Evaluating L2 Readers' Previewing Strategies Using Eye Tracking

Caleb Prichard
Okayama University

Andrew Atkins
Kindai University

ABSTRACT

Previewing a text is a key global reading strategy. Previewing may increase comprehension as it can activate schema, increase global awareness of the text, and enhance the use of other reading strategies. Despite its importance, an explicit focus on previewing skills has been lacking and previous research on the reading strategies of second language (L2) learners' has largely relied on surveys. This study utilizes eye tracking technology, in addition to surveys, to evaluate the previewing strategies of Japanese L2 readers of English. The eye movement data revealed that most learners did very little previewing of the text. One measure of previewing significantly correlated with learners' summary protocol scores, which were poor overall. Finally, the eye movement data did not correlate strongly with participants' survey results. Implications for both reading education and research are discussed.

INTRODUCTION

Reading proficiency greatly enhances a language learner's academic success, job prospects, and global citizenship, yet second language (L2) readers often struggle to comprehend authentic texts (Grabe & Stoller, 2013; Kern, 1989). While reading proficiency is influenced by a number of factors, including one's receptive vocabulary and knowledge of syntax (Alderson, 2000; Bernhardt, 1991), reading strategy usage is also a key predictor of reading comprehension (Carrell, 1991; Song, 1998; Wang, 2009). Research using survey instruments has suggested that more proficient L2 readers more often use a variety of reading strategies, compared to less proficient readers (Lau & Chan, 2003; Sheorey & Mokhtari, 2001). Rather than relying on linear reading and bottom-up processing of a text, strategic readers often

utilize top-down reading methods, such as previewing the text and allocating selective attention to the text's main points or their reading purpose (Sheorey & Mokhtari, 2001).

A significant limitation of the existing research on L2 reading strategies is that the studies tend to rely on participants' survey responses or think-aloud protocols, and such self-report measures may lack reliability (Bax & Weir, 2012; Hyönä, Lorch Jr, & Kaakinen, 2002). One alternative research method is to use eye-tracking technology to measure students' eye-movements over a text (Duchowski, 2007, Rayner, 1998). Empirical studies (e.g., Ariasi & Mason, 2014; Kang, 2014; Kaakinen & Hyönä, 2010) have used eye tracking to measure reading strategies with first language (L1) readers. Participants' eye movement data can validly show if readers are using certain strategies, such as skipping irrelevant sections, re-reading important passages, scanning for information, reading linearly, etc.

However, L2 research utilizing eye tracking has been extremely rare (Bax, 2013; Godfroid, 2012), and L1 research may or may not be relevant to L2 reading since it differs in several ways (Grabe & Stoller, 2013). For example, L2 readers often must cope with a lack of background knowledge and linguistic proficiency, and this may limit the efficacy of their strategy usage (Clarke, 1979; Laufer & Hadar, 1997; Schoonen et al., 1998). Therefore, eye-tracking research on L2 reading strategies has great potential to add to the field.

To fill this gap in the research, the authors have begun a series of studies aiming to utilize eye-tracking technology, along with the Survey of Reading Strategies (SORS; Mokhtari & Sheorey, 2002), to determine the effect of strategic reading on EFL readers' comprehension. This preliminary study analyzes Japanese university students' previewing strategies when given the task to read an expository text and to write a summary. Previewing strategy usage was selected for this initial study as it is a core top-down reading strategy; previewing represents cognizance of a text as a whole, including its organization and context, *before* reading the text. Moreover, few if any studies have focused explicitly on L2 readers' previewing strategies.

LITERATURE REVIEW

Theory and research concerning the role of global reading strategies, especially previewing, will be evaluated below. Second, the potential use of eye tracking to validly evaluate readers' global reading strategies will be described based on the literature.

The Importance of Global Reading Strategies and Previewing

While many L2 readers rely on bottom-up processing of a text (Kern, 1989), proficient readers utilize more strategies and they use them more purposely (Anderson, 1991;

Mokhtari & Reichard, 2002). The importance of reading strategy use, and particularly top-down strategies, is strengthened by numerous studies that have shown that strategy training enhances reading comprehension (see Taylor, Stevens, & Asher, 2006 for an overview).

In order to measure and evaluate the strategies of L2 learners, a number of studies have utilized the SORS (e.g., Mónos, 2005; Sheorey & Mokhtari, 2001; Taki, 2015; Tavakoli, 2014). SORS was designed to measure three constructs and consists of 30 items. The factor of interest to the current study was the global reading strategy subscale. Previewing is one of the key strategies of top-down reading, and two of the global reading strategy construct items on SORS directly concern it (Mokhtari & Sheorey, 2002): previewing to note the topic of the text and previewing to recognize text qualities like organization and length. Two additional items in this construct may be done while pre-reading, including determining "what to read closely and what to ignore" and utilizing "tables, figures, and pictures." Therefore, previewing is central to the global strategies construct. As described below, previewing may strengthen comprehension in that it activates schema, heightens text awareness, and can enable and enhance the use of other global reading strategies.

Previewing to activate schema. Previewing the title, section headings, and images to identify the topic and key points is important to activate schema. Bartlett (1932) was influential in defining schema and describing how constructing meaning in discourse is an interactive process based on one's previous experiences and knowledge. Goodman (1967) linked this process specifically to reading, showing that reading does not solely involve decoding a text in a bottom-up, linear fashion. Instead, he called reading a sort of "psycholinguistic guessing game" in which the reader takes their background knowledge, experiences and expectations to make meaning (p. 126).

While the study involved listening rather than reading, Bransford and Johnson (1972) clearly demonstrated the importance of schema in a research setting. Participants who were shown an image of one scene in the story before hearing it had little difficulty comprehending and recalling the story, while participants who were shown the image *after* listening to the passage comprehended and recalled roughly half as much. Similar results were shown in other follow-up experiments. For example, Wiley and Rayner (2000) found that the presence of titles improved the reading fluency and comprehension of short L1 texts.

The research by Bransford and Johnson (1972) were influential in highlighting the role of schema. Au (1979) and Langer (1981) later utilized schematic theories to create models to utilize in the reading classroom, and Spires, Gallini, and Riggsbee (1992) empirically examined the effect of strategy training. In the latter study, fourth-grade students who received training on previewing schematic cues significantly improved their comprehension in their L1 compared to a control group. Moreover, the previewing group

improved significantly more than a group that received training on recognizing structure-based cues. Pre-reading tasks in the ESOL classroom have now come to be considered a norm among TESOL-trained educators (Ajideh, 2003; Grabe & Stoller, 2013). Previewing a text may be even more essential for L2 readers, who may lack linguistic knowledge to comprehend a text in a bottom-up fashion (Swaffar, Arens, & Byrnes, 1991).

Previewing to heighten text awareness. Proficient readers tend to have more awareness of exactly what they are reading (Pressley & Afflerbach, 2012), and taking a top-down look at a text before reading can enhance awareness. This includes previewing a text's subheadings, layout, and context to identify aspects such as length, organization, genre, purpose, and source (Swaffar, Arens, & Byrones, 1991). Cognizance of such aspects as organization helps readers focus on key points and their relationship with each other, and this can assist in both comprehension and retention (Block, 1986; Carrell, 1991; Meyer, & Poon, 2001; Meyer, Brandt, & Bluth, 1980). Carrell (1985) demonstrated that teaching L2 learners to recognize text structure can improve their comprehension. Viewing images has also been shown to aid comprehension and memory of key points partially because they can be used to draw attention to key points and to help learners visualize them (Levie & Lentz, 1982). Understanding the genre and source can also help readers predict what they will read and the discourse and language features that will encounter. This leads to more efficient reading and enhances comprehension (Swaffar et al., 1991).

Previewing to enable strategic reading. Previewing the text is also essential to the metacognitive reading strategy of *planning* (O'Malley & Chamot, 1990). Reading strategies may be planned as readers preview the text and make connections to their prior experience, knowledge, and purpose. For example, previewing the length may prompt a reader to read more quickly based on time constraints and one's purpose. Previewing section headings may lead effective readers to read a relevant section carefully but to skim or skip over another section.

Indeed, planning one's reading behavior, along with other metacognitive strategies, such as monitoring one's strategy usage, has been shown to be a significant factor in reading comprehension (Anjomshoaa, Golestan, & Anjomshoaa, 2012; Ghafournia & Afghari, 2013; Phakiti, 2003; Zhang & Seepho, 2013). While more proficient and less proficient readers often use similar strategies, Anderson (1991) concluded that more successful readers can use the strategies purposefully. Such purposeful strategy usage can be greatly enhanced by previewing the text's context, genre, length, linguistic complexity, and organization.

Global reading strategies, and specifically previewing, may be becoming even more important as more and more reading is done online (Akyel & Ercetin 2009; Kang, 2014).

There is so much content available online that readers must be more selective, and this involves previewing articles for relevance, interest, and appropriacy.

Causes of a Lack of Strategic Competence among L2 Readers

There are several possible reasons that L2 learners may lack strategic competency in reading, including the tendency not to preview a text. First, there is some evidence that people of certain cultures may more often rely on certain reading strategies. For example, Canadian college students reportedly more often use a top-down reading style, while Iranian learners more favored bottom-up reading both in their L1 and L2 (Taki, 2015). L2 learners of Arabic from African backgrounds more often utilize global strategies than learners from Asian backgrounds (Alhaqbani, & Riazi, 2012).

Second, even if L2 learners have strategic competence when reading in their L1, their strategy use may not transfer to L2 reading. ESOL learners who have never had experience in reading English for authentic purposes may not have developed the strategic reading habits in the L2 (Zhang, 2001). Grammar-translation pedagogies are still dominant in certain contexts, such as EFL classes in Japanese high schools, and such learners may have developed the tendency to use bottom-up reading strategies when reading English (Sakurai, 2015). This is because grammar-translation tasks, answering comprehension questions, and test preparation often do not require top-down reading or reading for meaning. Moreover, while browsing media in the L2 to find relevant articles for pleasure or research requires previewing numerous articles, lower-level learners and learners in teacher-dominated classrooms may likely have had little or no experience in doing this.

While most TESOL-trained teachers and textbook publishers may understand the importance of activating schema and purposeful reading (Ajideh, 2003), it is unclear if students actually develop previewing skills through such pre-reading activities. While many strategy training studies have shown results as reported above, not all training has been shown to be successful (Taylor, Stevens, & Asher, 2006). Based on O'Malley and Chamot's CALLA model (1990), effective strategy training includes developing awareness and knowledge of strategies, extensive practice, reflection, and expansion. However, many instructors and textbooks do not explicitly teach previewing skills and metacognitive strategies. Therefore, simply going through pre-reading activities in class may not enough for learners to develop these habits when engaging in reading tasks on their own.

Limitations of Previous Research Methodologies and the Potential of Eye Tracking

While the existing research suggests the importance reading strategies, including previewing, there were many limitations to the research methodologies used. First, it is

difficult to get detailed data using surveys, such as SORS (Denscombe, 2014). Correlating learners' general reading tendencies and their test scores (the research methodology frequently utilized) does not clearly demonstrate how learners actually use reading strategies on a specific task. Moreover, this does not show how their strategy use affects their comprehension, given various texts and tasks.

Second, honesty and accuracy of respondents is a potential limitation of surveys and retrospective reports (Denscombe, 2014). Research participants may report based on what they perceive as the ideal response. In one study of L2 readers' strategy use, participants misreported their behavior nearly a third of the time (Bax & Weir, 2012). For example, several participants replied that they had read the whole text, but eye tracking revealed that they had not. This led authors to doubt the reliability of studies that rely on retrospective reports to examine readers' cognitive processing.

Think-aloud protocols and retrospective surveys, reports, or interviews about readers' strategy use may be more effective in highlighting how participants' process a specific text (Pressley & Afflerbach, 2012). However, metacognitive verbal reports may interrupt, interfere with, and influence silent reading (Cohen, 2010), and the protocols may not reliably grasp all the cognitive and metacognitive processes of readers, especially those that have become habitual or automated (Yoshida, 2012).

Eye-movement research in the L1. Given the limitations of surveys and think-aloud protocols, eye-tracking has been increasingly used as the main or supporting methodology in L1 reading research. While most research has looked at the eye movements of linear reading, eye tracking can also be used to reveal one's strategic processing of the text (e.g., Hyönä, Lorch, & Rinck, 2003). The body of research has convincingly shown that eye movements "reflect moment-to-moment cognitive processes" (Rayner, 1998, p. 372), and that they are "a window into language and cognition" (Spivey, Richardson, & Dale, 2009, p. 225).

Selective attention is a key metacognitive skill, and it may relate to previewing skills. Shebilske and Fisher (1983) carried out one of the earliest eye-tracking studies to measure L1 readers' selective attention. They found that readers tended to scan passages they perceived as relevant more slowly than passages deemed irrelevant. A series of studies led by Hyönä (Hyönä et al., 2002; Hyönä, Lorch, & Rinck, 2003; Hyönä & Nurminen, 2006) explored the selective attention of Finnish university students while reading expository texts in their L1 in order to complete a summary task. The results revealed that readers could be divided into non-selective *linear readers* and *topic structure processors*, who paid more attention to subject headings, topic sentences, and concluding sentences. While topic structure processors were a minority of the readers, they were much more successful on the text summary protocol. Kaakinen and Hyönä (2007) later analyzed how task affected readers' selective attention. Readers given a task to teach others key points of a text fixated more on relevant

sentences and more frequently skipped over other sentences, compared to readers who were not assigned a specific reading purpose. These studies highlight the importance of metacognitive skills and highlight the potential of eye tracking as a research tool.

Eye tracking in the L2. Utilizing eye-movement data in L2 settings is in its infancy, but it has greatly picked up in recent years (e.g., Godfriod, 2012; Godfroid & Spino, 2015; Winke, Godfroid, & Gass, 2013). However, few studies published thus far have examined L2 readers' strategies. Bax and Weir (2012) identified the various reading behaviors (focusing on the task, skimming, and selective attention of relevant text) of six participants who had successfully answered target test items. However, as the objective of the study was to evaluate the cognitive validity of a reading test, it did not empirically research the efficacy of their reading behaviors. Considering the research methodology, Bax and Weir concluded that eye-tracking provides "unprecedented insights into readers' moment-by-moment reading behaviour" and that this part of the research methodology was more valid and reliable than retrospective reports (p. 8).

In a follow-up study of 38 Malaysian learners of English, Bax (2013) compared the eye movements of successful and unsuccessful test-takers who needed to scan a text to answer test items. Most of the differences in participants' eye movement data were found to be related to the readers' processing of the text at a lexical and grammatical level. However, the analysis of readers' eye movements on certain items seemed to suggest to the researcher that that readers who answered the questions correctly scanned more strategically. In contrast, while learners who missed the questions were also scanning the text, they "seemed... to be searching almost at random, and with no strategic purpose" (p. 460). Readers who successfully scanned the text may have had more awareness of the text's overall structure based on previewing, but this was not discussed.

Kang (2014) carried out a small exploratory study comparing the reading comprehension and eye movements of nine native English speakers and nine Chinese graduate students in the United States. Other than the reading speed, few differences were found, but this is not surprising considering the L2 students' high proficiency. Moreover, the small sample size and the fact that the comprehension test had just five items hinder the validity of the study. Previewing and selective attention to main points was not evaluated.

Summary

Previewing a text is one of the core global strategies. Previewing a text may strengthen comprehension in that it activates schema, develops global awareness of the text, and enhances metacognitive strategies. Despite growing awareness of its importance among ESOL educators, many learners may lack top-down reading strategies, including previewing

skills. However, L2 readers' previewing strategies have not been evaluated empirically. Previous research has relied on survey protocols, which have some limitations. Eye tracking has potential to be a very useful research tool to validly analyze L2 readers' global strategy usage, including their pre-reading skills.

METHODS

This study analyzes the eye movements of Japanese readers of English to determine if and how they previewed an expository text to complete a summary task. Second, their ability to summarize the main points of the text will be analyzed to evaluate if their previewing behavior had any relationship with their task performance. Finally, the eye movement data will be compared with participants' responses on relevant items from SORS to consider the reliability and role of the two research methods.

Participants and Procedures

The study involved 38 Japanese university students from two well-known institutions in Western Japan. Their mean score 562 was on the Test of English for International Communication (TOEIC) by the English Testing Service. While it is extremely difficult to compare TOEIC scores with other tests and frameworks, 562 on the TOEIC seems to roughly equate with at least B1 ("independent users") on the Common European Framework (ETS, 2015). The students came from a broad range of faculties that included Literature, Arts and Cultural Studies; Law; Dentistry; Engineering; and Environmental Science.

Students were administered the SORS in their classes, and they were invited to further take part in the research study by reading an article the following week in the researchers' offices. The directions informed the participants that they would be shown a short article for three minutes and that, as in Hyönä, et al. (2002) and Hyönä and Nurminen (2006), they would then need to summarize the main points in five or six sentences in English without access to the article. They were told that they would not need to worry about spelling or grammar in their summary. After the participants confirmed they understood the directions, their eyes were calibrated to the eye tracker and the data collection began.

Materials

One expository text with 471 words was used. The topic of the text was the game *rock, scissors, paper*, and three subsections discussed game variations, worldwide competitions, and strategies of winning. The text was adapted from a Wikipedia entry, and a similar version was also used in previous research (Prichard, 2011). While research shows

that background knowledge affects comprehension, piloting of the text revealed that participants knew little of the text's content. As for the vocabulary level, the text was adapted so that over 95% of the running words were from the first 3,000 words of the British National Corpus (2007), after proper nouns and loanwords used in Japanese had been excluded.

As in the texts used in Hyönä, Lorch, and Kaakinen (2002) and Hyönä and Nurminen (2006), the article contained headings and clear topic sentences, which contained all the text's main points. There were six paragraphs, two for each section, and six images. The article was displayed on two pages open side by side on a monitor (see Figure 1). This enabled participants to easily preview the entire text without needing to turn pages or scroll down.

Figure 1. The Article File as It Was Displayed on the Monitor.

Equipment

The data collection utilized two Gazepoint GP3 Eye Trackers (one in each of the researchers' offices) and Gazepoint Analysis Professional Edition Software. The trackers were mounted under the screen. The tracker has a refresh rate of Hz 60, which is lower than the trackers used in many recent studies. However, this was not deemed a significant limitation as the purpose of the study was to analyze global text processing and eye movements were analyzed within relatively large chunks of space (i.e., paragraphs and images). Therefore, a lower sampling rate was considered more acceptable than in studies analyzing fixations at a lexical level. The article was displayed on a 24-inch high definition monitor and participants' eyes were approximately 60 centimeters from the screen. The body text was Times New Roman. The font size of the text is difficult to accurately gauge as an

image of the file was made and then altered to fit the screen size; however, the body text was between 16 and 18 point.

Analysis

  Previewing strategies of the target text (eye tracking). To determine the extent and characteristics of participants' previewing strategies, the following were recorded *before* the reader started linear reading of the first paragraph:

- the total pre-reading time
- the number of fixations and total fixation duration on the title and subtitle
- the number of fixations and total fixation duration on the body text
- the number of fixations and total fixation duration on the images
- the number of subject headings and topic sentences fixated on
- the number of paragraphs fixated upon
- the number of images fixated upon

  Participants' summary skills. As in Hyönä and colleagues (2002) and Hyönä and Nurminen (2006), the participants were given points on their summary based on their recall of the main features of the text. They were given five points for restating the topic, four points for mentioning each of the three subtopics (noted in the subheadings), and three points for their recall of each of the main points (mentioned in the topic sentences of the six body paragraphs). They were given no points for their recall of supporting details and examples and for ideas not presented in the text. The maximum total possible was 35 points. Language use, such as spelling and grammar accuracy, was not accounted for in the scoring. Pearson correlation coefficient was used to determine if there was any significant relationship between the summary scores and the eye-tracking measures.

  Previewing tendencies when reading English texts (SORS). The SORS was utilized to compare the participants' previewing behavior on the target text with their self-reported reading tendencies measured on a 5-point Likert scale. The survey was translated into Japanese and reviewed by five Japanese/English bilingual professors to check the accuracy of the translations.

  Internal consistency estimates of reliability were conducted for the 30-item SORS and for the 10-item Global Reading Strategies subscale. Values for coefficient alpha were .896 and .834 respectively, indicating good reliability for the SORS and for the subscale.

  The following four items were specifically targeted for a statistical comparison:

  4. I take an overall view of the text to see what it is about before reading it.

  8. I review the text first by noting its characteristics like length and organization.

12. When reading, I decide what to read closely and what to ignore.

15. I use tables, figures, and pictures in text to increase my understanding.

Items four and eight directly concerned pre-reading, while items 12 and 15 may be indirectly related. To determine if there was any significant correlation between the SORS results and the eye-tracking measures and the summary scores, Pearson correlation coefficient was utilized.

RESULTS

Eye-tracking Data

The eye-tracking data revealed that most participants did little or no previewing of the text. Thirteen (34.2%) displayed no other previewing behavior other than reading the title and subtitle. Six of the participants (15.8%) did not even fixate on the title or subtitle before reading the body text. Together these two groups, who represented half of the participants, will be labelled as *non-previewers*.

Only 18 of the readers (42.1%) fixated on the body text or images before linearly reading. These participants will be labelled as *previewers*. However, as shown in the fixation heat map (Figure 2) of the first ten seconds of the reading, most of the attention by the previewers was devoted to reading the title, subtitle, and the first subheading; less attention was given to other key parts of the text which can be utilized in previewing, such as the images and section headings.
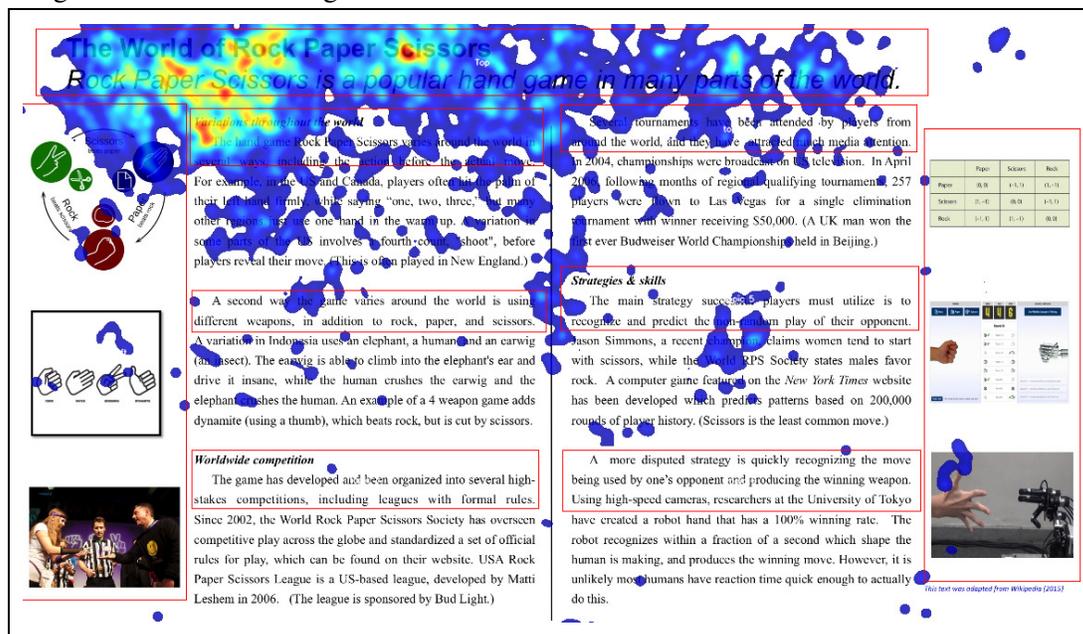

Figure 1. Fixation Map of the First Ten Seconds of Reading

The two remaining participants spent most of the session scanning the text, with very little linear reading. One did not start reading linearly until 67th second, and another participant spent 42.2 seconds scanning before reading. Even after beginning to read linearly, these two participants soon resumed scanning. Therefore, these participants were omitted from the *previewers* group and will be labelled as *text scanners* in this study.

As shown in Table 1, the mean time readers spent before linear reading of the text was 9.5 seconds; the median was much lower (6.7 seconds) considering the two text scanners.

Table 1. Duration before Linear Reading of the First Paragraph

	Total Time before Linear Reading	Title & Subtitle Fixation Time	Image Fixation Time	Body Text Fixation Time
Mean (*seconds*)	9.50	4.49	.63	1.92
Median	6.70	4.18	0	0
Range	0 - 67.07	0 - 20.3	0 - 7.7	0 - 48.37
SD	12.33	4.40	1.70	7.92

Very little time was spent previewing the images and text. Three-fourths of the students (76.3%) did not fixate on any of the images before they started linear reading the text. The mean fixation duration on the images was .63 seconds for all students and 1.46 seconds for the seven students in the preview group who fixated on images. The mean number of images fixated on was just 1.42 out of six images (see Table 2). Of the previewers who fixated on images, the mean number was 2.71.

Table 2. The Number of Fixations before Linear Reading of the First Paragraph

	Title & Subtitle Fixations	Image Fixations	Text Fixations
Mean	12.62	1.42	5.34
Median	14	0	0
Range	0 – 32	0 – 13	0 - 137

SD	10.28	3.41	22.23

Just thirteen of the students (34.2%) fixated on the body text (including subheadings) before reading. Just nine of them previewed subheadings and topic sentences, and none of the previewers fixated on more than one subheading or topic sentence before beginning to linearly read the body text.

Summary Protocol and Previewing Behavior (Eye-tracking)

Most students struggled to recall the main points of the text. The mean score was 10.24 out of 35 points (*SD* = 6.27; Median = 11; Range = 0 - 29). This was the case regardless of their proficiency level; the correlation between the participants' TOEIC scores and their summary protocol was not significant, $r(36) = .19$, $p = .13$.

Omitting the two participants in the text scanner group, there was no significant correlation between the total previewing time and the protocol score $r(34) = .25$, $p = .07$. However, there was a moderate significant correlation between the total fixation duration on the body text while previewing and the protocol score $r(34) = .31$, $p = .03$. There was no significant correlation among the other individual eye-tracking measures and the summary protocol score. As shown in Table 3, the previewers outscored those who in the other groups, but the difference between previewers and non-previewers was not significant, $t(34) = 1.04$, $p = .30$, based on an unpaired *t*-test.

Table 3. Mean Summary Protocol Scores of Participants

	Previewers (N = 17)	Non-previewers (N = 19)	Scanners (N = 2)
Mean Protocol Score	11.59	9.37	7
SD	7.37	5.26	4.24

Survey Results and Previewing Behavior (Eye-tracking)

There was little or no relationship between the target SORS items related to previewing and the participants' pre-reading eye-movements.

Item 4: I take an overall view of the text to see what it is about before reading it.
There was no significant correlation between this item and the time participants spent before reading the text $r(34) = .01$, $p = .48$, or any of the other eye-tracking measures. The students

in the previewer group agreed with this item somewhat more (*M*= 4.41; *SD*=1.47) than non-previewers (*M*= 3.47; *SD*=1.54), but this difference was not quite significant, $t(34) = 1.89$, $p=.07$, based on a *t*-test.

Item 8: I review the text first by noting its characteristics like length and organization. There was not a significant correlation between this item and the time participants spent before linear reading of the text $r(34)= -.09$, $p = .30$, or any of the other eye tracking measures. Those in the previewers group agreed with this item slightly more (*M*= 3.88; *SD*=1.69) than the non-previewers (*M*= 3.58; *SD*=1.12), but the *t*-test results did not show significance.

Item 12: When reading, I decide what to read closely and what to ignore. There was no statistical difference between this item and any of the eye-tracking measures. The previewers group had slightly higher levels of agreement with this item (*M*= 4.06; *SD*=1.43) and non-previewers (*M*= 3.84; *SD*=1.68), but the *t*-test analysis did not show significance.

Item 15: I use tables, figures, and pictures in text to increase my understanding. There was no significant correlation between this item and the number of fixations on the images before reading the text, $r(36) = .19$, $p = .13$, or any other previewing measures relating to images. The participants who fixated on images while pre-reading agreed slightly more with this item (*M*= 5.00; *SD*=1.12) compared to other participants (*M*= 4.79; *SD*=1.24), but the difference was not significant based on a *t*-test

DISCUSSION

Eye Movements while Pre-reading

Overall, the participants displayed very little previewing behavior, and this was surprising to the researchers. A handful of students did not even read the title or subtitle. Half of the students did not look at the body of the text before linear reading of the text, and most students did not fixate on the images before reading. It may be possible that some of the text's features, like length and the content of some images, could have been assessed parafoveally, and this should be examined in follow-up research. Finally, the students tended not to preview the headings or topic sentences, which may have helped them focus on the organization and key points, which is essential for summary writing. None of the students fixated on more than one section heading or topic sentence.

Follow-up research is needed to confirm if the reading behaviors observed in this study are the norm among Japanese L2 readers. If so, possible reasons for this should be examined through qualitative measures, such as follow-up interviews. As noted in the literature, much of the reading students do in Japan is based on grammar-translation and for test taking, and such reading activities do not focus on reading for main points. Moreover, entrance exams in Japan often remove the title and images, and the text source is only written at the end. Therefore, previous conditioning may have led the participants to read linearly.

Another possible reason for the lack of previewing could be related to the context. For example, the participants had a time limit, and they may have felt that they had little time to preview. However, if they perceived a lack of time, it could also be presumed that the previewing behavior could have been increased in order to plan the reading more effectively. In future studies, the time allotted to reading should be varied to see whether time is a factor.

Summary Protocol and Previewing Behavior

The participants struggled in their summary writing. As mentioned above, reading for main points and summary writing tends to be ignored in English education in Japan.

The correlation between eye movement data while pre-reading and the summary scores tended to have little or no correlation. This was not surprising considering success in reading comprehension and the summary task involves a number of other factors, such as the learners' proficiency level, task-familiarity, working memory, and the use of other reading strategies while reading. Despite this, one previewing measure (fixation duration on the body text) had a significant correlation and another measure (total pre-reading time) approached significance. More research, especially studies that involve more participants who preview the text thoroughly, is necessary before any firm conclusions can be made on the effect of previewing.

Survey Results and Previewing Behavior

The results from the targeted SORS items did not correlate with the readers' behavior. While the researchers did not expect a strong correlation based on concerns described in the literature, at least a moderate correlation was expected. Although more research is necessary, this may highlight the importance of utilizing more than one research method rather than relying solely on survey data.

Limitations

The main limitation in this study related to the accuracy of the eye tracking. Oily skin, sparkly makeup, and glasses sometimes caused detection issues with the tracking, resulting in seventeen participants being excluded from the analysis. Other issues may have been caused by eye shape or characteristics of the participants' pupils, as is described by Hansen and Ji

(2010). Participants whose tracking was lost at any point before linear reading began were excluded from the study.

Task familiarity with summarizing may also have been an issue. Summarizing is a fairly familiar classroom task, but it may have been unfamiliar to some participants. Multiple choice type questions could be used in addition to the summary task as this would provide a more receptive and cognitively less challenging task for participants.

CONCLUSION

Given the task of summary writing, this exploratory study examined the previewing strategies of Japanese university L2 readers, as measured by eye-tracking and a reading survey (SORS). Half the participants showed little if any previewing behavior, and several students did not even read the title or subtitle. Those that did have pre-reading eye movements previewed very quickly, and none of the participants referred to more than one of the subheadings or topic sentences. Most participants did not fixate on the images while pre-reading, and those that did viewed only one or two.

The summaries written by the participants were generally poor and failed to mention two-thirds of the key points in the text on average. There was a significant, but weak correlation between the participants' summary scores and their fixation duration of the body text while previewing. Other measures did not have a significant effect, but the total pre-reading time approached significance. More research is necessary before it can be confidently concluded that pre-reading enhances L2 readers' ability to summarize.

The participants also took the SORS on their general reading behavior in English, but the items concerning previewing did not correlate significantly with the relevant eye-tracking data. While one possible reason may have been that the context of the task differed greatly from what the participants were used to, this further calls into question research on strategy use that relies solely on survey instruments. In contrast, the use of eye tracking yielded valid and insightful data on the learners' actual reading strategy use in context. While there were some issues with the eye tracking and some data needed to be discarded, follow-up studies are planned using eye tracking and qualitative measures to gather more data on learners' global reading strategies.

This study did not investigate reasons for the participants' lack of previewing behavior and summarizing skills. However, the literature suggests that this may be partially the result of the Japanese students' prior English studies, which likely did not prioritize reading for main points. In addition to getting more experience reading for authentic purposes, the learners might benefit from strategy training on pre-reading and other global reading strategies. Future studies are planned which evaluate the efficacy of strategy training on learners' reading strategy use and summary writing.

Caleb Prichard *is an associate professor in Okayama University in Japan. His main research interests are reading strategy use and language program administration.*

Email: prichard@okayama-u.ac.jp

Andrew Atkins *is an associate professor at Kindai University in Osaka Japan. His research main interests include reading fluency development, intercultural communication and testing.*

Email: andrew@intl.kindai.ac.jp

REFERENCES

Ajideh, P. (2003). Schema theory-based pre-reading tasks: A neglected essential in the ESL reading class. *The Reading Matrix*, *3*(1). Accessed January 2nd, 2016, from http://www.readingmatrix.com/articles/ajideh/article.pdf?q=activating-and-building-schema-readers

Alderson, J. C. (2000). *Assessing reading.* Cambridge, UK: Cambridge University Press.

Alhaqbani, A., & Riazi, M. (2012). Metacognitive Awareness of Reading Strategy Use in Arabic as a Second Language. *Reading in a Foreign Language*, *24*(2), 231-255.

Anjomshoaa, L., Golestan, S., & Anjomshoaa, A. (2012). The Influences of Metacognitive Awareness on Reading Comprehension in Iranian English Undergraduate students in Kerman, Iran. *International Journal of Applied Linguistics and English Literature*, *1*(6), 193-198.

Anderson, N. J. (1991). Individual differences in strategy use in second language reading and testing. *The Modern Language Journal*, *75*(4), 460-472.

Akyel, A., & Ercetin, G. (2009). Hypermedia reading strategies employed by advanced learners of English. *System, 37*(1), 136 -152.

Ariasi, N., & Mason, L., (2014). From covert processes to overt outcomes of refutation text reading. *International Journal of Science and Mathematics Education, 12*(3), 493-523.

Au, K. (1979). Using the experience-text-relationship method with minority children. *The Reading Teacher, 32*, 677-679.

Bartlett, F. C. (1932). *Remembering: An experimental and social study.* Cambridge: Cambridge University.

Bax, S. (2013). The cognitive processing of candidates during reading tests: Evidence from eye-tracking. *Language Testing, 30*(4), 441-465. Accessed January 2nd, 2016, from http://ltj.sagepub.com/content/30/4/441.full.pdf+html

Bax, S., & Weir, C. J. (2012). Investigating learners' cognitive processes during a computer-based CAE Reading test. Cambridge ESOL. *Research Notes, 47*, 3-14. Accessed

January 2nd, 2016, from http://www.cambridgeenglish.org/images/22669-rv-research-notes-47.pdf

Bernhardt, E. B. (1991). *Reading development in a second language: Theoretical, empirical, and classroom perspectives.* Norwood, NJ: Ablex Publishing.

Block, E. (1986). The comprehension strategies of second language readers. *TESOL Quarterly*, *20*(3), 463-494.

Bowles, M. A. (2010). The think-aloud controversy in second language research. New York: Routledge.

Bransford, J. D., & Johnson, M. K. (1972). Contextual prerequisites for understanding: Some investigations of comprehension and recall. *Journal of Verbal Learning and Verbal Behavior*, *11*(6), 717-726.

The British National Corpus (2007), *BNC XML Edition*. Distributed by Oxford University Computing Services on behalf of the BNC Consortium.

Carrell, P. L. (1985). Facilitating ESL reading by teaching text structure. *TESOL Quarterly, 19*(4), 727-757.

Carrell, P. L. (1991). Second language reading: Reading ability or language proficiency? *Applied Linguistics, 12*, 159-179.

Clarke, M. (1979). Reading in Spanish and English: Evidence from adult ESL students. *Language Learning, 29*, 121-150.

Denscombe, M. (2014). *The good research guide: for small-scale social research projects.* McGraw-Hill Education (UK).

Duchowski, A. (2007). *Eye tracking methodology: Theory and practice*. London: Springer.

ETS (2015). Mapping the TOEIC® and TOEIC Bridge™ Tests on the Common European Framework of Reference for Languages. Accessed May 2nd, 2016, from http://www.ets.org/s/toeic/pdf/toeic_cef_mapping_flyer.pdf

Ghafournia, N., & Afghari, A. (2013). Relationship between Reading Proficiency, Strategic Competence, and Reading Comprehension Test Performance: A Study of Iranian EFL Learners. *International Education Studies*, *6*(8), 21-30.

Godfroid, A. (2012). Eye tracking. In P. Robinson (Ed.), *Routledge encyclopedia of second language acquisition*, (pp. 234-236), New York: Routledge.

Godfroid, A. & Spino, L. (2015). Reconceptualizing reactivity of think alouds and eye tracking: Absence of evidence is not evidence of absence. *Language Learning, 65*(4), 896-928.

Goodman, K. S. (1967). Reading: A psycholinguistic guessing game. *Literacy Research and Instruction*, *6*(4), 126-135.

Grabe, W., & Stoller, F. L. (2013). *Teaching and researching reading*. New York: Routledge.

Hansen, D. W., & Ji, Q. (2010). In the eye of the beholder: A survey of models for eyes and gaze. *Pattern Analysis and Machine Intelligence, IEEE Transactions on*, *32*(3), 478-500.

Hyönä, J., Lorch, R. F., & Kaakinen, J. K. (2002). Individual differences in reading to summarize expository text: Evidence from eye fixation patterns. *Journal of Educational Psychology*, *94*(1), 44.

Hyönä, J., Lorch, R. F., & Rinck, M. (2003). Eye movement measures to study global text processing. In R. Radach, J. Hyönä, & H. Deubel (Eds.) *The mind's eye: Cognitive and applied aspects of eye movement research* (pp. 313-334). Amsterdam: Elsevir.

Hyönä, J., & Nurminen, A. M. (2006). Do adult readers know how they read? Evidence from eye movement patterns and verbal reports. *British Journal of Psychology*, *97*(1), 31-50.

Kaakinen, J. K., & Hyönä, J. (2007). Perspective effects in repeated reading: An eye movement study. *Memory & Cognition, 35*, 1323–1336.

Kang, H. (2014). Understanding online reading through the eyes of first and second language readers: An exploratory study. *Computers & Education, 73*, 1–8.

Kern, R. G. (1989). Second language reading strategy instruction: Its effects on comprehension and word inference ability. *The Modern Language Journal*,*73*(2), 135-149.

Langer, J. A. (1981). From theory to practice: A prereading plan. *Journal of Reading*, *25*(2) 152-156.

Lau, K. L., & Chan, D. W. (2003). Reading strategy use and motivation among Chinese good and poor readers in Hong Kong. *Journal of Research in Reading, 26*(2), 177-190.

Laufer, B., & Hadar, L. (1997). Assessing the effectiveness of monolingual, bilingual, and "bilingualised" dictionaries in the comprehension and production of new words. *The Modern Language Journal*, *81*(2), 189-196.

Levie, W. H., & Lentz, R. (1982). Effects of text illustrations: A review of research. *ECTJ*, *30*(4), 195-232.

Meyer, B. J., Brandt, D. M., & Bluth, G. J. (1980). Use of top-level structure in text: Key for reading comprehension of ninth-grade students. *Reading Research Quarterly, 16*(1), 72-103.

Meyer, B. J., & Poon, L. W. (2001). Effects of structure strategy training and signaling on recall of text. *Journal of Educational Psychology*, *93*(1), 141.

Mokhtari, K., & Reichard, C. A. (2002). Assessing students' metacognitive awareness of reading strategies. *Journal of Educational Psychology*, *94*(2), 249.

Mokhtari, K., & Sheorey, R. (2002) Measuring ESL students' awareness of reading strategies. *Journal of Developmental Education, 25*(3), 2–10.

Mónos, K. (2005). A study of the English reading strategies of Hungarian university students with implications for reading instruction in an academic context. *Malaysian Journal of ELT Research, 1*, 1-23.

O'Malley, J. M., & Chamot, A. U. (1990). *Learning strategies in second language acquisition*. Cambridge University Press.

Phakiti, A. (2003). A closer look at the relationship of cognitive and metacognitive strategy use to EFL reading achievement test performance. *Language Testing*, *20*(1), 26-56.

Pressley, M., & Afflerbach, P. (2012). *Verbal Protocols of Reading: The Nature of Constructively Responsive Reading*. Routledge.

Prichard, C., & Matsumoto, Y. (2011). The Effect of Lexical Coverage and Dictionary Use on L2 Reading Comprehension. *Reading Matrix*, *11*(3), 207-225. Accessed January 2nd, 2016, from

http://www.readingmatrix.com/articles/september_2011/prichard_matsumoto.pdf

Rayner, K. (1998). Eye movements in reading and information processing: 20 years of research. *Psychological Bulletin, 124*, 372-422.

Sakurai, N. (2015). The influence of translation on reading amount, proficiency, and speed in extensive reading. *Reading in a Foreign Language, 27*(1), 96–112

Shebilske, W. L., & Fisher, D. F. (1983). Eye movements and context effects during reading of extended discourse. In K. Rayner (Ed.), *Eye movements in reading: Perceptual and language processes* (pp. 153– 179). New York: Academic Press.

Sheorey, R., & Mokhtari, K. (2001). Differences in the metacognitive awareness of reading strategies among native and nonnative readers. *System, 29*(4), 431-449.

Song, M. (1998). Teaching reading strategies in an ongoing EFL university reading classroom. *Asian Journal of English Language Teaching, 8*, 41-54.

Spires, H. A., Gallini, J., & Riggsbee, J. (1992). Effects of schema-based and text structure-based cues on expository prose comprehension in fourth graders. *The Journal of Experimental Education*, *60*(4), 307-320.

Spivey, M. J., Richardson, D., & Dale, R. (2009). The movement of eye and hand as a window into language and cognition. In E. Morsella, J. A. Bargh, & P. M. Gollwitzer. *Oxford handbook of human action* (pp. 225-249). Oxford: Oxford University Press.

Swaffar, J., Arens,K., & Byrones, H. (1991). *Reading for Meaning: an Integrated Approach to Language Learning*. Englewood Cliffs, NJ: Prentice Hall.

Taki, S. (2015). Metacognitive online reading strategy use: Readers' perceptions in L1 and L2. *Journal of Research in Reading*.

Tavakoli, H. (2014). The Effectiveness of Metacognitive Strategy Awareness in Reading Comprehension: The Case of Iranian University EFL Students. *Reading Matrix*, *14*(2).

Taylor, A., Stevens, J., & Asher, J. W. (2006). The effects of explicit reading strategy training on L2 reading comprehension. In J. M. Norris & L. Ortega (Eds.) *Synthesizing research on language learning and teaching* (pp. 213-244). Amsterdam: John Benjamins Publishing.

Wang, M. T. (2009). *Effects of metacognitive reading strategy instruction on EFL high school students' reading comprehension, reading strategies awareness, and reading motivation.* (Doctoral dissertation, University of Florida).

Wiley, J., & Rayner, K. (2000). Effects of titles on the processing of text and lexically ambiguous words: Evidence from eye movements. *Memory & Cognition*, *28*(6), 1011-1021.

Winke, P. M., Godfroid, A., & Gass, S. M. (2013). Eye-movement recordings in second language research. *Studies in Second Language Acquisition*, *35*(2), 205-212.

Yoshida, M. (2008). Think-aloud protocols and type of reading task: The issue of reactivity in L2 reading research. In M. Bowles, R. Foote, S. Perpiñán, & R. Bhatt (Eds.) *Selected proceedings of the 2007 second language research forum* (pp. 199-209). Somerville, MA: Cascadilla Proceedings Proje*ct*.

Zhang, L. (2001). Awareness in reading: EFL students' metacognitive knowledge of reading strategies in an acquisition-poor environment. *Language Awareness*, *10*(4), 268-288.

Zhang, L., & Seepho, S. (2013). Metacognitive Strategy Use and Academic Reading Achievement: Insights from a Chinese Context. *Electronic Journal of Foreign Language Teaching, 10*(1), 54-69.