How EFL Readers Understand the Protagonist, Causal, and Intentional Links of Narratives: An Eye-Tracking Study

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Abstract

This study explored how Japanese students learning English as a foreign language (EFL) understand the protagonist, causal, and intentional links between sentences during narrative reading employing an eye-tracking technique. Forty Japanese undergraduates read narrative texts, each of which contained a target sentence (e.g., Patricia ordered a cup of coffee) that was either consistent or inconsistent with a preceding context sentence (e.g., Patricia was a coffee lover or Patricia did not like bitter drinks), in terms of either of the protagonist, causality, or intentionality dimensions. The participants’ eye movements during reading were recorded. Analyses of eye movement data showed that regardless of the dimensions, the participants immediately noticed inconsistencies between sentences, when encountered, during reading. In addition, the participants reprocessed the target sentences to resolve protagonist and intentional inconsistencies, whereas such a process was not observed for causal inconsistencies. Finally, inconsistencies did not affect the number of participants who looked back to the context sentences. These results indicate that although the three types of links are important and understandable to EFL readers, they are different in terms of processes through which they were understood.
1. Introduction

To achieve coherent text comprehension, readers have to build a mental representation of situations described in the text, called a situation model (Kintsch, 1998). The construction of situation models involves understanding not only what each sentence means but also how multiple sentences are linked to one another (Zwaan, Langston, & Graesser, 1995; Zwaan & Radvansky, 1998). Such intersentential links are known to be established in different dimensions of comprehension, including protagonist, causality, intentionality, temporality, and spatiality (e.g., Zwaan & Radvansky, 1998). Accordingly, readers have to understand and integrate meaning across sentences along not only a single dimension but also multiple dimensions.

Although a number of studies have explored second-language (L2) reading comprehension, most of them have focused on one specific dimension of comprehension (Horiba, 1996; Morishima, 2013; Ushiro et al., 2010; Ushiro et al., 2016; Ushiro, Hamada, et al., 2018). Our previous study (Ushiro, Hosoda, et al., 2018) addressed this issue by simultaneously comparing L2 readers’ comprehension of different multiple dimensions; nevertheless, this study had a methodological limitation of not allowing readers to look at the entire text all at once and look back to the previous context during reading. Therefore, these previous studies have not provided sufficient information on the processes of how L2 readers achieve coherent comprehension along multiple dimensions, and how to support them to do so.

Exploring readers’ eye movements would uncover moment-by-moment reading processes involved in the multidimensional comprehension of learners of English as a foreign language (EFL), which was not revealed by previous studies. Thus, the present study employed eye tracking to reveal how EFL learners understand intersentential links along multiple dimensions during reading. The resulting insights would then provide further implications for reading instructions aimed at assisting students in their construction of coherent situation models.

1.1 Different Types of Situational Links in Narratives

In the field of first-language (L1) reading research, the multidimensionality of situation models is proposed by the event-indexing model (Zwaan & Radvansky, 1998). According to this model, readers understand intersentential links of narratives along five dimensions (i.e., protagonist, causality, intentionality, temporality, and spatiality). Of these, the current study focuses on the following dimensions, which are theoretically considered as important for comprehension: protagonist, causality, and intentionality.

The protagonist dimension is defined as links between characters’ trait and action (e.g., Patricia likes coffee and She ordered a cup of coffee). Stories in narratives usually center on a protagonist. Thus, the protagonist dimension plays an important role in narrative comprehension (Zwaan & Radvansky, 1998). This notion has received empirical support from studies showing
that L1 readers stably understand protagonist links (Hakala & O’Brien, 1995; O’Brien, Rizzella, Albrecht, & Halleran, 1998), and so do L2 readers, to a certain degree (Ushiro et al., 2016).

The causality dimension is defined as physical cause-effect links between story events (e.g., *Len put pieces of wood in the fire and The fire grew bigger and bigger*). Causality is important because it explains why a given story event occurred and how it led to other events. Hence, understanding causal links between sentences is directly linked to the coherence of situation models (Singer, Halldorson, Lear, & Andrusiak, 1992; Zwaan & Radvansky, 1998). Reports have indicated that both L1 and L2 readers understand causal links during reading (Myers, Shinjo, & Duffy, 1987; Singer et al., 1992; Ushiro, Hosoda, et al., 2018).

The intentionality dimension is defined as links between characters’ goal and action (e.g., *Emily decided to buy a mystery novel and She bought the novel*). The significance of the intentionality dimension in situation models is related to the fact that narrative stories are mainly guided by characters’ goals and their related actions (Trabasso & Suh, 1993; Trabasso, van den Broek, & Suh, 1989). Given such an important role of intentionality, L1 readers attempt to link all of the story information to characters’ goals during reading (Tapiero, van den Broek, & Quintana, 2002). Meanwhile, L2 readers can infer the characters’ goals from their actions (Ushiro et al., 2014), and the intentionality dimension is more stably understood during L2 reading compared with other dimensions (Ushiro, Hosoda, et al., 2018).

In sum, L2 and L1 readers understand the intersentential links along the protagonist, causality, and intentionality dimensions. However, researchers have reported that these three dimensions are not always understood to the same extent, owing to the limitation of cognitive resources available during reading; L1 children tend to understand only the causality dimension (Bohn-Gettler, Rapp, van den Broek, Kendeou, & White, 2011) or emotions of the protagonist and causality (Wassenburg, Beker, van den Broek, & van der Schoot, 2015).

### 1.2 Inconsistency Detection Paradigm

To examine readers’ understanding of intersentential links, researchers have employed the methodology called *inconsistency-detection paradigm* (IDP; e.g., Hakala & O’Brien, 1995; Ushiro et al., 2016). IDP uses a short narrative text, as shown in Table 1. In the text, a target sentence (e.g., “As she usually did, Patricia ordered a cup of coffee.”) is either consistent (the *consistent condition*) or inconsistent (the *inconsistent condition*) with a preceding context sentence (e.g., “Since childhood, her favorite drink had always been coffee.” and “Since childhood, she had not liked bitter drinks like coffee.” for the consistent and inconsistent condition, respectively). If readers attempt to connect the meaning of the context and target sentences, they should have difficulty processing target sentences in the inconsistent condition (Hakala & O’Brien, 1995). This difficulty slows down reading times for the target sentences (*target reading times*) in the inconsistent condition, compared with the consistent condition, which is regarded as the
inconsistency effect. This inconsistency effect on target reading times is interpreted as evidence of readers understanding intersentential links when reading.

Table 1

<table>
<thead>
<tr>
<th>An Example Protagonist Text</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction</td>
</tr>
<tr>
<td>Context</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Filler</td>
</tr>
<tr>
<td>Target</td>
</tr>
<tr>
<td>Closing</td>
</tr>
</tbody>
</table>

In L1 research, IDP studies have reported the inconsistency effect for the protagonist (Hakala & O’Brien, 1995), causality (Wassenburg et al., 2015), and intentionality dimensions (Poynor & Morris, 2003). Several recent studies have likewise applied IDP to L2 reading research. For example, Morishima (2013) employed IDP to examine L2 readers’ understanding of protagonist links. The results showed the inconsistency effect on target reading times when the context and target sentences are adjacent (i.e., no filler included). Ushiro, Hosoda, et al. (2018) extended Morishima’s (2013) findings to multiple dimensions (protagonist, causality, and intentionality) and identified the inconsistency effect for the causality and intentionality dimensions, but not for the protagonist dimension. As such, causal and intentional links are understandable to L2, whereas protagonist links are more difficult to understand.

It is important to note that the above L2 studies have a methodological limitation. Specifically, their experiments employed self-paced reading, in which a participant reads a text sentence by sentence. In this way, available information at any point in reading is limited to only one sentence. This methodological feature might increase the difficulty associated with understanding links across two or more sentences. Additionally, self-paced reading does not allow participants to look back to the prior context, which might alter their comprehension processes given that look-backs are one of the frequently used strategies when readers encounter text inconsistencies (Rinck, Gámez, Díaz, & de Vega, 2003).

1.3 Use of Eye Tracking in Reading Research

To overcome the limitation associated with self-paced reading, recent studies have combined eye tracking with IDP (e.g., Poynor & Morris, 2003; Rinck, et al., 2003; van der Schoot, Reijntjes, & van Lieshout, 2012). Eye tracking has several advantages over self-paced reading. First, participants do not have to perform a secondary task (e.g., frequent button presses) that may interfere with their natural reading process. Second, eye tracking presents the entire text at once, allowing participants to look back to and from any section whenever they want. Third, data from eye movements can discriminate between initial (e.g., analytical processes) and later reading
processes (e.g., integrative, strategic processes), thereby revealing the processes through which participants notice and resolve inconsistencies (Nahatame, 2015; van der Schoot et al., 2012).

Ushiro et al. (2016) employed eye tracking to examine L2 readers’ understanding of protagonist links, adopting the following eye movement measures: first-pass, second-pass, and look-back reading times (see Figure 1). First-pass reading times are the total duration of all fixations on a target sentence from the first fixation on the sentence until readers go out of the sentence. This measure reflects the initial reading processes, such as extracting the explicit meaning from the target sentence and then detecting inconsistencies (Hyönä, Lorch, & Rinck, 2003). Second-pass reading times are the total duration of all additional fixations on the target sentence that occur after fixation on at least one non-target sentence. This measure reflects later reading processes, such as resolving detected inconsistencies. Look-back reading times are the total duration of all fixations on the context sentence after fixation on the target sentence. This measure reflects readers’ confirmation of the source of inconsistencies (e.g., Hyönä et al., 2003).

![Diagram of eye movement measures](image)

*Figure 1. Eye movement measures in Ushiro et al. (2016). Interest areas of eye movement measures are context and target sentences. Arrows and lines indicate readers’ fixation and eye movement, respectively.*

Ushiro et al.’s (2016) results showed no inconsistency effect on first- and second-pass target reading times. However, the inconsistency effect affected the number of participants who looked back to the context sentences. Thus, eye tracking can expose readers’ inconsistency detection better than self-paced reading by providing information on readers’ regressive eye movements. Nevertheless, Ushiro et al. (2016) targeted only the protagonist dimension; few studies have applied eye tracking to examine how L2 readers understand multiple dimensions of narrative texts.

### 1.4 The Present Study

As described above, previous studies are limited in that they have only investigated L2 readers’ understanding of intersentential links along a single dimension of comprehension. Only a single study has explored L2 readers’ understanding of intersentential links along multiple dimensions (Ushiro, Hosoda, et al., 2018), and it does not provide evidence of specific reading processes involved owing to the methodological limitation of self-paced reading (e.g., participants cannot look back to prior text). Consequently, little is known of the kinds of difficulty that emerge
in L2 readers’ understanding of intersentential links along multiple dimensions.

To address this issue, we conducted an eye-tracking experiment with IDP designed to reveal how L2 readers understand protagonist, causal, and intentional links between sentences. The current study collected and analyzed several eye movement measures related to comprehension of intersentential links. The following research questions (RQs) were addressed.

RQ1: Do protagonist, causal, and intentional links affect EFL readers’ initial reading processes, as reflected by their first-pass target reading?

RQ2: Do protagonist, causal, and intentional links affect EFL readers’ later reading processes, as reflected by their second-pass target reading?

RQ3: Do protagonist, causal, and intentional links affect EFL readers’ look-backs to context sentences?

2. Method

2.1 Participants

A total of 40 Japanese university students with normal or corrected-to-normal vision participated in the experiment. Data from three participants were excluded from the analysis owing to inaccurate eye movement recording. Consequently, the analyses were conducted on 37 participants (9 females and 28 males; average age = 20 years, range = 18–22 years). All of the participants were native speakers of Japanese who had learned English for at least six years in Japanese formal education. Their majors varied, including those in the areas of human sciences, humanities and culture, and science and engineering.

Their general English proficiency was estimated as the intermediate level according to their self-reported standardized test scores: TOEIC listening and reading (M = 731.25, SD = 184.77, range = 460 to 860, n = 4), TOEFL ITP (440, n = 1), TOEFL iBT (49, n = 1), and the EIKEN Test in Practical English Proficiency (Grade 3 to Pre-1: Grade 3, n = 5; Grade Pre-2, n = 4; Grade 2, n = 12; Grade Pre-1, n = 1). Of all participants, 25 reported at least one of the scores, and 12 reported none.

2.2 Materials

Twelve short narratives were adopted from Ushiro, Hosoda, et al. (2018), which originally came from other prior studies (e.g., Wassenburg et al., 2015). Every four experimental texts were manipulated with consistencies in their protagonist, causality, and intentionality dimensions. All of the texts consisted of five sentences: (a) an introduction that introduced the settings, (b) a context that provided description of one of the three dimensions that was consistent or inconsistent with a target sentence, (c) a filler that separated the context and target sentences, (d) a target that provided either consistent or inconsistent information to the context sentence, and (e) a closing
*sentence* that concluded the story. Examples of the experimental texts in the three dimensions are shown in Tables 1 to 3.

Table 2
An Example Causality Text

<table>
<thead>
<tr>
<th>Introduction</th>
<th>Len went camping in the forest and made a big campfire.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Context</td>
<td>After a while, he put pieces of wood in the fire. (Consistent)</td>
</tr>
<tr>
<td></td>
<td>After a while, he poured buckets of water on the fire. (Inconsistent)</td>
</tr>
<tr>
<td>Filler</td>
<td>Len enjoyed his food and drinks in the forest.</td>
</tr>
<tr>
<td>Target</td>
<td>The fire grew bigger and bigger, and kept Len warm.</td>
</tr>
<tr>
<td>Closing</td>
<td>Len had a wonderful and fun camping trip.</td>
</tr>
</tbody>
</table>

Table 3
An Example Intentionality Text

<table>
<thead>
<tr>
<th>Introduction</th>
<th>Emily went to a store before her brother’s birthday party.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Context</td>
<td>Emily decided to buy a video game for him. (Consistent)</td>
</tr>
<tr>
<td></td>
<td>Emily decided to buy a mystery novel for him. (Inconsistent)</td>
</tr>
<tr>
<td>Filler</td>
<td>She wanted to buy the present with her own money.</td>
</tr>
<tr>
<td>Target</td>
<td>She bought a popular game that her brother wanted.</td>
</tr>
<tr>
<td>Closing</td>
<td>Emily headed home to get ready for the party.</td>
</tr>
</tbody>
</table>

The experimental texts were provided in either consistent or inconsistent condition. In the consistent condition, a context sentence (e.g., “Since childhood, her favorite drink had always been coffee.”) was consistent with a target sentence (e.g., “As she usually did, Patricia ordered a cup of coffee.”). In the inconsistent condition, a context sentence (e.g., “Since childhood, she had not liked bitter drinks like coffee.”) was inconsistent with the target sentence. Consistency manipulation was piloted in Ushiro, Hosoda, et al. (2018) using a likelihood rating that confirmed that the links between the context and target sentences are significantly less likely in the inconsistent condition than in the consistent condition.

The texts were modified for EFL readers to focus the readers’ attention to discourse-level understanding and to avoid the effect of unintended language difficulty. Specifically, low-frequency words at Level 5 or above on the *Japan Association of College English Teachers (JACET) 8000 list* (Ishikawa et al., 2003) were paraphrased into high-frequency words at Level 4 or below. The text length was also controlled across the dimensions and consistency conditions: protagonist (*M* = 47.50 words, *SD* = 3.54 for consistent, *M* = 49.50 words, *SD* = 0.71 for inconsistent), causality (*M* = 48.00 words, *SD* = 1.41 for consistent, *M* = 45.50 words, *SD* = 0.71 for inconsistent), and intentionality (*M* = 45.50 words, *SD* = 2.12 for consistent, *M* = 48.50 words, *SD* = 0.71 for inconsistent).

To motivate the participants to read for understanding, each text had a comprehension question. Each question measured the participants’ literal understanding of a sentence in the text, except for the context and target sentences (e.g., “Did Patricia study in the library?” for the passage in Table 1). Two material sets of 12 texts (four texts for the protagonist, causality, and intentionality dimensions, respectively) were created. The consistency conditions were
counterbalanced across the two sets such that the experimental texts were presented in the consistent condition in one set and in the inconsistent condition in the other set, and vice versa.

2.3 Apparatus and Procedure

The experiment was conducted from April to June 2018. The participants were tested individually for approximately 60 min. Before the experiment, the participants were informed of the purpose and procedures of the study, and their signed informed consent was obtained (approved by the research ethics committee of the university to which the first author belongs).

The participants’ eye movements were recorded with EyeLink® 1000 Plus eye tracker (SR Research Ltd., Canada). They sat 51 cm from the camera and 70 cm from a 21.5-inch computer screen (screen resolution: 1920 × 1080). They were asked to put their chin and forehead on a chinrest to prevent their movement. The eye tracker was calibrated three times ([a] before a practice text, [b] before an experimental text, and [c] after six experimental texts) using a nine-point grid in the reading session. The experimental texts were presented on the screen in 20-pt Times New Roman font using EyeLink® Experiment Builder.

Before the reading session, the participants were instructed to read for understanding and answer a comprehension question after reading each text. They familiarized themselves with the experimental procedure with one practice text presented in the consistent condition. If they had any problems, they were instructed to ask the experimenter to address and resolve them.

In the reading session, the participants read 12 experimental texts presented on the screen in their entirety. Each text was displayed after the participants’ pressing an enter key with their index finger to the prompt “Ready?” The participants read the text silently at their own pace and pressed the enter key when finished. Each text was followed by a comprehension question. The participants answered the question by looking at either “Yes” or “No” presented on the screen for 5 s. They then pressed the enter key to confirm the correct answer and pressed to move to the next text. This sequence was repeated for 12 texts. A 5-min rest time was given after reading six texts to reduce the participants’ burden.

2.4 Scoring and Analysis

Data from an accurately recorded eye (usually the right eye) were used for analyses. Prior to the analysis, the data were removed when the participants mistakenly skipped sentences by checking the recorded movie (9.58% of the dataset). The participants’ fixation times over \( M + 3 SDs \) in each condition were replaced by their \( M + 3 SDs \) (1.30% of the dataset). The fixation times of words in the target sentences were then summed to compute those of the target sentences. Subsequently, the target reading times were converted to milliseconds (ms) per syllable to account for differences in sentence length.

The areas of interest for eye movement measures were the target and context sentences relevant to the consistency manipulation (Ushiro et al., 2016). For the target sentences, we first
computed first-pass reading times indicative of the initial reading processes. If readers immediately detect an inconsistency between the context and target sentences, their first-pass target reading times will increase, reflecting immediate awareness (e.g., van der Schoot et al., 2012).

Next, the second-pass reading times for target sentences were computed, indicative of later reading processes. However, second-pass target reading occurred in less than half the cases (48%), and standard deviation was large (26%). Thus, in consideration of interpretative difficulty, we computed the number of the participants who did and did not show second-pass target reading in each condition. This technique was employed in previous eye-tracking research to address interpretative difficulties (Ushiro et al., 2016; van der Schoot et al., 2012). The strategic process of attempting to resolve the inconsistency between sentences tends to increase the number of participants conducting second-pass target reading (e.g., Pynor & Morris, 2003).

Finally, look-backs to the context sentences were computed. As in second-pass target reading, look-backs occurred in less than half (43%) of the cases with a large a standard deviation (28%). We therefore computed the number of the participants who did and did not show look-backs in each condition. Look-backs reflected readers’ confirmation of the source of inconsistencies after encountering target sentences (Hyönä et al., 2003; Rinck et al. 2003).

3. Results

3.1 Comprehension Questions

The proportion of correct answers for the comprehension questions was high overall ($M = .89$, $SD = .23$). A 3 (dimension: protagonist, causality, intentionality) × 2 (consistency: consistent, inconsistent) repeated analysis of variance (ANOVA) on this proportion showed that none of the dimensions, $F(2, 146) = 0.72, p = .488$, $\eta^2 = .00$, consistency, $F(1, 73) = 0.47, p = .495$, $\eta^2 = .00$, nor their interaction, $F(2, 146) = 1.57, p = .211$, $\eta^2 = .00$, affected the results. This outcome indicates that the participants understood the texts equally well across the conditions (Causality × Consistent: $M = .86$, $SD = .34$; Causality × Inconsistent: $M = .89$, $SD = .31$; Intentionality × Consistent: $M = .91$, $SD = .29$; Intentionality × Inconsistent: $M = .84$, $SD = .37$; Protagonist × Consistent: $M = .91$, $SD = .29$; Protagonist × Inconsistent: $M = .91$, $SD = .29$).

3.2 First-Pass Reading for Target Sentences

Table 4 shows the descriptive statistics of the first-pass reading times for the target sentences. The data were submitted to a 3 (dimension: protagonist, causality, intentionality) × 2 (consistency: consistent, inconsistent) repeated ANOVA. Prior to the analysis, we confirmed that the assumptions of ANOVA were all met. The results showed main effects of the consistency, $F(2, 66) = 3.34, p = .042$, $\eta^2 = .02$ and dimension, $F(1, 33) = 8.73, p = .006$, $\eta^2 = .04$. The Dimension × Consistency interaction was not significant, $F(1.53, 50.6) = 11679.76, p = .259$, $\eta^2 = .01$. 
Regarding the consistency main effect, the first-pass target reading times were significantly longer in the inconsistent condition than in the consistent one. Regarding the dimension main effect, a multiple comparison with the Bonferroni adjustment showed that the first-pass reading times were significantly longer for the causality than for the protagonist texts, $t(33) = 2.62, p = .013, d = 0.33$. Conversely, no significant difference was observed between the causality and intentionality texts, $t(33) = 1.21, p = .234, d = 0.15$ or between the intentionality and protagonist texts, $t(33) = 1.35, p = .187, d = 0.16$.

<table>
<thead>
<tr>
<th>Condition</th>
<th>Causality</th>
<th>Intentionality</th>
<th>Protagonist</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$M (SD)$</td>
<td>$95% CI$</td>
<td>$M (SD)$</td>
</tr>
<tr>
<td>Consistent</td>
<td>305.97</td>
<td>[272.24, 339.70]</td>
<td>270.18</td>
</tr>
</tbody>
</table>

### 3.3 Second-Pass Reading for Target Sentences

Chi-squared tests were conducted to examine whether the number of the participants who performed second-pass target reading increased in the inconsistent condition, as opposed to the consistent condition. The results showed that the number of these participants (see Table 5) significantly increased in the inconsistent condition for the intentionality text, $\chi^2(1) = 4.26, p = .039, \phi = .27$, and for the protagonist text, $\chi^2(1) = 5.63, p = .018, \phi = .31$. Meanwhile, the difference was not significant for the causality text, $\chi^2(1) = 0.42, p = .518, \phi = .10$.

<table>
<thead>
<tr>
<th>Second-pass reading</th>
<th>Causality</th>
<th>Intentionality</th>
<th>Protagonist</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Consistent</td>
<td>Inconsistent</td>
<td>Consistent</td>
</tr>
<tr>
<td>Yes</td>
<td>22</td>
<td>25</td>
<td>22</td>
</tr>
<tr>
<td>No</td>
<td>15</td>
<td>11</td>
<td>15</td>
</tr>
</tbody>
</table>

*Note. Data on 14 cases (0.2% of all data) were excluded from this analysis because of inaccurate recordings.*

### 3.4 Look-Backs to Context Sentences

As in the second-pass reading, we used chi-squared tests to examine whether the number of the participants who conducted look-backs increased in the inconsistent condition, as opposed to the consistent condition (see Table 6). The results revealed no difference between the consistency...
conditions for any of the three dimensions, causality: $\chi^2(1) = 2.53, p = .112, \phi = .22$; intentionality: $\chi^2(1) = 1.10, p = .294, \phi = .15$; and protagonist: $\chi^2(1) = 0.40, p = .529, \phi = .10$.

Table 6

<table>
<thead>
<tr>
<th>Look-backs</th>
<th>Causality</th>
<th>Intentionality</th>
<th>Protagonist</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Consistent</td>
<td>Inconsistent</td>
<td>Consistent</td>
</tr>
<tr>
<td>Yes</td>
<td>21</td>
<td>29</td>
<td>15</td>
</tr>
<tr>
<td>No</td>
<td>15</td>
<td>8</td>
<td>22</td>
</tr>
</tbody>
</table>

Note: Data on 14 texts (0.2% of all data) were excluded from this analysis because of inaccurate recordings.

4. Discussion

4.1 RQ1: Inconsistency Effect on Initial Reading Processes (First-Pass Target Reading)

The results showed that participants took significantly longer first-pass target reading times in the inconsistent condition than in the consistent one. This inconsistency effect was not different according to dimension, as reflected by the absence of the Consistency × Dimension interaction. Together, these results indicate that the participants immediately understood the links between the context and target sentences along the three dimensions.

This finding coincides with the event-indexing model, which assumes that these three dimensions constitute important components of situation models (Zwaan & Radvansky, 1998). Specifically, they describe characters’ trait-action links (protagonist) and explain why events in the story occurred physically (causality) as well as motivationally (intentionality). Given such important roles, these dimensions were likely to attract the participants’ attention, resulting in the immediate inconsistency detection during reading.

Nevertheless, this finding is in contrast to those in Ushiro, Hosoda, et al. (2018), in which EFL readers failed to understand the protagonist links during reading. This discrepancy may be explained by the methodological difference between the studies. That is, Ushiro, Hosoda, et al. (2018) used self-paced reading, where participants are presented with only one sentence at a time, whereas the present study employed eye tracking, which allows participants to see the entire text at one time. This difference implies that a richer amount of information was available for understanding intersentential links in the present study than that in Ushiro, Hosoda, et al. (2018). Consequently, the present participants understood links across sentences more readily than those in Ushiro, Hosoda, et al. (2018).

4.2 RQ2: Inconsistency Effect on Later Reading Processes (Second-Pass Target Reading)

As opposed to the first-pass target reading, the three dimensions yielded different results for second-pass target reading. Specifically, protagonist and intentionality inconsistencies increased
the number of the participants who conducted second-pass target reading, relative to the consistent condition, whereas such an inconsistency effect was not observed for the causality texts. As second-pass reading reflects later reading processes, this finding suggests that the participants differently engaged in later reading processes to resolve the detected inconsistencies according to the types of dimensions.

The dimension difference that emerged in later reading processes can be explained by the directness of inconsistencies. In the protagonist and intentionality texts, the directness of inconsistencies is not so strong that it might leave room for readers to make inferences to resolve inconsistencies. Taking the protagonist text in Table 1 for example, Patricia’s (who did not like bitter drinks) ordering of coffee can be justified by the reasoning that she felt so sleepy that she ordered coffee to keep herself awake. Likewise, for the intentionality text in Table 3, the readers could infer that Emily bought a game because she remembered that her brother wanted it. In this manner, the participants might strategically reprocess the target sentences to conduct such resolution processes, resulting in the inconsistency effects on second-pass target reading for protagonist and intentionality texts. By contrast, the causal inconsistencies seemed difficult to resolve. In an example in Table 2, pouring water on the fire and the fire’s becoming bigger cannot coexist logically, leaving little room for inferences, and thus leading to the absence of reprocessing of target sentences. Note that this reasoning stands only when the same causal passages (i.e., including physical inconsistencies) are used as in the present study.

In sum, different reading processes found for the three dimensions were likely to stem from the extent to which these dimensions allow for readers’ inference generation to resolve the detected inconsistencies. This view partly matches with that in Ushiro, Hamada, et al. (2018); EFL readers seek to resolve protagonist inconsistencies through strategic processes and inferences. Thus, the results of second-pass target reading suggest that protagonist, causal, and intentional links are differently processed in terms of strategic and later comprehension processes, despite the fact that they all are immediately understandable (as shown by the first-pass reading time results of the present participants).

4.3 RQ3: Inconsistency Effect on Look-Backs

The results showed no inconsistency effect on the participants’ look-backs to the context sentences in any dimension condition. This finding runs counter to that in Ushiro et al. (2016), which reported the inconsistency effect on look-backs using protagonist text.

Although the present findings cannot provide a conclusive explanation, existing research indicates that look-backs may be constrained by readers’ individual differences, which are not considered here. For example, L1 researchers have reported that the frequency of look-backs differs depending on one’s reading styles, called reading profiles (Hyönä & Nurminen, 2006). Frequent look-backs are characteristics of the most strategic reading profiles. Look-backs are also reported to depend on the reader’s self-monitoring skills or evaluative mindset (Wassenburg et al.,
2015). Indeed, some studies failed to find the inconsistency effect on look-backs (van der Schoot et al., 2012), as in the present study. These clashing views suggest that readers’ looking back behavior builds on complex influences from various reader factors. Additional research is necessary to gain direct evidence on whether and how differences in L2 readers’ profiles cause different patterns of eye movements and processes during reading.

5. Conclusion

5.1 Summary of Findings

This study used eye tracking to reveal how EFL readers understand protagonist, causal, and intentional links. The findings can be summarized as follows. First, the participants immediately understood the links between the context and target sentences along all the three dimensions. Second, the participants additionally engaged in later reading processes to resolve inconsistencies for the protagonist and intentionality dimensions, but not for the causality dimension. Third, the inconsistencies of either dimension had no effect on the participants’ look-backs to the context sentence. These findings indicate that the protagonist, causality, and intentionality dimensions are all important in EFL readers’ situation models. However, readers alter their strategic and later comprehension processes according to the dimensions.

5.2 Implications for Researchers and Educators

The findings demonstrate the multidimensionality of EFL readers’ situation models and reveal that these readers engage in different kinds of processes to understand different dimensions. Compared with previous L2 studies that have mostly focused on one dimension, the present study indicates that considering multiple dimensions of situation models can better explain the dynamic reading processes involved in EFL readers’ text comprehension. Therefore, our study advances the theory of L2 reading by showing the significance and necessity of considering the multidimensionality of EFL readers’ text comprehension.

Moreover, this study offers a methodological implication. The different reading processes observed for the three dimensions cannot be captured in the conventional self-paced reading because such a method does not allow readers to reread the target sentences. Thus, eye tracking is a powerful method for studying L2 reading processes at a discourse level. We believe that L2 studies can utilize eye tracking to address several issues in L2 text comprehension and learning.

Finally, this study provides pedagogical implications for reading instruction in the classroom. Teachers should be aware of the importance of the protagonist, intentionality, and causality dimensions in text comprehension. As all of these dimensions were immediately understood by the participants, their links are useful for post-reading activities. For example, teachers can give students character actions and instruct them to reconstruct what they understood from the text using that character information. Moreover, teachers are advised to assist learners to
notice and understand autonomously these links using activities like inference questions (e.g., *Please explain why Patricia ordered coffee*). Learners may process causal links differently compared with the other dimensions. Therefore, if learners mistakenly understand causal information, it would be difficult for them to resolve the misinterpretations. In such a case, teachers should ask questions to have learners confirm their comprehension and promote learners’ use of reading strategies, such as rereading, to address their difficulty.

### 5.3 Limitations of This Study

To conclude, we note the limitations of this study that can guide future research. First, this study focused on only three out of the five dimensions assumed in the event-indexing model (Zwaan & Radvansky, 1998). How EFL readers understand intersentential links along the other two dimensions (i.e., temporality, spatiality) remains unresolved. Additional research is desired to address this issue and gain a more comprehensive account of L2 text comprehension.

Second, in regard to second-pass reading and look-backs, we considered the number of participants rather than their reading times because relatively few participants showed such behavior. However, reading times are informative in giving information about the time course of the processes readers engage in during reading. Analyzing the reading times of second-pass reading and look-backs will thus provide a more detailed view of L2 reading processes.

In addition, we did not consider readers’ individual differences, including the reading profiles of each participant. Individual differences reportedly have a large influence on strategic processes, such as look-backs (Hyönä & Nurminen, 2006). It is possible that the large standard deviations observed in look-backs might be caused by undefined reader factors. Future research should explore the relationship between L2 readers’ strategy use during reading and their individual differences. This line of research will provide empirical evidence that informs implications for supporting text comprehension in L2 students with different reading profiles.

### Acknowledgments

This study was conducted by Tsukuba Reading Research Group, supported by Grants-in-Aid for Scientific Research (B) (No. 16H03439) and partially supported by Grants-in-Aid for Challenging Exploratory Research (No. 16K13256). We express our gratitude to three anonymous reviewers for their constructive comments.

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