

Exploring Online Reading Attention and Question-Generation Task Completion of English Learners at Different Proficiency Levels by Eye Tracking Method

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Abstract: This study investigated online reading attention from the viewing patterns of English learners at different proficiency levels as well as their completion of question-generation task on English grammar. Seven college students participated and were classified to low ($n=3$) and high ($n=4$) English proficiency. Eye tracker Tobii X60 was used to record data on the participants' eye fixations within areas of interest (AOIs) and their visits between AOIs while reading online materials of different instructional functions (i.e., Review, Instruction, Situation, Related hints, and Unrelated hints) for student-generated questions task. Two major findings were obtained. First, there were salient different online reading attention patterns in terms of fixation duration and visit counts between students at different English proficiency levels. Specifically, based on Kruskal-Wallis tests, the High English Proficiency Group (HEPG) paid more attention to areas related to the targeted SGQ task, by visiting significantly more frequently on 'Instruction' and 'Related hints' type of information, and spending significantly more time attending to 'Related' useful information, rather than on 'Unrelated' information, as compared to the Low English Proficiency Group (LEPG), who seemed to have less attention tactics to help them filter out unrelated information. Furthermore, based on the Fisher exact tests, significant differences were detected between HEPG and LEPG on SGQ task completion, with HEPG having a higher task completion rate than LEPG. Limitations of this study are noted, and suggestions for instruction as well as future studies are provided.

Keywords: English grammar, eye tracking, individual differences, online reading attention, second language learning, task completion

1. Introduction

The crucial role of attention and its positive association with second language learning have been studied for decades (Al-Hejin, 2004; Dolgunsöz, 2015; Robinson, 1995; Robinson, Mackey, Gass, & Schmidt, 2012; Schmidt, 1990, 2001, 2010; Song, 1998). The Noticing Hypothesis has been proposed to accentuate that input does not become intake for language learning unless it is noticed (Izumi, 2002; Robinson, 1995; Schmidt, 1990, 2001). Researchers considering attention as a key factor affecting language learning examined its facilitative role for vocabulary acquisition (Godfroid, Ahn, Choi, Ballard, Cui, Johnston, et al., 2018; Godfroid, Boers, & Housen, 2013) and reading (Dolgunsöz, 2015; Godfroid et al., 2018) and have found empirical evidence substantiating the significant implications of attention and awareness for language learning (Bialystok & Feng, 2009; Chung & Segalowitz, 2004; Hama, & Leow, 2010; Gass, Svetics & Lemelin, 2003; Ishikawa, 2006; Robinson et al., 2012; Schmidt, 2010).

Learners at different language proficiencies have later been found to develop different reading strategies and processing types. For instance, McCrudden and Schraw's research (2007) reported that proficient readers were aware of their information needs and, thus, had the ability to locate information and free themselves from irrelevant messages. Rouet and Britt (2011) found that when faced with several pieces of text, proficient readers can select information and make decisions for the most important, relevant, and accurate information. As shown in Yildiz and Çetinkaya's findings

(2017), there is a significant relationship among good readers' attention, reading speed, and comprehension.

While the effects of attention and the moderating role of language proficiency on language learning have been noted, existing studies mostly deal with learners processing reading materials for comprehension and vocabulary learning (i.e., the 'knowledge consumption' notion) without further calling for knowledge production. With the increasing recognition of the value of the learner-as-producer approach (Arruabarrena, Sánchez, Blanco, Vadillo, & Usandizaga, 2019), issues as to 'if reading attention and task performance of English learners at different proficiency levels differ under the learner-generated content paradigm' await to be investigated.

Today's learners are born as digital natives and accustomed to learning from online materials (Prensky, 2001). Student-generated questions (SQG) as a pedagogically sound strategy to support knowledge construction and higher-order cognitive development on the part of learners has been well acknowledged (Song, 2016; Yu, 2009). In light of these, in this study, the researchers aimed to examine 'if students at a high English proficiency level would better select relevant, helpful information when reading online short passages and complete the targeted SQG task, as compared to students at a low English proficiency level.' Two frequently used indices of eye tracking method (i.e., fixation duration and visit counts) are used for examining online reading attention from the viewing patterns of readers at different English proficiency levels for SQG tasks. Fixation duration is the period of time when the reader's gaze focuses still on an area of interest (AOI) for gaining information. A longer duration indicates a more complex task, a more difficult text, or readers have more interest toward the AOI (Kim, Dong, Xian, Upatising, & Yi, 2012). Visit is considered a good index for observing how readers switch their fixations among different stimulus features (Kim et al., 2012). It starts when a reader first focuses on an AOI and ends when he or she looks away from the AOI.

In summary, two research questions are examined in this study:

RQ#1. Are there significant differences in eye movement and online reading patterns in terms of fixation duration and visit counts of AOIs between learners in the High English Proficiency Group (HEPG) and Low English Proficiency Group (LEPG)?

RQ#2. Are there significant differences in SQG task completion between learners in HEPG and LEPG?

2. Methods

2.1 Participants

Seven students (2 males) from three universities in southern Taiwan participated in this study. Of these, three participants were classified as below B1 in the LEPG by a standardized test of the TOEIC based on the Common European Framework of Reference for Languages: Learning, Teaching Assessment (CEFR), with B1 level equivalent to the TOEIC score of 550. The other four with above B1 level were, thus, classified to HEPG.

2.2 Stimulus Materials, Study Context, and Equipment

The stimulus material produced by the researcher consists of three slides and was specified with different AOIs according to five instructional functions: Review, Instruction, Situation, Related hints, and Unrelated hints. For the study, the participants had to read the stimulus material for the SQG task from a computer screen in an eye-tracking lab. Eye tracker Tobii X60 was used to collect data of the participants' online viewing patterns, and Tobii Pro lab was used to record and calculate data.

For Slide 1 (see Figure 1), which is for 'Review' purposes, two examples related to the unreal second and third conditionals were presented for a quick summary of the two grammatical rules. For Slides 2 and 3, two cases (i.e., Cases 1 and 2) involving unreal conditionals and instruction for SQG tasks were presented. For Case 1 (see the left of Figure 2), the general instruction for the reading and SQG tasks (i.e., 'Instruction') was placed above a short passage (i.e., 'Situation'), followed by the specific instruction for SQG on the unreal third conditional (i.e., 'Instruction'). The short passage

shown on the computer was from the intermediate level of the textbook, Top Notch 3 (Saslow & Asher, 2015). Placed at the bottom of Slide 2 were the same set of examples shown in Slide 1 (i.e., ‘Review’), with the unreal second conditional classified as ‘Unrelated hint’ and the unreal third conditional classified as the ‘Related hint,’ due to its direct relevancy to the SGQ task to be completed, which requested the participants to generate questions on the unreal third conditional with answers. For Slide 3 (the right of Figure 2), it showed Case 2 and had the same layout as in Case 1. The only difference was that a different reading passage from the intermediate level of Top Notch 3 was given on the computer as the ‘Situation’ for the reading and SGQ tasks.

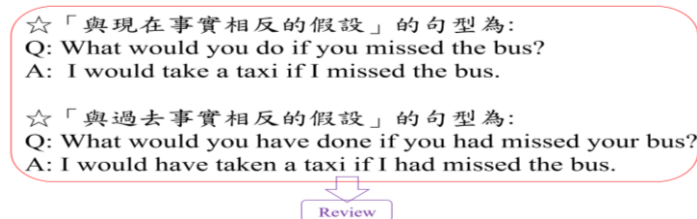


Figure 1. Stimulus material shown in Slide 1 and the AOI specified for data analysis

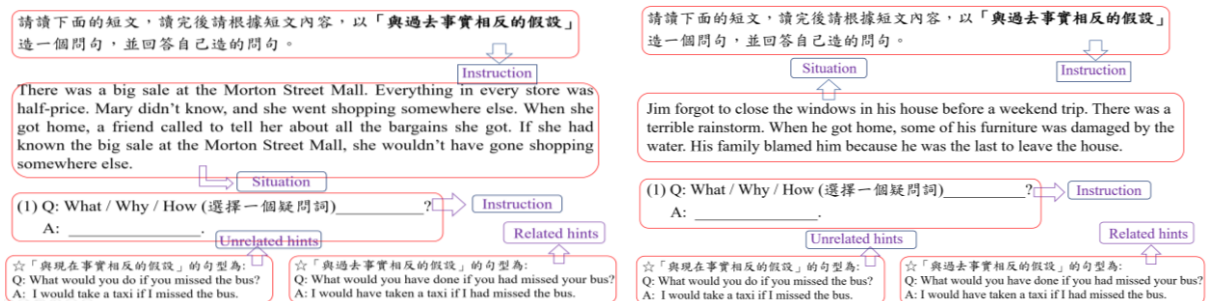


Figure 2. Stimulus material shown in Slide 2 for Case 1 (left) and Slide 3 for Case 2 (right) and the AOIs specified for data analysis

2.3 Data Compilation and Analysis of AOIs

In this study, fixation duration and visit counts of AOIs in Cases 1 and 2 were combined for the five instructional functions, respectively, before proceeding to data analyses. Non-parametric statistics of Kruakal-Wallis tests are adopted to test if there are significant differences between HEPG and LEPG in attention allocation via eye movement in terms of fixation duration and visit counts of AOIs.

2.4 Assessment and Data Analysis of SGQ Task Completion

The generated questions with answers for Cases 1 and 2 had to satisfy the criteria of ‘correct use of the unreal third conditional according to the given situation.’ Due to the small sample size in this study and the fact that the expected frequency is lower than five, non-parametric statistic of the Fisher exact test is applied to analyze if there are significant differences between HEPG and LEPG in SGQ task completion.

3. Results

With regard to RQ#1, as shown in Table 1, the mean scores of both indices (i.e., fixation duration and visit counts) for HEPG were all higher than those of LEPG except for the ‘Unrelated hints’ instructional function. Further Kruskal-Wallis tests showed that there were significant differences between HEPG and LEPG in ‘Review’ (fixation duration, $p=.034$), ‘Instruction’ (visit counts, $p=.05$), ‘Unrelated hints’ (visit counts, $p=.032$), and ‘Related hints’ (fixation duration, $p=.034$; visit counts, $p=.026$).

Table 1. *Fixation Duration and Visit Counts of AOIs along the Five Instructional Functions of English Learners in HEPG and LEPG*

Group	Participants	Review	Instruction		Situation		Unrelated hints		Related hints	
		Fixation Duration ⁺	Fixation Duration	Visit Count	Fixation Duration	Visit Count	Fixation Duration	Visit Count	Fixation Duration	Visit Count
HEPG	P1	25.33	17.47	11	57.36	21	1.95	2	5.41	5
	P2	14.04	27.1	23	91.25	35	2.2	3	11.93	14
	P3	26.09	16.84	17	98.08	29	3.21	4	9.63	14
	P4	21.27	12.64	18	54.19	40	1.07	2	31.14	30
	mean	21.68 ms	18.5 ms	17.25	75.22 ms	31.25	2.11 ms	2.75	14.53 ms	15.75
LEPG	P5	10.07	2.9	7	60.83	35	9.88	9	0.18	1
	P6	11.38	15.02	9	53.24	18	7.06	11	0.6	1
	P7	7.36	7.79	11	95.23	33	1.29	6	0.22	1
	mean	9.60 ms	8.57 ms	9	69.77 ms	28.67	6.08 ms	8.67	0.33 ms	1
	Kruskal-Wallis tests	4.50	3.13	3.85	.13	.29	1.13	4.58	4.50	4.94
	<i>p</i>	.034*	.077	.05*	.724	.593	.032*	.289	.034*	.026*

⁺Only one area was specified in ‘Review’ so no visit counts metric was calculated, and only fixation duration metric was reported.

* < .05

With regard to RQ#2, as shown in Table 2, 87.5% of the participants in HEPG satisfactorily completed the SGQ task, but not a single participant in LEPG did. The Fisher exact test further found significant differences ($p=.005<.05$) between HEPG and LEPG in SGQ task completion, with HEPG having a higher task completion rate than LEPG.

Table 2. *SGQ Task Completion of English Learners in HEPG and LEPG*

	No <i>f</i> (%)	Yes ⁺ <i>f</i> (%)
LEPG	6 (100%)	0 (0%)
HEPG	1 (12.5%)	7 (87.5%)

⁺Questions/answers correctly used the unreal third conditional for SGQ task

4. Discussion and Conclusion

To explore how learners at different English proficiency levels attended to online reading materials of different instructional functions for ‘student-generated content’ type of learning task, in this study SGQ was targeted, and eye tracking method was adopted where data on fixation duration and visit counts as well as SGQ task completion were collected and analyzed. The major findings obtained revealed that when tasked with a knowledge-production type of assignment, HEPG paid more attention to relevant information shown on screen and spent considerably less time on unrelated information, as compared to LEPG. This obtained result corroborated with the findings of McCrudden and Schraw’s study (2007), which indicated that proficient readers were cognizant of their informational needs and capable of zooming in on relevant information while deterring from unrelated, unfruitful messages. It was also in alignment with the finding of Rouet and Britt’s research (2011) showing that proficient readers could target the most essential and pertinent information when given multiple pieces of text for better goal attainment (e.g., reading for understanding, task completion, etc.).

In addition, in this study, substantially more percentages of HEPG were found to satisfactorily

produce SGQ. This finding seemed to echo the findings of Yildiz and Çetinkaya's study (2017) in that positive relationships exist between proficient readers' attention and learning outcomes (e.g., comprehension, task completion).

4.1 Suggestions for Instructional Implementation

This study confirmed the findings of previous research that students at different English proficiency levels processed reading materials differently (in specific, attention allocation and management, as evidenced by fixations duration and visit counts) to better help meaningful input from the online reading material be noticed and become intake for learning (Schmidt, 1990, 2001). By purposively fixating on relevant, useful information presented on screen, successful task completion was ensured (as evidenced by SGQs satisfactorily meeting the criteria in this study).

On the basis of the current findings and in reference to existing literature on language learning, two suggestions are provided for instruction. First, instructors are advised to provide explicit attention cues and direction so as to effectively guide the attention of English learners with less language proficiency for focused, effective online reading and task completion. Second, instructors should simplify instructional screen message design presented to learners by taking out information not directly related to the assigned task for ensuring better attention management of low language proficient learners.

4.2 Limitations of This Study and Suggestions for Future Studies

Despite the promising findings of this study, the generalizability of the results should be considered limited due to its small sample size, short reading passages, and the difficulty level of the reading material. Future studies with a larger sample size, longer reading passages, and reading materials with different difficulty levels are needed. Also, mixed methods research by including other data collection methods, for instance, in-depth interviews or think-aloud protocols, can be considered for future studies. By so doing, insights on the reasons for attention allocation and management especially of the participants in LEPG regarding some areas of inquiry (e.g., why skipping viewing on-screen related hints, why fixating on unrelated hints presented on-screen, etc.) can be understood.

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