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研究課題名（英文）Effects of VSTF on Intensive Reading

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研究成果の概要（和文）：本研究は、外国語としての英語の習得において、英文の精読の効率に及ぼす構文的にパースされたテキストの効果を、スキャンニング、スキミンク、リーディング、ならびにトピックの推測に着目して明らかにしようとしたものである。本プロジェクトの６種のタスク全てを行った参加者のうち、取得できた１６名分の眼球運動データを分析し、その結果は数値的データの詳細な解析の補助とした。これらのタスクは、パースされたテキストのスキャン、スキム、ならびにリーディングと、通常のブロック形式のテキストのスキャン、スキム、ならびにリーディングで構成されている。一人の参加者につき６ページ分の視線追跡データが各タスクについて取得できた。

研究成果の概要（英文）：This study focused on the effects of syntactically parsed texts on intensive reading efficiency in EFL with respect to scanning, skimming, reading, and topic guessing. The parsed texts proved to be especially helpful to some but not all participants, and noteworthy results were found with respect to scanning and topic guessing for most of the participants. Interpretations of numerical results and the participants' processing of language were made easier by the successful collection of eye tracking data from 16 of the final 49 participants on all six of the final tasks of the project. These tasks included one parsed text to be scanned, skimmed, and read and one conventional block text to be scanned, skimmed, and read. After each task, the participants guessed the topic of the reading. These tasks provided six pages of eye-tracking data per participant.

研究分野： EFL Reading

キーワード： VSTF　scanning　skimming　intensive reading　language chunks　syntactic parsing

Effects of VSTF on Intensive Reading[1]

John C. Herbert

Introduction

At the JALTCALL 2011 Conference in Kurume, Dr. Mark Warschauer's plenary speech stimulated conference participants' interests in visual- syntactic text formatting (VSTF), which is a form of text manipulation involving syntactically parsed chunks. Dr. Warschauer portrayed VSTF as the next logical step in the evolution of written text on the basis of the format being much easier to read because of the way it requires the visual parsing of text into meaningful language chunks which cascade down a page with verbs indicated by color changes (Warschauer, 2011, June). (See Figure 1.) The reformatting of conventional text into VSTF has proven to be beneficial for native and non-native English readers across the United States with respect to reading efficiency and comprehension (Walker et al., 2007). Dr. Warschauer's talk and the aforementioned literature have provided a catalyst for the study herein. Henceforth, this report examines whether or not derivatives of VSTF are appropriate for EFL contexts with a particular focus on intensive reading.

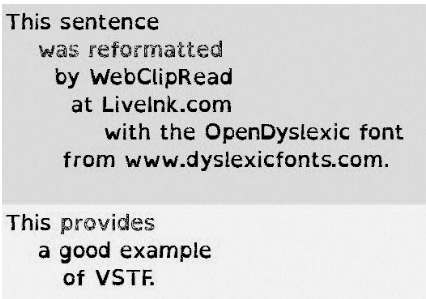

Figure 1. Sample text presented in a visual-syntactic text format (Walker Reading Technologies, Inc., 2014).

Rationale

In the empirical study described herein, the participants were required to complete 20 intensive reading assignments as part of a control group or an experimental group over a three month period before taking a post-test in front of an eye-tracking device. The control group was trained to complete the post-test by carrying out 20 assignments in a block text format that were similar in readability and instruction to that of the post-test. At the same time, the experimental group had the same amount of training for the post-test with identical content and instruction, but the format of the content had been changed to a derivative of VSTF. The intensive nature of the timed reading activities in this study accompanied by the parsed text format were expected to result in more productive scanning and skimming, more accurate topic guessing upon scanning and skimming, and faster reading with better reading comprehension through the prolonged exposure to the treatment. The goal of the intensive reading activities themselves was to improve these skills, and including parsed text in the mix of activities was expected to enhance these improvements.

In order to determine actual gains, numerical results are examined on the number of scanning words found under a time constraint; the accuracy of guessing the gist of a reading just by scanning, skimming, or reading; reading speed; and, comprehension as effected by both conventional block text and parsed text. Furthermore, this report includes heat maps displaying where the research participants' eye gaze plots indicate common fixation points while the participants scanned, skimmed, and read each of two final texts – one block and one parsed. These heat maps are important because they provide visual representations of how the readers' eyes collected information with very different eye movement patterns between each text format. Where the parsed text is used, the eye movement patterns reveal fixation points centralized within each language chunk while block text lends itself to more word-by-word fixation points. Advocates of VSTF believe this unique difference encourages readers to process language chunk-by-chunk rather than one word at a time; and, in turn, this leads to better reading efficiency (Warschauer, 2011, June).

Research questions

This study focused on the following research questions: In an intensive EFL reading context, does syntactically parsed text affect the . . .

1. Number of words found during timed scanning?
2. Extent of one's ability to capture the gist of a reading by scanning, skimming, or timed reading?
3. Speed of reading?
4. Extent of reading comprehension?
5. Eye movements of readers during scanning, skimming, and timed reading?

Creating the parsed format

The derivative of VSTF created for this research project differed from that produced by WebClipRead in that the verbs were not colorized, and the determination of where to cut each chunk was decided by the researcher. The criteria used for determining how to divide up the language chunks included the

[1]This is a shortened version of *The Effects of Syntactically Parsed Text Formats on Intensive Reading in EFL* which was first published in the JALTCALL Journal, Vol. 10, No. 3, pages 237-254 in December 2014.

following considerations:

1. Number of eye spans required for perusing one line of text
2. Natural pauses
3. Syntax familiarity

Following a model set by Walker and Vogel (2005), one or two eye spans, or a total of up to 30 characters per line, was regarded as an optimal amount of text per line to minimize distractions from other surrounding text. Next, in an effort to minimize the interruptions in subvocalization due to frequent line breaks, back indentation was used to indicate natural pauses, or new breath groups. In addition, one blank line was inserted between each sentence. But, there were no paragraph markers. Finally, with respect to syntax familiarity, teacher intuition was used to cater to the participants' presumed syntax knowledge.

Materials

The 20 readings which made up a prerequisite for participating in this project were selected from McGraw-Hill's SRA Reading Lab 1b. Ten of these readings were uploaded to a Moodle 1.9 LMS with two versions each, block and parsed, for the respective groups to complete as homework. The other ten readings were printed as classroom materials in the same two formats.

The reading materials used for the post-test were two 185 word expository texts about birds also from McGraw-Hill's SRA Reading Lab 1b, which had been slightly altered with permission, both in content and format. The minor content changes ensured the equal length and first grade readability level of each text.

Research Participants

In order to recruit a large number of research participants, the 20 aforementioned reading activities were integrated into the curriculum of six third- and fourth-year English conversation classes at a five-year technical college in Japan. As such, the students ranged from age 17 to 21. One set of three classes had 118 regularly attending students, most of whom completed all of the reading assignments in a conventional block text format. Students pulled from these classes to take the post-test were recruited by monetary incentive for the project control group and referred to as the block text group, or BT group because their training in intensive reading focused on block formats. At the same time, the other three classes consisted of 113 regularly attending students, most of whom completed all of the reading assignments in a parsed text format. Therefore, students pulled from these classes were recruited, also by monetary incentive, for the experimental group and were referred to as the parsed text group, or PT group because their training in intensive reading focused on parsed text. In total, 60 paid research participants were equally divided into two groups of 30 with 15 BT group members and 15 PT group members in each group; hereafter referred to as Group One and Group Two.

Procedures

Two post-test readings were shown to each group, one block and one parsed. However, where block text was shown to one group, it was displayed as parsed text to the other, and vice versa. Each reading was displayed in its entirety within a single view of a 21.5 inch monitor screen. The eye tracking equipment itself was a non-obtrusive desk-mounted device that could be adjusted to accommodate the participant's physical position.

Numerical Results

Numerical results for the number of keywords found, the accuracy of topic guesses, reading speed, and comprehension scores were analyzed via t-tests for 49 research participants using SPSS statistical analysis software. The other 11 participants, who were excluded from the statistical analysis, experienced distractions such as computer malfunctions and loud noise from the school halls. This left 24 PT participants and 25 BT participants in the data pool. In each statistical analysis, the software's default probability value for keeping a null hypothesis, $\alpha = 0.05$, was used to calculate the critical value of t for a two-tailed t-test at $t = 2.0106$. For the true t-values calculated from post-test data in each of the four categories identified above, an absolute value of $t(48) > 2.0106$ and a probability of $p < 0.05$ were sought for throwing out each null hypothesis. However, the only category in which this degree of statistical significance was achieved was in the number of keywords found during the scanning task when the text was parsed.

Scanning results

Regarding the scanning activity, many of the research participants commented that the parsed text made it much easier for them to find the words that they were scanning the text to find. On average, the 49 participants found 8.53 out of ten words in each of the two parsed texts, while they only found 7.57 out of ten words within the block texts. (See Table 1.) As stated above, this discovery was the only one in the study which yielded statistically significant results based on a two-tailed t-test, where $t(48) = -2.6172$, $p = 0.0118$. As such, the researcher could claim with nearly 99% confidence that students, who have received training in scanning drills, should be able to scan for words more easily if the text were parsed.

However, despite these encouraging results, a closer look revealed a bit of irony. That is, while 37 of the 49 participants found the same number of words or more when the text was parsed than when it was not, most of the participants who did not find the same number or more were the ones who had been in the PT group. Specifically, seven participants from the PT group (30% of all the PT group's research participants) found more words in the block text than the parsed text. At the same time, only five participants from the BT group (just 20% of all the BT group's research participants) found more words in the block text than the parsed text.

Table 1: Statistical analysis on scanning results (number of words found)

α = 0.05	Critical value: t = 2.0106 (two-tailed)		
	Block		Parsed
Average =	7.57		8.53
Std. Dev. =	2.14		1.50
Higher score distribution All (PT only)	12 (7) >	=10 (4)=	< 27 (13)
t(48) = −2.6172, p = 0.0118			
Interpretation: Throw out the null hypothesis			

Topic guessing results

Another noteworthy result about introducing parsed text to the scanning exercise was that it led to more accurate topic guesses just by quick glances over the reading content. Normally, one might not imagine using a scanning activity as a comprehension measure. The purpose of scanning is not to find the same general information that skimming helps one find, but to find specific details. However, throughout this project, the keywords that were scanned for and any information that may have stuck with the participant after catching his or her eyes during the scanning task were used by participants to guess the gist of the reading. Only seven out of 49 participants could guess the main topic of the reading by scanning the block text, but 13 out of 49 guessed the topic correctly after scanning the parsed text. (See Table 2.) Based on the two-tailed t-test for topic guessing, where t(48) = 1.9415, p = 0.0581, the numbers fall just short of the necessary t-value and probability for claiming a statistical significance.(See Table 3.) Therefore, though noteworthy, the researcher must concede that these results are not widely generalizable.

Table 2: Number of correct topic guesses after each task

		Block	Parsed
After Scanning (3pt)	=	7/49	13/49
After Skimming (2pt)	=	21/49 (+14)	26/49 (+13)
After Reading (1pt)	=	35/49 (+14)	41/49 (+15)
Incorrect (0pt)	=	14/49	8/49

Table 3: Statistical analysis on topic guesses

α = 0.05	Critical value: t = 2.0106 (two-tailed)		
	Block		Parsed
Average =	1.29		1.63
Std. Dev. =	1.04		1.05
Higher score distribution All (PT only)	12 (4) >	=13 (8)=	< 24 (12)
t(48) = 1.9415, p = 0.0581			
Interpretation: Keep the null hypothesis			

Timed reading results

The average reading speed of the parsed texts among all 49 participants was 139.6 words per minute; 11.5wpm faster than the 128.1wpm taken by the same participants to read the block texts. These numbers are reported in seconds to completion in table 4 below. The data sounds impressive until one considers the fact that 36.7% (18) of all 49 participants actually read the block text faster; and, even more surprisingly, 54.2% (13) of the 24 participants from the PT group read the block text faster, while only 20% (5) of the 25 participants from the BT group read the block text faster. Furthermore, with statistics which read t(48) = 1.600, p = 0.116, these results suggest that no significant difference is being made between the reading rates across the two formats. As such, neither format has actually proven to lead to faster reading than the other.

Table 4: Statistical analysis on reading rates

α = 0.05	Critical value: t = 2.0106 (two-tailed)	
	Block	Parsed
Average =	86.62 sec	79.50 sec
Std. Dev. =	5.52	28.95
Higher score distribution All (PT only)	5.52	< 31 (11)
t(48) = 1.600, p = 0.116		
Interpretation: Keep the null hypothesis		

Comprehension score results

Results from comprehension scores were similar. Again, the BT group out-performed the PT group on the parsed reading questions. While 60% of the participants from the BT group scored the same or higher points for comprehension on the parsed text than on the block text, only 50% of the PT group could say the same. Although the scores were largely different, 81.6 points for the block text compared to 75.5 points for parsed, the two-tailed test, t(48) = 1.597, p = 0.117, once again implies that no significant difference was made between comprehension scores across the two formats. As such, neither format has actually proven to lead to better comprehension or reading efficiency than the other.

Table 5: Statistical analysis on comprehension scores

α = 0.05	Critical value: t = 2.0106 (two-tailed)		
	Block		Parsed
Average =	81.63		75.51
Std. Dev. =	19.08		20.92
Higher score distribution All (PT only)	22 (12) >	=14 (6)=	< 13 (6)
t(48) = 1.597, p = 0.117			
Interpretation: Keep the null hypothesis			

Eye tracking *results*

After data was collected, the eye movement patterns of 16 participants were compared in three sets of heat maps generated by the eye-tracking software (one set for scanning, one for skimming, and one for timed reading). Each set included four maps; one image for Group One looking at block text, another for Group One looking at parsed text, a third for Group Two looking at block text, and a fourth for Group Two looking at parsed text. Each heat map image was generated by a compilation of gaze traces from eight group members from each group whose eye movement patterns were properly recorded on all six pages that they were asked to scan, skim, or read. A proper recording was defined as one in which the eye tracking equipment maintained a constant and accurate trace for the same participant on every task that participant completed.

Scanning Heat Maps

In Figures 2 and 3 below, two heat maps generated by the recordings of eight participants' eye movements during scanning exercises in two different groups are displayed. As each image is a compilation of eight participants' data points, the fixations which lasted for the shortest moments and those fixation points which did not fall in a region common to others do not show up here.

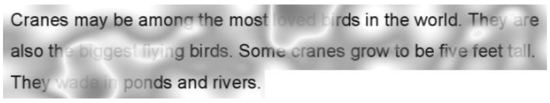

Figure 2. Heat map of eye fixations while scanning block text.

Figure 3. Heat map of eye fixations while scanning parsed text.

In the eye movement recordings taken for the image in Figure 2, the average fixation duration was calculated to be 227.7ms. Therefore, it can be said that the words inside the white-outlined shapes were most likely looked at for more than a quarter of a second while the other words most likely were not. The heat maps in Figures 2 and 3 were recorded over the few seconds of time that the researcher had just called out the word "loved" and then "wade." Since the participants had to find those two words, both of the words are hidden under the darkest shade of gray here. For the block text format, only two words come remotely close to warranting the same amount of attention, "biggest" and "flying." However, for the parsed text format of the same section of text, these two words plus four more (also, cranes, five, and feet) draw the attention of the participants with fixation durations of more than the average 205.1ms for that recorded image.

Skimming data

The video screen captures of the participants' eye movements as they skimmed the block text revealed a tendency for experienced skimmers to fixate on topic and closing sentences. However, the parsed text masked the topic sentences and encouraged the skimmer to quickly skim through as much as possible with fewer fixation points along the way. The number of fixation points while skimming for 15 seconds dropped from 26.9 for block text to 21.4 for parsed text on average for Group One and from 23.4 (block) to 16.3 (parsed) for Group Two.

Timed reading heat maps

The number of fixation points during timed readings also decreased noticeably. The number dropped from 134.5 for block text to 90.6 for parsed text on average for Group One and from 90.8 (block) to 76.3 (parsed) for Group Two. As seen by comparing Figures 4 and 5, fewer words are buried under the darker shades of fixation intensity in the parsed text than in the block text. This suggests that the readers have a tendency to observe larger language chunks in one fixation on parsed texts, while they take more time per individual word on block texts.

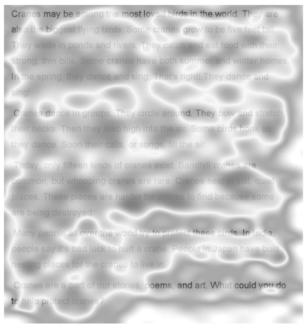

Figure 4. Heat map of eye fixations while reading block text.

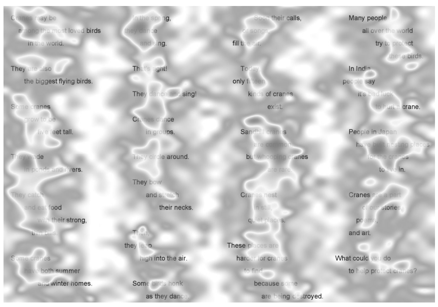

Figure 5. Heat map of eye fixations while reading parsed text.

Interpretations of scanning, topic guessing results

As seen in a comparison of Figures 2 and 3, the block text format lends itself to a wider range of words that are glanced over quickly while scanning than the parsed format. According to Samuels, Rasinski, and Hiebert (2014), a non-fluent reader needs 300ms to recognize a word and longer to comprehend it. As the white-outlined shapes in Figures 2 and 3 are estimated to represent fixations of about 200 to 250ms, and all fixations outside of the white-outlined shapes are estimated to have even shorter durations, the outlying words are assumed to have not been recognized at all. On the other hand, many of the much darker shaded words within the white-outlined shapes have fixation durations well over 300ms. Therefore, Figure 3 reveals a tendency, or at least a potential, for participants to recognize more words, irrespective of what they are looking for, during a parsed scanning activity than with a block scanning activity. This sheds light on the reason why the participants were able to guess the topic of the parsed text somewhat more quickly than the block text: Because they were actually taking in more vocabulary during scanning.

Further discussion

When the 231 English conversation students in the six classes mentioned above finished all 20 intensive reading activities, each class was given one more activity in the format that they had not yet used for the activity. Then, they were asked in which format they preferred doing the activity. Among the 113 students in the PT group, only 21.2% (24) preferred block over parsed. However, 58.5% (69) of the 118 students in the BT group preferred block over parsed. This information alone shows that when the activity itself is presented in a nonconventional format, it takes time to become comfortable with the new format.

Concluding recommendations

Based on the observations made regarding scanning, if a reader is interested in capturing the gist of a reading or quickly obtaining a better understanding of how keywords may be used in context, a syntactically parsed text could help. However, for traditional instruction in skimming, in which developing English readers are taught to find key information by looking at topic sentences and closing statements, a parsed text format might be less desirable because it eliminates the ease at which such statements can be found in conventional paragraphs. Finally, since the effect of a parsed text format seems to differ between individual readers and contexts, and in answering to the voice of several research participants, it would be ideal if a reader could have a choice of format. On paper, that might appear to most as a wasteful project; but, in the form of an e-book reading, in which a push of a button would allow a reader to switch back and forth between formats, such an idea has merit.

References

Samuels, S.J., Rasinski, T.V., & Hiebert, E.H. (2014). Eye movements and reading: What teachers need to know. *TextProject Article Series, February 2014*. Retrieved from: http://textproject.org/library/aricles /eye-movements-and-reading-what-teachers-need-to-know/

Walker , R.C., Gordon, A.S., Schloss, P., Fletcher, C.R., Vogel, C., & Walker, S. (2007). Visual-syntactic text formatting: Theoretical basis and empirical evidence for impact on human reading. Paper presented at the IEEE Professional Communication Conference, 2007, Seattle. 1-14. Retrieved from: http://ieeexplore.ieee.org

Walker Reading Technologies, Inc. (2014). WebClipRead. Last retrieved on July 31, 2014 from: http://www.liveink.com/

Walker, R., & Vogel, C. (2005). Live Ink®: Brain-based text formatting raises standardized test scores. Paper presented at the National Educational Computing Conference, 2005, Philadelphia. 1-39. Retrieved from: http://www.liveink.com/

Warschauer, M. (2011, June). Re-imagining reading in digital learning environments. Plenary address to the JALTCALL annual conference, Kurume, Japan.