Syntactic Prediction in L2 Comprehension: Evidence from Japanese Adverbials

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Native speakers are often able to guess what comes next in a sentence (Kimball, 1975). This phenomenon reflects our ability to predict upcoming words on the basis of what has been processed so far. Research has shown that this predictive behavior is a critical component of language comprehension that makes processing robust and efficient (Marslen-Wilson, 1973). Previous second language (L2) studies, however, have suggested that learners do not generate predictions to the same extent as native speakers do, although this may depend on the type of linguistic structure in question (for a review, see Kaan, 2014).

The present study follows this line of research by examining incremental processing in L2 Japanese. In Japanese, a verb-final language, the thrust of an utterance is reserved for the end of the sentence (Shibatani, 1990). For instance, negation is expressed as a part of the sentence-final verb. Therefore, it is often unclear during processing whether the upcoming verb involves affirmative or negative polarity. Nevertheless, conversation analysis studies have shown that native speakers of Japanese effectively use adverbials to provide a sense of how a sentence continues (Tanaka, 2001). These studies demonstrated that, aided by adverbials, interlocutors were able to complete each other’s sentences collaboratively or to prepare for a next conversational turn (Hayashi, 1999, 2003). This is possible because adverbials are often associated with particular predicates syntactically and semantically. However, to date, no studies have provided empirical evidence for the processing benefit of the adverbial-driven predictions. Such empirical examination is crucial to understanding how predictable syntactic structures are built in verb-final languages.

1. Predictive processing

In processing sentences, native speakers not only integrate each word into a syntactic structure incrementally but also activate structural representations before they appear in the linguistic input. Adult psycholinguistic research shows how this predictive behavior makes comprehension rapid and robust (e.g., Altmann & Kamide, 1999). Anticipation plays a central role in recent models of

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sentence comprehension, and moreover it has been considered the driving force for incremental processing (Altmann & Mirkovic, 2009; Federmeier 2007; Levy 2008; Pickering & Garrod 2013).

To the degree that L2 learners also engage in real-time comprehension, the same mechanism may be operative. Accordingly, generating predictions should also result in efficient and reliable processing of the L2. However, there are mixed findings for and against how well L2 learners are able to generate predictions (Dowens, Vergara, Barber & Carreiras, 2010; Dussias, Valdés Kroff, Guzzardo Tamargo & Gerfen, 2013; Foote, 2010; Grüter, Lew-Williams & Fernald, 2012; Hopp, 2013; Keating, 2009).

In response to L2 learners’ nonnative like processing routines in generating predictions, Grüter, Rohde, and Schafer (2016) proposed that learners have a reduced ability to generate expectations, dubbed the RAGE hypothesis. Grüter and her colleagues argued that the reduced ability of anticipatory processing is attributed to a limited capacity of the L2 processor; the processor does not have enough resources for updating predictions after dealing with the immediately required linguistic processes. Nevertheless, exceptions to this pattern have been observed (Dussias et al., 2013; Hopp, 2013; Keating, 2009). The question remains as to what the conditions are under which L2 learners have difficulties in achieving predictive processing: Do the issues in the L2 processing mechanism affect anticipatory processing in general, or is it only relevant to morphosyntactic processing?

In addressing this issue, the present study considered anticipatory processing in L2 Japanese. The Japanese language provides a strong test case for incremental and expectation-driven sentence comprehension. Previously, we have explored how L2 learners engage in prediction in the domain of morphosyntax (Mitsugi, 2017; Mitsugi & MacWhinney, 2016). In Mitsugi and MacWhinney (2016), we replicated Experiment 3 of Kamide, Altmann, and Hayward (2003) with L2 learners with an L1 of English. In line with the results obtained in the original study (Kamide et al., 2003), we observed that native speakers showed anticipatory eye movements, predictively looking at the theme object in the visual scene after hearing part of a ditransitive sentence sequence more than when hearing part of an accusative sentence sequence. However, we failed to observe the facilitation effect entailed in native speakers by case-marking cues. The present study continues this line of research on L2 predictive processing but focuses on semantic information: whether L2 learners integrate negative polarity information in adverbials and generate predictions of whether the upcoming predicate involves negative polarity.

2. The structure of and projectability in Japanese

The Japanese language is verb final; all of the noun phrases precede the verb (Shibatani, 1990). This structural property could imply that it is sometimes difficult to determine the course of the sentence until the arrival of the verb. However, previous psycholinguistic research has shown that Japanese native
speakers of Japanese rely on case markers for thematic role assignments for incremental processing (Miyamoto, 2002; Yamashita, 1997) and that they use them to anticipate upcoming arguments (Kamide, et al., 2003).

Coming at this issue from a different perspective, conversational analysis researchers have examined the use of linguistic cues that allow speakers to predict the direction of a conversation. Researchers have documented and described how the participants of a conversation jointly complete an ongoing utterance, known as co-participant completion, joint production, or collaborative completion in English (Lerner, 1991, 1995, 1996; Sacks, 1995; Sacks, Schegloff, & Jefferson, 1974). For instance, in example (1), speaker A left a syntactic unit unfinished, and speaker B finished it, confirming the inference underlying speaker A’s unfinished sentence.

(1) A: I don’t have any time for basketball  
B: because you are working twelve hours  (Ono & Thompson, 1996)

The Japanese language places a particular importance on collaboration among speakers for achieving of successful conversational interaction (Maynard, 1990). Although co-construction is not very frequent and can also be considered rude in Japanese (Ono & Yoshida, 1996), Japanese speakers use a variety of linguistic cues to signal the direction of conversation. One of those linguistics cues that has attracted attention recently is Japanese adverbials. Adverbials often provide a preliminary sense of what kind of predicate will complete an ongoing sentence (Tanaka, 2001). Adverbials are often closely associated with particular predicates within specific contexts. Aided by the projective properties of adverbials, speakers may refrain from articulating the main predicate of an utterance, instead leaving others to infer what is being projected (Hayashi, 1999). In Example (2), Speaker B was able to complete the clause left unfinished by Speaker A, because the adverbial polarity item zenzen ‘at all’ projects negation on predicates or words with negative meaning, such as chigau ‘different.’

(2) A: Okurahoma QT English in pronounce if (not) at all

‘If you pronounce Oklahoma in English, (it is not) at all’

B: nihongo to chigau yo ne

‘different from (the pronunciation in) Japanese.’  (Hayashi, 1999)

It has also been shown that when negative sentences are long, native speakers of Japanese often place negative polarity adverbs, such as zenzen ‘at all’

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1 The inflectional abbreviations in this paper are ACC, accusative case; FP, final particle; GEN, genitive case; NEG, negation; PAST, past tense; QT, quotative.
or amari ‘much’ early in sentences, which helps reduce the ambiguity for listeners (Thompson & Ono, 2014). Negative adverbials serve as resources that can compensate for delayed projectability in Japanese because of its head finality. Placing linguistic cues that are strong in projectability helps listeners align themselves to the progress of the conversation, expediting their subsequent responses (Tanaka, 2001).

These conversational analysis studies have provided evidence for the predictive properties of Japanese adverbials and how they are used in conversation. However, no psycholinguistic studies have experimentally examined adverbial-driven predictive processing, and, therefore, the processing benefits of adverbials are unknown. The present study examined whether the processing of negative polarity adverbials can provide cues to the type of predicate that follows, using the visual-world paradigm (Tanenhaus, Spivey-Knowlton, Eberhard, & Sedivy, 1995).

3. Method
3.1. Participants

Twenty L2 learners of Japanese with L1 English and 15 native speakers of Japanese took part in an eye-tracking experiment. They each received US$10 for their participation. The L2-learner participants were undergraduate and graduate students at a North American university (mean age = 21.7, SD = 2.9), and the native-speaker participants were also recruited from this university’s community (mean age = 23.5, SD = 6.35). The learners were enrolled in sixth-semester Japanese courses at the time of data collection.

The L2 learners took part I of the Japanese Skill Test (Itomitsu, 1996). This test is a criterion-reference test and is reported to be effective and reliable in determining Japanese learners’ proficiency (Eda, Itomitsu & Noda, 2008). The test consists of 45 multiple-choice items assessing a variety of grammatical structures in Japanese, including case marking, conjugation, and sentence structure rules. The results of this test were included as a fixed effect in the statistical analysis model.

3.2. Materials and procedure

The experimental conditions consisted of sentences with a predicate involving negative polarity and with or without negative polarity adverbials, as in (3a) and (3b). The presence of a negative polarity adverbial, zenzen ‘at all,’ in (3a) projects a negative ending, whereas we placed an uninformative word (i.e., jibunno, ‘my’) in the same position in (3b). In this experiment, we have tested two negative adverbials, zenzen ‘at all’ and amari ‘much.’

We also included distractors, which are affirmative sentences with or without neutral polarity adverbials, such as yoku ‘well’ and takusan ‘a lot,’ as shown in (3c) and (3d). The adverbial yoku ‘well’ in (3a) is a neutral polarity item, which has an affirmative bias, but it can occur in a negative sentence; the
presence of neutral adverbial is uninformative about the predicate’s polarity. The inclusion of this type of distractor is to ensure that the effect of presence or absence of negation is clear.

For all of the experimental sentences, there was a lead sentence in Japanese (e.g., ‘Your parents are coming this week, right? Have you cleaned your room yet?’), and an experimental sentence was designed to provide an answer to this question. An echo question (e.g., sooji desuka ‘Are you taking about cleaning?’) was added at the beginning of each experimental sentence in order for the sentences not to start with critical linguistic information.

(3) a. zenzen heya-o soji-shimasen-deshita
   at.all room-ACC clean-NEG-PAST
   ‘I did not clean the room at all.’

b. jibun-no heya-o soji-shi-masen-deshita
   my-GEN room-ACC clean-NEG-PAST
   ‘I did not clean my room.’

c. yoku heya-o soji-shi-mashita
   well room-ACC clean-PAST
   ‘I cleaned the room well.’

d. jibun-no heya-o soji-shi-mashita
   my-GEN room-ACC clean-PAST
   ‘I cleaned my room.’

When presented with a visual scene (Figure 1), the participants were expected to make more anticipatory eye movements toward the picture on the right when hearing sentences with negative polarity adverbials, as in (3a), than during those without an adverbial, as in (3b). If the participants do not make predictions using adverbials, no difference would be expected in their eye movements between (3a) and (3b) until the sentence-final predicates are presented.
For the eye-tracking task, we constructed 48 experimental sentences, with 12 sentences per condition based on the four patterns illustrated in (3a)–(4d). Twelve visual scenes were created, with two picture objects each. Two native speakers of Japanese recorded each experimental sentence. These prerecorded sentences were randomly assigned to four lists. These experimental sentences were combined with filler sentences that were similar in length and complexity to the experimental sentences.

In order to ensure the reliability of these drawings, two native speakers of Japanese and one native speaker of English with advanced Japanese proficiency who did not participate the main experiments, were asked to match the experimental sentences with the corresponding drawings. There was no disagreement or confusion in the matching procedure. The vocabulary items were drawn from the textbooks used in the first- to third-semester Japanese courses at the institution where the study was conducted in order to ensure lexical familiarity.

The participants’ eye movements were recorded with an EyeLink 1000 desktop-mounted tracking device manufactured by SR Research, with a monocular sampling rate of 1000 hertz. After the standard physical setup, the participants were instructed to determine which picture scene would match the sentence they heard and to click the picture with the mouse. No feedback was given to their response. At the beginning of each trial, the participants viewed a fixation cross at the center of the screen. The fixation cross disappeared automatically after 1500 ms, and then a trial started. A visual scene with two picture objects appeared on the screen, and a lead sentence was played. The onset of the visual scene display was matched to the onset of the lead sentence. After hearing the lead sentence, the participants heard an echo question, followed by a target part of the sentence. This orally presented sentence matched one of the picture objects in the visual scene. The visual scene disappeared 2000 ms after the offset of the sentence-final verb. Five practice sentences preceded the experimental items. The eye-tracking session took approximately 25 minutes to complete.
In order to ensure that the L2 learners had sufficient offline knowledge about adverbials to process the sentences under investigation, the L2 participants’ knowledge of adverbials was assessed via a paper-and-pencil sentence-completion task. The task covered but was not limited to the adverbials relevant to the present study. The target items were the two negative polarity adverbials (i.e., *amari* ‘much’ and *zenzen* ‘at all’) used as the target items in the eye-tracking experiment and two neutral adverbs as distractors (i.e., *yoku* ‘well’ and *takusan* ‘a lot’). There were eight items in total. The target items took the form of a predicate phrase, headed by a subordinate clause. An example is given in (4). Unlike the example below, all questions were written in Japanese.

(4) kinou-wa tesuto-no benkyoo-ga atte, zenzen _____________
yesterday exam-GEN study-NOM there.was at.all _____________
‘Yesterday, I had studying to do for exam, and I not at all {blank}’

We developed this task to exclude data from any participants whose responses were incorrect on more than one of the negative adverb items in order to ensure the reliability of their declarative adverbial knowledge. However, there was no such participant; the data from all of the native Japanese participants and the L2-learner participants were carried forward for analysis.

3.3. Analysis procedure

The analyses were conducted on the participants’ empirical logit of fixation probabilities to the target picture object, following the transformation procedure discussed in Barr (2008). We conducted statistical analyses using linear mixed-effects models on the participants’ logit-transformed proportions of fixation to the correct picture object compared with the other picture object in the visual scene (Baayen, 2008; Baayen, Davidson & Bates, 2008). These analyses were performed using the lme4 package in the statistical software environment R (Bates, Maechler, Bolker & Walker, 2014).

The linear-mixed model allows us to analyze the change in fixation probabilities during the analysis period. We used a time-dependent model that is characterized by the linear equation \( \eta = \pi_0 + \pi_1 t \), where \( \eta \) represents the estimated log-odds of fixating the target for a given frame and \( t \) represents the time relative to the onset of the analysis window (following Barr, 2008). The variables \( \pi_0 \) and \( \pi_1 \) are estimated by the regression analysis; \( \pi_0 \) captures any pre-existing effect at the onset of the analysis window, and \( \pi_1 \) captures such an effect modulated by time. Specifically, \( \pi_1 \) captures the changes in the anticipatory effect during the periods of interest. For the analysis, we analyzed the fixations to both picture objects in the visual scene for the duration of 1200 ms for the critical region, which is the region that involves negative polarity adverbials or uninformative words.

Our model includes fixed effects for the sentence condition and time and includes the maximum random effect structure justified by our design (Barr,
Levy, Scheepers & Tily, 2013). Specifically, the model includes the slopes for
time, the sentence condition, and the combination of those two. The without-
adverb condition was treated as a baseline with which the with-adverb condition
was compared.

4. Results

First, we analyzed the native Japanese speakers’ looks to the correct picture
objects during the critical region. For the intercept term, we did not observe a
significant main effect of the with-adverb condition (estimate = −0.40, SE = 1.13,
\( p = .772 \)). This result indicates that there was no difference in looks toward the
two picture objects between the sentence conditions at the onset of the critical
region. For the time terms, there was a significant effect of time, suggesting that
the participants tended to look at the correct picture object progressively more
over the course of time in both conditions (estimate = 4.88, SE = 1.38, \( p = .002 \)).
Critically, the interaction of the with-adverb condition and time (estimate = 4.24,
SE = 2.02, \( p = .042 \)) was significant. That is, the slopes in the with-adverb
condition were higher than the slope in the baseline without-adverb condition.
These results suggest that the native speakers looked progressively more at the
correct picture object in the with-adverb conditions during the critical region.
Figure 2 shows the time course of fixations to the correct picture objects. A
summary of the results is shown in Table 1.\(^2\)

![Figure 2. Native speakers’ looks to the correct picture objects.](image)

\(^2\) We conducted the same series of analyses for distractors (i.e., sentences with or without
neutral adverbials). Unlike the negative adverbs, there was no interaction effect of adverb
and time (estimate = 1.66, SE = 3.12, \( p = .601 \); estimate = 1.89, SE = 2.51, \( p = .46 \), the
native speakers and the L2 learners, respectively).
Table 1. Analysis of empirical logits to the correct picture object

<table>
<thead>
<tr>
<th></th>
<th>Estimate</th>
<th>SE</th>
<th>t</th>
<th>p</th>
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<tbody>
<tr>
<td><strong>Native speakers</strong></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>(Intercept)</td>
<td>-4.67</td>
<td>0.62</td>
<td>-7.50</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>With adverb</td>
<td>-0.40</td>
<td>1.13</td>
<td>-0.36</td>
<td>.722</td>
</tr>
<tr>
<td>Time</td>
<td>4.88</td>
<td>1.38</td>
<td>3.54</td>
<td>.002</td>
</tr>
<tr>
<td>Adverb × time</td>
<td>4.24</td>
<td>2.02</td>
<td>2.10</td>
<td>.04</td>
</tr>
<tr>
<td><strong>L2 learners</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Intercept)</td>
<td>-3.17</td>
<td>1.96</td>
<td>-1.61</td>
<td>.116</td>
</tr>
<tr>
<td>With adverb</td>
<td>-0.24</td>
<td>0.99</td>
<td>-0.25</td>
<td>.807</td>
</tr>
<tr>
<td>Time</td>
<td>5.82</td>
<td>1.35</td>
<td>1.66</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>Proficiency</td>
<td>-0.03</td>
<td>0.07</td>
<td>-0.46</td>
<td>.649</td>
</tr>
<tr>
<td>Adverb × time</td>
<td>4.80</td>
<td>2.16</td>
<td>2.22</td>
<td>.037</td>
</tr>
</tbody>
</table>

We conducted a separate analysis for L2 learners. The results from the L2 learners are also summarized in Table 1. For the intercept, there was no significant difference between the with-adverb and without-adverb conditions (estimate = −0.24, SE = 0.99, p = .807). At the onset of the critical region, there was no difference in looks between conditions. Also, there was no effect of time (estimate = 5.82, SE = 1.35, p < .001). However, the critical comparison, the interaction of time and condition, demonstrated a significant difference (estimate = −0.03, SE = 0.07, p = .649). These results suggest the facilitative effect of adverbials in L2 processing. The performance of the L2-learner group is plotted in Figure 3.

Figure 3. L2 learners’ looks to the correct picture objects.
5. Discussion

In this study, we have demonstrated that native speakers of Japanese use information provided by adverbials to predict the polarity value of an upcoming predicate during comprehension. The previous conversational analysis studies showed that adverbs facilitate projections in Japanese discourse (Hayashi, 1999, 2003; Tanaka, 2001). Our eye-tracking experiment provides support for their claim. The present study further showed that adverbials play a facilitative role in real-time language comprehension. We have also presented results from L2 learners of Japanese. We found comparable performance across the native speaker group and the L2 learner group; the L2 learners were able to generate predictions for the polarity of the as-yet-unmentioned predicates, based on information encoded on the adverbials.

Importantly, the current results demonstrated that semantic cues offer a different means of anticipation from that of morphosyntactic cues for L2 learners of Japanese. This finding, the L2-learners’ ability to use adverbials for anticipatory processing, presents a striking contrast to the absence of processing facilitation observed in the domain of case-marker-driven processing in L2 Japanese (Mitsugi, 2017; Mitsugi & MacWhinney, 2016). With the current findings, together with our previous two eye-tracking studies, the pattern of results consistent with the shallow structure hypothesis (Clahsen & Felser, 2006), according to which L2 learners have more difficulty with syntactic processing than semantic processing. Then, the critical question is what would make adverbials better cues for L2 learners of Japanese.

The L2 learners’ success in adverbial-driven processing can be attributed to the saliency of the cue. DeKeyser (2005)’s proposal on the opacity of form and meaning may help us explain why L2 learners of Japanese did use the information from adverbs but did not use that from case-marker cues. DeKeyser (2005) argued that, when distinct forms express the same meaning and the same form expresses distinct meanings, it makes establishing the link between form and meaning difficult for L2 learners. The Japanese case system seems to be an instance of such opacity. For instance, the nominative case marker -ga usually marks a noun as the logical subject, but in passive sentences, the nominative-marked noun is a logical object (i.e., a theme or patient) that functions as the grammatical subject.

On the other hand, adverbials tested in the current study immediately and unambiguously coded the polarity of predicates, and therefore, they do not have opaque mapping. In conversational Japanese, however, we observe zenzen used in a positive sense, such as in the expression zenzen ii ‘(it is) completely good.’ Nevertheless, this should not disconnect the form and meaning mapping. The use ofzenzen in positive sense is limited to situations where affirmation is made. Specifically, it is used when there is an assumption of something not being X, but that something actually is X. For instance, you observe that a friend is not sure whether it is okay to push back an appointment with you, and she is
apologetic about it. Then, you assure her that her negative assumption is completely unfounded, by saying zenzen daijobu ‘(it is) completely okay.’ Therefore, the context disambiguates early in the discourse, and there is no competition between the two functions that would result in a dichotomous outcome, like a -ga-marked noun being a logical subject or patient. Our results give rise to a number of issues that warrant further investigation, on the degree of opacity of linguistic cues and the types of language input that encourage form–meaning mappings. We hope that the present study may serve as a starting point for more-detailed and extensive explorations of how L2 speakers of Japanese integrate information encoded in various types of linguistic cues in real-time processing.

References


