slow condition (p = .004 for Fast, p = .001 for Normal), while there were no differences between the Fast and Normal conditions (p = .278).

<table>
<thead>
<tr>
<th></th>
<th>Fast condition</th>
<th>Normal condition</th>
<th>Slow condition</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
<td>M</td>
</tr>
<tr>
<td>Upper</td>
<td>21</td>
<td>48.15</td>
<td>21.69</td>
</tr>
<tr>
<td>Lower</td>
<td>22</td>
<td>27.79</td>
<td>17.66</td>
</tr>
<tr>
<td>Total</td>
<td>43</td>
<td>37.73</td>
<td>22.05</td>
</tr>
</tbody>
</table>

*Note. Maximum possible score = 100 for the Fast, 60 for the Normal, and 40 wpm for the Slow.*
The results between reading speed condition indicated that the Fast condition promoted reading fluency of high and low proficient learners. Therefore, the positive effects of accelerated chunk reading on fluency were found out in EFL reading, even though the effects of Breznitz’s fast-paced reading (Breznitz et al., 1994; Breznitz & Share, 1992) were not obtained. These differences between comprehension and fluency were due to presentation speed of chunk. Therefore, the contribution of accelerated presentation to reading fluency was found out. As for individual differences between reading proficiency, the high-proficient learners’ performance of reading fluency at the Fast condition improved, but one at the Normal condition declined. On the other hand, the learners with low proficiency maintained their performance high at the Fast and Normal conditions, but it decreased at the Slow condition.

Summing up the results of reading fluency and perception, it was revealed that the reading fluency became greater when the presented speed was almost equivalent to learners’ ordinary reading speed (i.e., the Fast condition for high-proficient learners and the Normal condition for low-proficient learners), or faster than their own paces.

4. Conclusions

4.1 Summary of findings in this study
The current study investigated the role of chunk-process fluency in reading comprehension in terms of reading proficiency levels, with manipulated chunk presentation speed (fast, normal, and slow paces). Results of comprehension show significant differences between reading proficiency levels in the fastest reading condition. However, low-proficient readers performed equally well as high-proficient readers in normal condition, indicating that low-proficient readers are possibly comprehend texts better, if they have adequate time to process. Therefore, the findings suggest that the knowledge of lexical or syntactic information might not be the only reason behind the differences in proficiency levels among learners; it is also caused by phrase-level processing fluency.

Comprehension also relates to readers’ perception of reading speed. The optimal reading speed perceived by learners promoted their reading comprehension best. However, as for reading fluency, the presented speed faster than readers’ own reading rate would increase reading fluency, although there were no differences in comprehension.

4.2 Pedagogical implications and further research
This study showed that the chunk presentation with rate manipulation is effective for reading fluency, even if teachers do not give any special training for chunking or reading strategy. In
addition, accelerated chunk reading would promote reading fluency of university-level students. According to the findings, when teachers decide the presentation speed, it is recommended to set faster speed than the reader’s ordinary reading. Meanwhile, the slow-paced presentation might not be appropriate for fluency instruction, at least for high-proficient learners, as it impedes their fluency. It should be noted that low-proficient learners’ comprehension can decrease in faster reading, which needs some follow-up activities. Rather, accelerated chunk reading is considered to be effective for low-proficient readers who suffer from lack of fluency, because they can undergo fluent reading as a model reading. When there are EFL students with various reading proficiency levels in a class, carrying out the accelerated reading might be difficult all together, because optimal reading speed might be different between learners. In that case, learners can perform the accelerated reading in chunk-by-chunk style as individualized instruction.

Further research is needed to explore new methods to determine (a) reading style and (b) presentation time. Regarding reading style, the chunk unit of presentation utilized in this study may not necessarily suit all participants’ reading requirement. Even though reading situation among three speed conditions was consistent, this method of presenting chunk segmentation in advance prevents readers from observing the learners’ real active chunking process. As discussed in Breznitz and Share (1992), the processing unit and speed could be inextricably linked together. Therefore, other methods or measurements are required. The determinant of presentation time should also be improved. In this study, the presentation time of chunks is determined based on averaged reading times of learners. However, ideally not only the chunk reading time, but pause should also be examined. The high-proficient learners did not perceive even the Fast condition as higher speed than their ordinary reading speed. More speed conditions appropriate for broad range of learners should be investigated in future.

Acknowledgements

I would like to thank Prof. Yuji Ushiro and his seminar members for their insightful comments. In addition, I would also like to acknowledge my gratitude to my reviewers for their useful remarks.

References


Journal of Educational Psychology, 84, 193-199. doi: 10.1037/0022-0663.84.2.193


Appendices

Appendix A: An Example of Reading Passages in Experimental Study (Text 1)

Many birds produce / two types of sounds: / calls, such as a danger call or a gathering call, / which they are mostly born with, / and songs, which often involve learning. / Humans are also born / with inherent “calls”, / the cries uttered by babies, / at least / two of which are distinguishable worldwide: / a pain cry and a hunger cry. / However, / language itself requires learning, / and it exists alongside this old “call” system. / Birds and humans therefore / share a two-fold system, / with one part in place at birth, / and the other acquired later. /

Note. Slush shows segmentation of presented chunks. Indices of segmentation were followed by Hijikata (2012): S (Subject) V (Verb), SVC (Complement), SV/O (Object), SV/OO, SV/OC, basically. The number of phrases containing content words is two, plus or minus two. As to exceptions, see Hijikata (2012).

Appendix B: Characteristics of Three Reading Passages Chosen in Pilot Study

<table>
<thead>
<tr>
<th></th>
<th>words</th>
<th>chunks</th>
<th>FKGL</th>
<th>Recall</th>
<th>Topic familiarity</th>
<th>Perceived difficulty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Text 1</td>
<td>89</td>
<td>18</td>
<td>9.3</td>
<td>63.19</td>
<td>3.38</td>
<td>4.50</td>
</tr>
<tr>
<td>Text 2</td>
<td>91</td>
<td>18</td>
<td>8.9</td>
<td>60.49</td>
<td>3.75</td>
<td>4.38</td>
</tr>
<tr>
<td>Text 3</td>
<td>101</td>
<td>21</td>
<td>8.7</td>
<td>75.00</td>
<td>3.50</td>
<td>5.00</td>
</tr>
</tbody>
</table>

Note. FKGL = Flesch Kincaide Grade Level as an index of readability. N = 9 for Texts 1 and 2, N = 2 for Text 3.

Appendix C: The Averaged Reading Time and the Presentation Time (milliseconds)

<table>
<thead>
<tr>
<th>Words/chunk</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Averaged</td>
<td>1500.6</td>
<td>2458.7</td>
<td>3117.3</td>
<td>3476.6</td>
<td>4782.2</td>
<td>5169.1</td>
<td>6333.8</td>
<td>8104.0</td>
<td>6526.2</td>
<td>8164.1</td>
</tr>
<tr>
<td>Presentation</td>
<td>1690</td>
<td>2440</td>
<td>3200</td>
<td>3950</td>
<td>4710</td>
<td>5460</td>
<td>6220</td>
<td>6970</td>
<td>7720</td>
<td>8480</td>
</tr>
</tbody>
</table>

Appendix D: Questionnaire on Perceived Reading Speed

とても速かった 遅かった やや遅かった 普通 やや速かった 速かった とても速かった

1 --------- 2 --------- 3 --------- 4 --------- 5 --------- 6 --------- 7