How Japanese EFL Readers Revise Their Situation Models: 
Focusing on Reading Skills and the Causal Structure of Texts

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**Abstract**

The present study examined how Japanese EFL readers revise their situation models, focusing on two factors: (a) learners’ reading sub-skills, and (b) the causal structures of stories. A total of 76 Japanese undergraduates read stories which required them to revise their interpretation of the stories during reading (i.e., situation model revision), then they performed sentence verification and recall tasks. The readers’ success with the situation model revision was assessed using the combined data on those tasks. The results showed that reading skills needed for successful revision can be explained by the two textual factors specified by causal network analysis: the explicitness of the revision clues (+ explicitness) and the complexity of the causal structures in each text (+ simplicity). Specifically, higher level reading processing (e.g., making inferences) was needed for readers to revise their situation models when they read a story which did not include explicit revision clues (i.e., - explicitness), whereas lower level processing (e.g., paraphrasing) was needed when reading a story with a complicated causal structure (i.e., - simplicity). It is suggested that teachers should carefully take into account students’ reading sub-skills and the causal structure of a text when requiring them to flexibly interpret the text.
1. Introduction

In order to comprehend a text successfully, readers have to flexibly alter their interpretation as it unfolds. When reading stories such as mysteries, for example, it is commonly seen that readers encounter an unpredicted ending or information about a character which will ultimately turn out to be inaccurate. In many situations, readers process new text information and update their interpretation to construct appropriate and coherent comprehension. For a more concrete example, let us consider the following passage from Alba (1984, p. 228):

The artist was concerned about having the painting ready for the exhibit deadline. While he was busily painting one day, he received a phone call. He was told that he had three more months ...

After reading these sentences, readers might understand that the artist was told to finish his painting within three months. However, consider what happens to their interpretation of the passage as they read the succeeding sentences below:

... His doctor expressed his sympathy and hung up. Suddenly, the painting was no longer important.

Readers would notice that their interpretation of the earlier passage contradicts the sentence being processed. They have to modify their interpretation in order to reconcile the contradiction and achieve successful comprehension of the passage (i.e., the artist was told that he had only three months to live). This kind of flexible reading process includes modification of the cognitive representations of interpreted text (called situation models by van Dijk & Kintsch, 1983).

According to Rapp and Kendeou (2007, 2009), the process of modifying situation models is defined as revision. The revision process requires readers to substantially modify their existing situation models, which are constructed from old information, using the new information they encounter. In the past decade, the revision of situation models has been investigated exclusively in first language (L1) reading research (e.g., Albrecht & O'Brien, 1993; Guéraud, Harmon, & Peracchi, 2005; O'Brien, Rizzella, Albrecht, & Halleran, 1998; Radvansky & Copeland, 2001; Rapp & Kendeou, 2007, 2009; Zwaan & Madden, 2004). The main finding of those studies was the importance of clues which indicate to readers the necessity of revision. In the example above, readers cannot revise their situation models until they read the latter part of the story and comprehend that the character heard unfortunate news from a doctor on the phone. In other words, information as mentioned in the latter part can function as revision clues, which trigger readers' correct interpretation of the story. Furthermore, Rapp and Kendeou (2007, 2009) recently established the importance of explicit causal explanation included in revision clues. In their studies, the revision of situation models was successful when the text explained why the old
information was inappropriate for constructing correct situation models, whereas it was unsuccessful when the story just suggested that the old information was inappropriate, without any explicit explanation as to why. As a result, they suggested that the explicitness of the causal relationship was a crucial factor encouraging readers to revise their situation models. However, their research did not consider qualitative features such as the explicitness of the causal relations, and discussed the presence/absence of causal relation clues exclusively. It still remains an open question how causal relations among information in a whole narrative affect the revision of situation models.

Causal network analysis (Trabasso & Sperry, 1985) enables us to see how revision clues are connected to other information in a story. In this analysis, multiple raters analyze a text in small units such as clauses, then evaluate the existence of causal relationships between each clause. One clause might have a large number of causal connections with other clauses, and another clause might have only a few. Using this analysis, Horiba (1996) and Ushiro et al. (2010) examined how causal relations among information in a whole narrative story affected the text comprehension of readers with different proficiencies. Horiba found L1 readers comprehended text information with a larger number of causal connections better than text information having fewer connections. In the case of second language (L2) reading, she found that L2 readers could not make use of causal information effectively in their first reading of a passage, but advanced learners became able to use such information in their second reading of the same passage. That is, proficient L2 readers recalled information with more causal connections better than information with fewer causal connections. Ushiro et al. confirmed Horiba’s result in their participants’ recall after their first reading. In addition, Ushiro et al. reported that L2 readers processed text information with more causal connections faster than that with fewer connections. Considering the importance of explicit causal explanation in revising situation models suggested by Rapp and Kendeou (2007, 2009), it is highly possible that the quality of the causal structure (e.g., the presence of explicit revision clues) and the quantity of the causal connections (e.g., how simple the connections are), will influence the success of the situation model revision in L2 reading. However, the past research mentioned above did not clarify the effects of causal structure when the text requires a revision process. Thus, further research was necessary using texts that require readers to modify their interpretations flexibly at a certain point in a text.

In addition to textual factors, reader variables may affect the revision of situation models. Another L2 study, Ushiro (2010), investigated the situation model revision process of Japanese EFL readers, dealing with two factors arising from the differences between individual learners (i.e., L2 reading proficiency and working memory capacity). One notable finding was that L2 reading proficiency significantly predicted how successfully readers revised their situation models. That is, proficient L2 readers revised their interpretations of texts more flexibly and precisely than less proficient readers did. However, his research did not take the components of reading ability, or reading sub-skills, into consideration. Reading proficiency is regarded as having several
components, such as word recognition, semantic analysis, and inference generation. According to Grabe (2000, 2009), components of reading processing fall into two broad sub-categories: lower level processing (e.g., integration of individual word meanings into propositions) and higher level processing (e.g., inferences and strategy use). Higher level processing is said to be more difficult in L2 than L1 since L2 readers devote more of their cognitive resources to the lower level processing (Horiba, 1996, 2000). However, no research to date has been conducted to reveal how lower and higher level reading processing works in the revision of the situation model.

In summary, past studies have shown the effects of reader factors (e.g., reading proficiency) as well as text factors (e.g., causal relations) on text comprehension and revision of situation models. However, it remains unclear which level of reading processing works in the revision of situation models and how readers revise their interpretations of texts with different causal structures. The present study aims to investigate the revision process of Japanese EFL readers, focusing on the following two points: (a) the levels of reading skills required for successful revision, and (b) the causal structures of texts. Two research questions (RQs) were addressed:

RQ1) Do Japanese EFL readers utilize higher and lower level reading skills in order to revise their situation models?  
RQ2) How do causal structures of narratives interact with the reading sub-skills required in EFL readers' revision process?

To examine these RQs, the success of a reader’s revision of a situation model was assessed using multiple measures: a written recall task, a true-false sentence verification task, and an error identification task. RQ1 was investigated in terms of readers’ higher and lower level reading skills. To test RQ2, structures of texts were analyzed by raters based on causal network analysis (Trabasso & Sperry, 1985) to examine whether different types of texts require different reading skills for readers to revise their situation models. By examining these RQs, the skills necessary for successful revision will be suggested.

2. Method

2.1 Participants

The participants were 76 undergraduates majoring in engineering or social sciences. They had studied English for more than six years. The reading subsection of the paper-based TOEFL practice test (Educational Testing Service, 2002), which was composed of a total of 50 items with five passages, was used to measure the participants’ reading proficiency ($M = 27.97$, $SD = 7.21$, $Max = 42$, $Min = 16$, Cronbach’s $\alpha = .82$). The results estimated their overall TOEFL scores to be in the range of 390-590. The data of this test were analyzed in order to (a) confirm the equivalence between groups of different booklet types, and (b) assess the participants’ higher and lower level
reading skills as in Shimizu (2006). Twelve students were excluded from the analysis because they failed to complete all the experimental tasks, and four other students were excluded because their recall production rates were less than 50.00%, and thus were regarded as outliers in the context of the data as a whole ($M = .82$, $SD = .15$). Therefore, the data of the remaining 60 students were analyzed.

2.2 Materials
2.2.1 Selection of Texts and Causal Network Analysis

Twelve narrative passages were adopted from Alba (1984), each of which had two versions: a control version and a revision-necessary version. Both versions of each passage consisted of two parts. In each control version, the first part of a passage led participants to make an accurate interpretation (e.g., after reading \textit{He received a phone call he had been expecting from the doctor's office. The artist was told that he had three more months}, readers will expect \textit{three more months} to mean “three months to live”). This interpretation is validated in the second part (e.g., \textit{His doctor expressed his sympathy and hung up}), which allows participants to comprehend the context of the second part smoothly. On the other hand, in the revision-necessary version, a few changes were made in the first part, whereas the second part conveyed the same message as the control version. The first part in the revision-necessary version causes the participants to make an interpretation that is not suitable for the context of the second part (e.g., after reading \textit{The artist was concerned about having the painting ready for the exhibit deadline. ... The artist was told that he had three more months}, the interpretation will be “three months to finish the painting”). Thus, successful comprehension of the story could not be reached unless readers appropriately revised their interpretations by processing the new information introduced in the second part (e.g., the part including \textit{His doctor expressed his sympathy and hung up}). In addition, each of the two versions had its own target sentence, which was abstracted from the first part of the passages. Examples of the target sentences were: \textit{The artist was told that he had three more months to live} (for the control) or \textit{to finish the paintings} (for the revision-necessary version). In the control version, the target sentence was “true” throughout the whole story, while in the revision-necessary version, it would seem “true” after reading the first part, but would turn out to be “false” at the end of a story (see Appendix).

Using the revision-necessary version of Alba’s (1984) 12 passages, two pilot studies were conducted in order to select appropriate stories. Because the goal of this study was to examine the differences between successful and unsuccessful readers of revision, stories needed to meet the following criteria: (a) the revision of interpretation was necessary for comprehension of the whole story; (b) the success rate of revision was expected to be moderate, which enabled readers to be grouped into successful and unsuccessful revisers; and (c) each story did not include any excessively difficult words, which would obscure the focal point in comprehension. In the first pilot study, 10 undergraduate or graduate students evaluated the 12 passages in terms of the
necessity of the revision using a 7-point scale to confirm the first point (a). As a result, six passages were eliminated because their rating points were lower than the other six passages and were regarded needing less revision. In the second pilot study, 23 undergraduates read the remaining six revision-necessary passages and were required to judge whether or not the target sentence was appropriate for the content of the passage. As a result, two passages were eliminated because the accuracy rates of the sentence verification were quite high (100.00% and 85.71%, respectively), indicating that these passages could not reflect the difference between successful and unsuccessful revising processes. The mean accuracy rates of the remaining four passages were moderate (63.75%), all of which satisfied the second point (b). Finally, as to the third point (c), participants were asked to identify all the unknown words in the texts, and frequently identified words were replaced with easier words in cooperation with a native speaker of English. This manipulation controlled the difficulty of word-level understanding; the difference of revision success between texts was therefore assumed to be caused by higher and lower level reading comprehension processes rather than whether or not readers knew certain words in the text. The four passages selected as the experimental materials in the present study were labelled as Stories A, B, C, and D, and listed in the Appendix.

Then, causal network analysis (Trabasso & van den Broek, 1985) was conducted on four passages. Two paired raters divided text information into statements that were equal to simple clauses. Each text had one statement corresponding to the focus of the sentence verification task; this statement was labelled as the key statement in this study (e.g., Statement 5 in Story A: that he had 3 more months). The inter-rater agreement of statement division was 99.58% and all disagreement was solved through discussion. After that, another two paired raters described each story’s text structure by causal network analysis based on the procedure described in Trabasso and van den Broek (1985) and the validity was double checked by the other two paired raters.

2.2.2 Reading Proficiency Test and Classifications of Reading Sub-skills

Items from TOEFL Practice Tests (Educational Testing Service, 2002) were divided into seven types following Shimizu’s (2006) categorization: (a) paraphrase, (b) inference, (c) thematic, (d) referential, (e) vocabulary, (f) text organization, and (g) exception questions. Two raters independently categorized the 50 items and the inter-rater agreement was 92.00%; the disagreements were resolved through discussion. Then, these seven question types were grouped into three categories based on Grabe’s (2000, 2009) reading component framework: higher level questions (i.e., inference, thematic, and text organization questions), lower level questions (i.e., paraphrase questions), and the other questions. The number of question items in the higher and lower levels and the other categories were 16, 8, and 26, respectively. Participants’ scores on higher level questions and lower level questions were used in the analyses.
2.3 Procedure

All materials were presented in a booklet that included the four texts. The order and versions of the four passages in the booklet were counterbalanced. Half of the participants read Stories A and B in the revision-necessary condition, and Stories C and D in the control condition. The others read Stories C and D in the revision-necessary condition, and Stories A and B in the control condition. The overall procedure is summarized in Figure 1.

![Figure 1](image)

Figure 1. Overall procedure of the experiment.

In the experimental session, the participants were instructed to read the passage at their own pace and write down what they understood and remembered from the passage in Japanese (i.e., the written recall task). After the recall task, the participants were given a target sentence and asked to judge whether it was true or false (i.e., the sentence verification task). As mentioned in Section 2.2.1, the target sentence presented was different between the control and revision-necessary versions. In addition, they were also required to perform one of the following tasks: (a) L2-to-L1 translation of the target sentences when they answered “true” in the verification task, or (b) error identification and modification of the target sentences when they answered “false” in the verification task. The error identification task ensured the precise assessment of the revision successfulness, testing whether or not readers made a random guess in the sentence verification task. Finally, they were asked to rate the interest of the text on a 7-point Likert scale, which was done to examine whether their situation model revision was reflected in the subjective rating. Participants repeated these procedures for four items (i.e., two revision-necessary and two control passages) at their own pace. The experiment was conducted in approximately 60 minutes.

2.4 Scoring and Data Analysis

For the scoring of recall data, all the passages were parsed into a set of idea units (IUs) by two raters on the basis of Ikeno’s (1996) criteria, resulting in a high inter-rater agreement (97.05%). Disagreements were resolved by a third rater. In scoring, 30% of the recall protocols of each story were scored by the pairs of raters, which indicated an agreement ratio of 87.23% to 96.55%. After discussions to solve disagreements, the other 70% of the recall protocols were scored, resulting in an inter-rater agreement of 94.02% to 97.75%. Again, all disagreements were solved through discussion. In order to evaluate the success of revision, readers’ answers on
revision-necessary versions were marked as correct when their response satisfied all the following three points: (a) their response to the sentence verification task was correct (i.e., the participants answered “false”); (b) their error identification was appropriate (e.g., “Three months is the artist’s life expectancy. It has nothing to do with the painting”); and (c) their recall production indicated an appropriate interpretation of the second part of the story (i.e., the interpretation was regarded as a failure whenever their recall protocols provided any suggestion of a mistaken interpretation such as “The artist had to finish the painting earlier than he had expected”). Participants’ answers in the control version were not used in the analyses because they did not need to revise their situation models when reading these passages.

A one-way multivariable analysis of variance (MANOVA) was conducted on each story using the score rates of the two categories (higher and lower level reading skills). The independent variable was the reader groups (successful and unsuccessful readers).

3. Results and Discussion

3.1 Revision Success

Based on the true-false sentence verification task and other supplementary tasks, the success of the revision of the situation models was assessed, and two groups were formed: successful and unsuccessful reader groups. Table 1 shows the numbers of participants who successfully or unsuccessfully revised the situation models of each text. It shows that rates of successful revision differed across stories; almost all readers successfully revised the interpretation of Story D (93.33%), whereas the rates of successful readers were moderate among Stories A, B, and C (50.00%, 56.67%, and 46.67%, respectively).

Table 1
Numbers of Readers who Successfully or Unsuccessfully Revised Situation Models Across Four Passages

<table>
<thead>
<tr>
<th>Revision of situation models</th>
<th>Successful</th>
<th>Unsuccessful</th>
<th>Success rate (%)</th>
<th>$\chi^2$ (1)</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Story A</td>
<td>15</td>
<td>15</td>
<td>50.00</td>
<td>0.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Story B</td>
<td>17</td>
<td>13</td>
<td>56.67</td>
<td>0.53</td>
<td>.465</td>
</tr>
<tr>
<td>Story C</td>
<td>14</td>
<td>16</td>
<td>46.67</td>
<td>0.13</td>
<td>.715</td>
</tr>
<tr>
<td>Story D</td>
<td>28</td>
<td>2</td>
<td>93.33</td>
<td>22.53</td>
<td>.000</td>
</tr>
</tbody>
</table>

Chi-square tests were conducted in order to determine whether the frequency of successful and unsuccessful revision of each story was statistically different for the following analyses or not. The result showed that there were no such significant differences in Stories A, B, and C ($p > .05$) but the number of successful and the unsuccessful readers of Story D was significantly different ($p$...
This means that Story D did not satisfy the premise of the following analyses, which aimed at comparing the difference between successful and unsuccessful readers in terms of their reading skills for higher and lower reading processing. Hence, the data of Story D were excluded from the following analyses.

### 3.2 L2 Reading Skills for Higher and Lower Level Processing and Success of Revision

In order to answer RQ1, the successful and unsuccessful readers of each story were compared in terms of their score rates (.00-1.00) in two skill types: higher and lower level skills. Table 2 summarizes the results of the score of each reading skill. These scores were compared by a one-way MANOVA.

**Table 2**

<table>
<thead>
<tr>
<th>Rates of Reading Skill Scores by Successful and Unsuccessful Readers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Successful readers</td>
</tr>
<tr>
<td>Higher level skill</td>
</tr>
<tr>
<td>---------------------</td>
</tr>
<tr>
<td>Story A</td>
</tr>
<tr>
<td>Story B</td>
</tr>
<tr>
<td>Story C</td>
</tr>
</tbody>
</table>

*Note.* Rates were calculated by dividing the number of correct responses by the total number of items in each category. Numbers in parentheses indicates standard deviations (SDs).

As for Story A, there were significant differences in the scores of both higher and lower level reading skills between revision successful and unsuccessful readers, $F(1, 28) = 8.89, p = .006$ for higher skills; and $F(1, 28) = 6.12, p = .020$ for lower skills. As to Story B, there was a significant difference in the scores of only higher reading skills, $F(1, 28) = 4.40, p = .045$ for higher skills; and $F(1, 28) = 2.24, p = .145$ for lower skills. As to Story C, none of the scores showed significant differences between revision successful and unsuccessful readers, $F(1, 28) = 0.55, p = .463$ for higher skills; and $F(1, 28) = 1.05, p = .314$ for lower skills.

These results clearly showed that the reading sub-skills required for successful revision were different between stories. Specifically, the skills for the higher level processing such as inferencing were needed for revising situation models in Stories A and B. On the other hand, the skills for lower level processing (i.e., paraphrasing) were related to revision success in only Story A. As for Story C, however, there was no difference in the scores for higher and lower level reading skills between successful and unsuccessful readers. That is, neither higher nor lower level reading skills could explain the differences between successful and unsuccessful readers of Story C.

These results highlighted the importance of text factors for interpretation revision. Although the numbers of successful and unsuccessful readers were similar across the three stories, these
stories required different reading processes for successful revision. Since reading processes were said to interact with the causal structures of texts (see Horiba, 1996), it is possible that the difference in required reading skills was caused by differences in the causal structure of the three passages. Our next question was how the causal structures of these passages affected the success of revision.

3.3 Relationships Between Causal Structures and Success of Revision

Figure 2 illustrates the causal structures of each story identified by causal network analysis. In the figure, qualitative information was added to the causal structures; black circles represent the key statements and grey circles represent the revision clues (i.e., information triggering the appropriate interpretation). In addition, bold arrows indicate explicit connections with revision clues, and broken arrows indicate implicit ones. For example, a key statement of Story A, Statement 5, has one explicit causal relation with Statement 3, and five implicit causal relations with Statements 6, 7, 8, 9, and 11.

![Causal networks of the revision-necessary versions.](image)

As Rapp and Kendeou (2007, 2009) suggested, the revision process can be facilitated by the causality explained explicitly in the text. When the revision clues have implicit connections with key statements, it seems necessary to comprehend these connections by making inferences for successful revision. Additionally, the remarkable difference among the stories presented in Figure 2 was the number of connections between the key statement and revision clues. When the key statement has more connections with revision clues, readers might require skills to process a larger amount of written information in order to successfully revise situation models. Therefore, it was possible that the aforementioned difference in the text structures was a significant factor affecting what reading skills were required for successful revision.

To examine this possibility, the differences among the three revision-necessary versions were examined on the basis of the following two perspectives: (a) the explicitness of the revision clues, which was determined according to whether or not statements triggering the revision directly rejected the false interpretation suggested by the first part of a text, and (b) the simplicity...
of the causal structure, which was determined by the number of causal connections between the key statement and revision clues. The characteristics of the text structure on the basis of two perspectives are summarized at the bottom of each causal network in Figure 2: the label of "+ simplicity" indicates that the story has a simpler structure with fewer connections; "+ explicitness" indicates that the revision clues directly reject the false interpretation of the key statement.

The results of qualitative analysis of the three text structures (i.e., Stories A, B, and C) are as follows. Story A, in which both higher and lower reading skills were needed for proper understanding, was found to have (a) implicit clues for revision (- explicitness) and (b) complicated information structure (- simplicity). Firstly, as for the explicitness of revision clues (i.e., Statements 6, 7, 8, 9, and 11), none of these statements included direct rejection of misleading interpretation. For instance, Statement 6 (His doctor expressed his sympathy) did not explicitly suggest that the interpretation of three months was related to the artist's life. These revision clues did not clearly indicate the necessity of the revision of the existing situation models. Therefore, readers had to generate inferences from such implicit information to construct the proper situation models. This inference generation was related to higher level processing. Secondly, as for the simplicity factor, the causal structure was the most complicated of the three texts in that Story A had more causal connections between key statement and the revision clues (i.e., five connections) than Stories B and C (i.e., one and two connections, respectively). This feature may explain why lower level processing took an important role for successful revision of Story A. It is supposed that readers had to adequately comprehend the clues scattered through this passage in order to revise the situation models, and in this comprehension process, understanding of text propositions contributed to the revision success.

Next, Story B, in which only skills for higher level reading processing were found to be important for successful revision, had (a) implicit clues for revision (- explicitness) and (b) simple information structure (+ simplicity). Concerning the explicitness of revision clues (i.e., Statements 5 [he asked the attendant to put some oil on the chain] and 7 [and pedalled on to work]), these statements contained no explicit rejection of the misleading interpretation; the clues did not directly say "The businessman was riding a bike, not a car." Thus, as in Story A, the successful revision of situation models was supported by readers' higher level reading skills, including the skill of making inferences. On the other hand, the causal structure of Story B was simpler compared to that of Story A. The result suggesting the reduced significance of lower level processing for successful revision in Story B was probably caused by this relatively simple causal structure.

Unlike Stories A and B, none of the skills were related to successful revision in Story C. This story had (a) explicit clues for revision (+ explicitness) and (b) rather simple information structure (+ simplicity). Regarding the explicitness of the causal clues (i.e., Statements 6, 7, 8, and 9), they strongly rejected misleading interpretation and explicitly provided a proper interpretation. For example, Statements 8 (when he was home) and 9 (and not working) make it clear that the
pilot was not working in the plane. These statements functioned as explicit clues for revision, strongly suggesting that the interpretation of where the character was should be changed. Since the revision clues were explicit, higher level processing such as generating inferences played little role in achieving successful revision. As for the simplicity, the causal structure of this story was rather simple and the total number of causal connections between the key statement and revision clues was smaller than those in Story A. Thus, the lower level processing was not important in successful revision.

Interestingly, in Story C, the causal structure and reading skills did not relate to the revision. Therefore, the differences between successful and unsuccessful readers should be attributed to other factors. One possibility is that the skill in grasping the spatial situation described in the text affected the comprehension success. Although all of the three stories required readers to revise the earlier interpretation related to the protagonists, only Story C required the revision of the protagonist’s location (The airline pilot was in a cockpit. → The airplane pilot was at home). As Friedman and Miyake (2000) discovered, the role of visuospatial working memory (WM) in the construction of the situation model is different from that of the verbal WM. Therefore, it is likely that the revision of the situation models in Story C, in which the spatial representation needed to be updated, substantially required other skills that were not assessed by the TOEFL reading section. The revision of spatial representations among L2 readers needs to be investigated by further research.

In summary, the results of the text analysis showed the close relationship between reading skills and the text structures, as shown in Figure 3. The explicitness of the revision clue was the main factor that affected the necessity to use higher level reading skills, whereas the simplicity of the causal structure had an effect on the necessity of using lower level skills. These results suggested that the reading skills required for the successful revision of situation models were determined by the causal structures of texts.
3.4 Interestingness Ratings

The descriptive statistics of interestingness ratings are shown in Table 3. The results of interestingness rating in Stories A and B showed that readers who succeeded in revision gave interestingness ratings that were significantly higher than those who failed in revision, Story A: \( t(28) = -3.00, p = .006 \); Story B: \( t(28) = -2.87, p = .008 \). On the other hand, the result of Story C showed that ratings were not significantly different between successful and failed readers, \( t(28) = -1.19, p = .245 \).

Table 3
Descriptive Statistics of Interestingness Ratings

<table>
<thead>
<tr>
<th>Story</th>
<th>Revision of situation models</th>
<th>( n )</th>
<th>( M )</th>
<th>( SD )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Story A</td>
<td>Successful</td>
<td>15</td>
<td>5.13</td>
<td>1.13</td>
</tr>
<tr>
<td></td>
<td>Unsuccessful</td>
<td>15</td>
<td>3.87</td>
<td>1.19</td>
</tr>
<tr>
<td>Story B</td>
<td>Successful</td>
<td>17</td>
<td>4.35</td>
<td>1.17</td>
</tr>
<tr>
<td></td>
<td>Unsuccessful</td>
<td>13</td>
<td>3.07</td>
<td>1.26</td>
</tr>
<tr>
<td>Story C</td>
<td>Successful</td>
<td>14</td>
<td>3.93</td>
<td>1.64</td>
</tr>
<tr>
<td></td>
<td>Unsuccessful</td>
<td>16</td>
<td>3.31</td>
<td>1.20</td>
</tr>
</tbody>
</table>

*Note.* Maximum possible score was 7.00.

Taking these results together, it is suggested that the interestingness of the story might increase when readers achieve successful revision with higher level reading processing, which was supported by the fact that the results of interestingness ratings were consistent with the results of the score for higher level processing. Since the revision clues of Stories A and B were not explicit, successful readers not only comprehended the textual propositions stated in the text but actively attempted to establish relationships between key statements and revision clues by making inferences. These active reading processes might influence readers’ interest in these stories.

4. Conclusion

Flexible interpretation of a text is essential in both L1 and L2 reading but there have been very few L2 studies focusing on the revision process. Past studies have suggested (a) the importance of understanding the causal explanation in the text, and (b) the necessity of proficient reading ability for the process of revising the situation models. Therefore the present study aimed to further reveal how L2 readers revise their situation models using different reading sub-skills that depend on the causal structures of stories.

The main finding of this study was that the reading skills needed for successful revision in L2 reading can be determined by two text structure factors: the explicitness of the revision clues
successfully, the causal structures (± specificity) and the complexity of the causal structures (± simplicity). Concretely, the successful readers of the stories including implicit clues for revising situation models (i.e., Stories A and B) had better higher level reading skills such as inference skills than the unsuccessful readers. On the other hand, the successful readers of the passage with the most complicated causal structure (i.e., Story A) had better lower level reading skills such as paraphrasing ability compared to the unsuccessful readers. These results indicate that both higher and lower reading sub-skills contribute to successful revision in L2 reading (the answer to RQ1) but the types of skills required for revision vary according to the text structure (the answer to RQ2), although the rates of successful revision among Stories A, B, and C were equally moderate. Higher level reading skill was needed when readers revised situation models with implicit clues for the revision, whereas lower level skill was needed when readers revised the situation models of stories with a complicated causal structure. That is, the revision process in L2 reading was found to be complex in that both reader and text factors interacted intricately.

According to the present results, it is suggested that L2 teachers should carefully take into account students’ reading sub-skills and the causal structure of a text when requiring them to flexibly interpret the text. Because different text structures may lead to different processes of story comprehension, the types of reading process that are important for flexible reading. Therefore, even if the text analysis adopted in this study (e.g., causal network analysis) is difficult to utilize in everyday classroom instruction, it is advisable for teachers to observe discourse features in the text. With careful attention to whether the text includes a complicated structure or implicit information, teachers can estimate what kinds of reading skills will be required by their students. Furthermore, students may find passages attractive when they flexibly and successfully comprehend them using higher level reading processes, and such an effect can be created by implicit interpretation clues. Therefore, L2 teachers should make a further effort to promote students’ flexible reading and cultivate a higher level reading ability, as well as a lower level one.

Acknowledgements

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References


Albrecht, J. E., & O’Brien, E. J. (1993). Updating a mental model: Maintaining both local and


Ushiro, Y. (2010). *Flexibility of updating situation models: Schema modification processes of...*
Appendix: Reading materials used in the current study

<table>
<thead>
<tr>
<th>Story A</th>
<th>Story B</th>
<th>Story C</th>
<th>Story D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Revision-necessary version (73 words)</td>
<td>Revision-necessary version (50 words)</td>
<td>Revision-necessary version (48 words)</td>
<td>Revision-necessary version (65 words)</td>
</tr>
<tr>
<td>[S1] The artist was concerned about / having the painting ready / for the exhibit deadline. / [S2] While he was busily painting one day, / [S3] he received a phone call. / [S4] The artist was told / [S5] that he had three more months. / [S6] He was shocked. / [S7] He had not been feeling well. / [S8] but he did not expect / to hear that kind of news from his doctor. / [S9] His doctor expressed his sympathy / [S10] and hung up. / [S11] Suddenly, the painting / was no longer important.</td>
<td>Control version (69 words)</td>
<td>[S1] The businessman always left for work / at the same time each day. / [S2] While riding to work one morning, / [S3] the businessman stopped at the gas station. / [S4] While he was there, / [S5] he asked the attendant / to put some oil on the chain. / [S6] He then paid the attendant / [S7] and pedaled on to work.</td>
<td>Control version (52 words)</td>
</tr>
<tr>
<td>Target sentence: The artist was told that he had three more months to finish the paintings. (&quot;false&quot;)</td>
<td>Target sentence: While riding his car to work one morning, the businessman stopped at the gas station. (&quot;false&quot;)</td>
<td>Target sentence: Just before the start, the airplane pilot adjusted all the controls on the airplane. (&quot;false&quot;)</td>
<td>Target sentence: The troublesome boy played paint onto the window. (&quot;false&quot;)</td>
</tr>
<tr>
<td>Control version (69 words)</td>
<td>Control version (52 words)</td>
<td>Control version (49 words)</td>
<td>Control version (65 words)</td>
</tr>
<tr>
<td>[S1] The artist was busily painting one day / [S3] when he received a phone call / [S12] he had been expecting / from the doctor's office. / [S4] The artist was told / [S5] that he had three more months. / [S6] He was shocked. / [S7] He had not been feeling well, / [S8] but he did not expect / to hear that kind of news from his doctor. / [S9] His doctor expressed his sympathy / [S10] and hung up. / [S11] Suddenly, the painting / was no longer important.</td>
<td>Control version (69 words)</td>
<td>[S1] The airplane pilot had been waiting for the big game. / [S7] Watching sporting events / was his way of / relaxing / [S8] when he was home / [S9] and not working. / [S2] Just before the start, / the airplane pilot adjusted all the controls. / [S3] The reception was perfect. / [S4] He sat back / [S5] and watched / [S6] as the game began.</td>
<td>Control version (65 words)</td>
</tr>
<tr>
<td>Target sentence: The artist was told that he had three more months to live. (&quot;true&quot;)</td>
<td>Target sentence: While riding his bicycle to work one morning, the businessman stopped at the gas station. (&quot;true&quot;)</td>
<td>Target sentence: Just before the start, the airplane pilot adjusted all the controls on the television. (&quot;true&quot;)</td>
<td>Target sentence: The troublesome boy sprayed paint through the window. (&quot;true&quot;)</td>
</tr>
</tbody>
</table>

Note: Each passage is divided into IUs with slash marks and statement units with the numbers from [S1] to [S12].