Tolerance of Ambiguity and EFL Readers' Dictionary Look-up Strategies: An Eye-Tracking Analysis

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Abstract: When readers decide to look up words, when do they perform the action of dictionary consultation? The goal of this study was to investigate whether EFL readers with low tolerance of ambiguity have higher percentages of consultation immediately when they use computer-mediated dictionaries. Through analyzing look-up patterns from eye-tracking, we found that readers with different ambiguity tolerance levels did perform different look-up patterns, although not significantly.

Keywords: Tolerance of Ambiguity, Computer-Mediated Dictionary, Dictionary Consultation, Eye Movement

1. Introduction

When readers encounter unfamiliar words while reading for comprehension, readers can choose to ignore unfamiliar words and keep reading, to infer word meanings from context, or to look up word meanings in the dictionaries (Fraser, 1999). However, when the context cue is too weak to infer word meanings, dictionaries have become important reading aids (Laufer & Hill, 2000; Laufer & Hulstijn, 2001). If readers decide to look up words, *when* do they perform the action of dictionary consultation? Some readers may consult dictionaries right away when they encounter unfamiliar words (i.e., consult immediately); the other readers may consult dictionaries after they finish reading other words or sentences to get a sense of the text comprehension (i.e., consult later). What is the difference between these two groups (immediately or later) in terms of readers' tolerance of ambiguity?

1.1 Tolerance of Ambiguity and Strategy Use

Tolerance/intolerance of ambiguity in second language learning is the relative degree of discomfort associated with situations: when language learners do not know or understand exact meaning; when they are not able to express their ideas accurately or exactly; when they are dealing with overly-complex language; or when there is a lack of correspondence between the first language (L1) and second language (L2) (Ely, 1989). El-Koumy (2000) suspected that high, mid, and low ambiguity tolerance students may exhibit different learning strategies that could, in turn, lead to different rates of language learning success.

Norton's (1975) Measure of Ambiguity Tolerance (MAT-50) and Ely's (1989, 1995) Tolerance of Ambiguity Scale (TAS) have been commonly used to measure tolerance of ambiguity. However, the MAT-50 is not specifically concerned with language learning settings. Although Ely's TAS is designed for language learning settings, it is not

specifically concerned with dictionary use situations. Therefore, a dictionary use related tolerance of ambiguity scale is needed for investigating readers' dictionary consultation strategies.

To investigate the relationships between tolerance of ambiguity and strategy use, one of the strategy questions Ely (1989) asked is: *If I'm reading in Spanish and come across an unknown word, the first thing I do is to look it up to see what it means in English*. Ely found that tolerance of ambiguity was indeed a significant negative predictor of looking up words in English right away when reading. However, the result is based on participants' self-report, not from direct observation of cognitive processes when participants use computer-mediated dictionaries.

1.2 Computer-mediated Dictionary

Among computer-mediated dictionaries, the two most commonly used dictionaries are the key-in spelling dictionary and the click-on word dictionary. Comparing with using a key-in dictionary, readers who use a click-on dictionary only have to perform one click on the unfamiliar word to find a headword. The results from previous studies indicated that second language readers were more willing to look up words because of the convenience of click-on dictionary in finding a headword (Liu & Lin, 2011). In this case, do EFL (English as a Foreign Language) readers with low tolerance of ambiguity have higher percentages of consultation immediately when they use click-on dictionaries than use key-in dictionaries?

1.3 Eye-Tracking

Many researchers used self-reported questionnaires or log files to study cognitive processes (Liu & Lin, 2011; Loucky, 2003), but it is impossible to find *where* readers have actually looked on the screen with either design. It's even more impossible to observe readers' actual dictionary look-up patterns. Over the past decades, researchers have been using eye movement behaviors to infer cognitive processes (Rayner & Duffy, 1986). However, there has been no attempt to apply eye-tracking technology to discover whether tolerance of ambiguity influences readers' dictionary look-up strategies.

1.4 Purpose of the Study and Hypotheses

To further explore learners' dictionary look-up strategies among high, mid, and low ambiguity tolerant readers, the present study applied eye-tracking technology to record and analyze readers' dictionary look-up patterns. A tolerance of ambiguity scale of dictionary use was designed. Two experimental groups including key-in dictionary use and click-on dictionary use were designed.

When readers encounter unfamiliar words in the text at the first time, low ambiguity tolerant readers may immediately turn to dictionary area to look up words in the dictionary. This pattern is defined as TED, where T referred to Target unfamiliar word, E referred to the action of moving from text to dictionary, and D referred to Dictionary area. Therefore, we postulate that **low ambiguity tolerant readers would have a significantly higher percentage of consultation immediately (TED patterns) than the high and mid groups (H1)**. Because of the convenience of click-on dictionary in finding a headword (Liu & Lin, 2011), we postulate that **low ambiguity tolerant readers using click-on dictionary would have a higher percentage of consultation immediately (TED patterns) than readers using key-in dictionary (H2)**.

2. Method

2.1 Participants

Twenty-three EFL undergraduate students in Taiwan participated in this pilot study. Eleven students are in the click-on dictionary group, and 12 students are in the key-in dictionary group. All participants were between ages of 19 and 23 (M = 20.7 years, SD = 1.15 years; 10 females and 13 males).

2.2 Design

Participants were randomly assigned to one of the two experimental groups. English proficiency, reading material, dictionary material, and computerized environment were either controlled or standardized in both conditions. The content of dictionary is from Oxford Advanced Learner's English-Chinese Dictionary (7th edition). All words in the reading text could be found in both computer-medicated dictionary conditions. Analysis of variance (ANOVA) and Cohen's (1988) effect size indices *d* were used to detect any significant differences between groups for all measurements. The level of confidence was set at the 0.05 significant level.

2.3 Tolerance of Ambiguity Scale of Dictionary Use

To meet our experiment purposes, a tolerance of ambiguity scale of dictionary use (TAS-DU) including four questions related to dictionary use ambiguous situations were designed:

Q1. After consulting the dictionary, I feel uncomfortable if I can't write down the Chinese annotation beside the English word in an article.
Q2. When I'm consulting the dictionary, I feel impatient if I have to read back and forth from the article to the dictionary in order to find the right definition.
Q3. When I'm reading something in English, I don't enjoy using a dictionary that takes a while to find the right definition.
Q4. When I'm reading something in English, I feel impatient when I encounter a word I don't totally understand and can't consult the dictionary.

These four questions were presented in Mandarin Chinese to make sure that participants understood the questions. Participants rated the items using a four-point Likert scale: "strongly disagree," "disagree," "agree," "strongly agree." The higher the score, the more intolerant the learners are of foreign language ambiguity in dictionary use settings.

2.4 Coding of Dictionary Look-up Patterns through Eye-Tracking

To record participants' eye movement data, an EyeLink 1000/2k Eye Tracker at the sampling rate of 250Hz was used. GazeTracker 9.0 eye movement data record and analysis software was used. Fixations were identified as a set of gaze points that fell within a 40-pixel dispersion and together lasted for at least 200 ms (Reichle, Pollatsek, Fisher, & Rayner, 1998).

To test research hypotheses, three types of AOI (Area of Interest) in the reading text field (B, T, A) and one type of AOI in the dictionary field (D) were setup. In the click-on condition, readers started to read the area containing contextual phrases before target word (AOI-B), and they could click the mouse once on the target words (AOI-T) to bring the headword and definition content (AOI-D). In addition, they read the area containing

contextual phrases after target word (AOI-A). The contextual sentence structure for all 11 target words was BTA where the target word was located within the sentence.

2.5 Variables

For research purpose, there were 2 independent variables including *tolerance of ambiguity level* and *dictionary type*, and 2 dependent variables related to dictionary look-up patterns.

- Dictionary look-up pattern for each target word was represented by the sequence of fixation locations and actions from the first word of AOI-B to the first fixation on AOI-D.
- Percentage of consultation immediately when readers encounter unfamiliar words (TED %) was represented by the total frequency of TED pattern divided by the total dictionary consultation frequency.

2.6 Procedure

Participants were tested in single sessions. At the first stage, participants were screened for eye-tracking calibration and took pretest. Next, each participant was randomly assigned into one of the two experimental groups, and an experimental tutorial was provided to make sure that participants got familiar with experimental tools. They were told to read for comprehension. Screen contents, mouse click actions, and eye movements were recorded. At the last stage, participants were debriefed and thanked for their participation.

3. Results

In this section, three results are presented in the following: (1) dictionary use tolerance of ambiguity rating, (2) dictionary look-up patterns through eye-tracking, and (3) percentages of consultation immediately.

3.1 Tolerance of Ambiguity Rating

Analysis of variance (ANOVA) of participants' tolerance of ambiguity score indicated that participants under the two different dictionary groups had approximately the same tolerance of ambiguity level, F (1, 22) = .791, p = .384, d= 0.375. Because of the small sample size, using plus/minus 1 standard deviation from mean as the high/low criteria ended up with 1 low ambiguity tolerant reader for each group, which was too small to make any comparison. We used total scores to divide participants into three groups: low, mid, and high ambiguity tolerant readers.

3.2 Dictionary Look-up Patterns

For click-on and key-in dictionary groups, 72 different look-up patterns were found. Numbers of dictionary look-up pattern for both dictionary groups were summarized in Table1. For readers using click-on dictionary, high ambiguity tolerant readers had less number of look-up pattern (5.50) than mid (6.00) and low (6.00) ambiguity tolerant readers. Similar result was found in key-in group: high ambiguity tolerant readers had less number of look-up pattern (6.25) than mid (6.75) and low (6.75) ambiguity tolerant readers. However, there was no significantly different number of patterns among different tolerant ambiguity groups.

Table 1. Dictionary look-up patterns and readers' tolerance of ambiguity

Variables	Low tolerance of ambiguity		Mid tolerance of ambiguity		High tolerance of ambiguity		F	*p*
	Mean	SD	Mean	SD	Mean	SD		
Click-on								
Number of pattern	6.00	1.83	6.00	1.00	5.50	1.73	.12	.887
Key-in								
Number of pattern	6.75	2.63	6.75	4.65	6.25	3.78	.02	.977

The major four dictionary look-up patterns were found including BTED, BTATD, BTAD, and BTBD. Around 27% to 60% of the pattern was BTED, which indicated that readers frequently consulted dictionary immediately after they encountered unfamiliar words (i.e., TED). The second major pattern is BTATD, which indicated that participants read the whole contextual sentences (BTA) first, and then went back to fixate on the unfamiliar words again, then immediately looked up the words. Another similar pattern is BTAD, which indicated that participants read the whole contextual sentences first, and then clicked-on the unfamiliar word to bring forward the headwords without fixating on the unfamiliar word more than 200 ms.

3.3 Percentages of Consultation Immediately

Percentages of consultation immediately (TED %) was presented in Figure 1. For both click-on and key-in groups, low ambiguity tolerant readers did not have a significantly higher percentage of consultation immediately than the high and mid groups, so Hypothesis 1 was not confirmed. In addition, low ambiguity tolerant readers using click-on dictionary (M = 29.25%) did not have a higher percentage of consultation immediately than readers using key-in dictionary (M = 32%), so Hypothesis 2 was not confirmed, either.

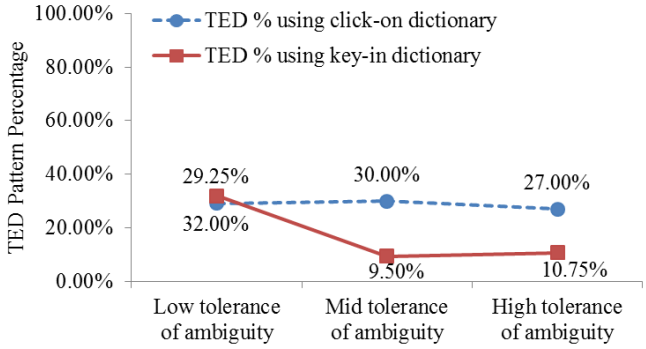

Figure 1 Percentages of consultation immediately (TED %) in click-on and key-in group

4. Conclusion and Discussion

The purpose of this study was to investigate whether EFL readers with low tolerance of ambiguity had higher percentages of consultation immediately when they used computer-mediated dictionaries. Although low ambiguity tolerant EFL readers did not have a significantly higher percentage of consultation immediately pattern, they had higher percentages in click-on (29.25%) and key-in (32%) than high ambiguity tolerant EFL readers in click-on (27%) and key-in (10.75%). In particular, low ambiguity tolerant EFL

readers using key-in dictionary almost looked up words immediately three times more than high ambiguity tolerant EFL readers.

In terms of the convenience in finding a headword, mid and high ambiguity tolerant EFL readers using click-on dictionary had approximately higher percentages of consultation immediately (around 30%). It seems that technological convenience affect readers' individual differences. On the other hand, finding a headword by using key-in dictionary was harder than using click-on dictionary, but low ambiguity tolerant EFL readers still decided to consult dictionary and consulted immediately when they encountered unfamiliar words. However, for mid and high ambiguity tolerant EFL readers using key-in dictionary, they performed different look-up patterns.

The major limitation in this study is the small sample size. The major contribution of this study is using eye-tracking technology to directly observe readers in reading and look-up processes. In conclusion, through analyzing look-up patterns, we found that readers with different ambiguity tolerance levels did perform different look-up patterns, although not significantly.

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