No ambiguity about it: Korean learners of Japanese have a clear attachment preference

Mari Miyao and Akira Omaki University of Hawai'i and University of Maryland

1. Introduction

One of the goals of sentence processing research is to understand the properties of the parsing mechanism, which uses various types of linguistic information to comprehend the input. In this context, resolution of syntactic ambiguity has been extensively investigated, as it is instrumental in revealing the nature of parsing strategies and constraints (e.g., Frazier & Clifton, 1996). Locality constraints, for example, favor local integration of incoming words as it consumes fewer memory resources (e.g., Gibson & Pearlmutter, 1998). However, with respect to the relative clause (RC) attachment ambiguity shown in (1), in which the RC can attach to either NP1 (High Attachment, HA; interpretation: "The servant of the actress was on the balcony") or NP2 (Low Attachment, LA; interpretation: "The actress was on the balcony"), it has been found for particular languages that speakers demonstrate a preference for either HA or LA (Cuetos & Mitchell, 1988). The finding of such cross-linguistic differences initiated numerous studies investigating what factors play a role in the variation of RC attachment preferences (for reviews, see Fodor, 2002; Mitchell & Brysbaert, 1998).

High Attachment (HA)

(1) Someone shot $[_{NP1}$ the servant of $[_{NP2}$ the actress]] $[_{RC}$ who was on the balcony].

Low Attachment (LA)

Based on such cross-linguistic variation in RC attachment preferences, second language (L2) researchers have started to investigate how L2 learners (L2ers) resolve this type of ambiguity, in order to address to what extent first language (L1) processing and L2 processing differ. As the transfer of grammatical properties has been robustly attested in L2 acquisition research (e.g., Schwartz, 1998), it is also possible that L2ers transfer their processing strategies used in their L1s to parse L2 sentences. Moreover, it is interesting to see whether L2ers can acquire target-like strategies when they differ from those of their L1s, even though it is often claimed that L2ers fail to become target-like in their grammatical competence (e.g. Hawkins & Chan, 1997). L2 processing studies so far have produced mixed findings on this issue (Dussias, 2003; Felser, Roberts, Marinis, & Gross, 2003; Frenck-Mestre, 1997, 2002).

Furthermore, Papadopoulou and Clahsen (2003; henceforth P&C) found a lack of transfer in L1 processing in their L2ers, even though native speakers of their L1s and those of the target language are reported to show a similar attachment preference. In order to shed further light on this issue, this paper examines RC ambiguity resolution by Korean learners of Japanese, whose L1 (Korean) and L2 (Japanese) are reported to show a similar attachment preference in off-line processing but not in on-line processing. We used (a) an off-line task that is slightly different from the one used in P&C as well as (b) an on-line reading task. Contrary to P&C's findings, the results demonstrate that our L2ers have a very clear HA preference in off-line processing and a LA preference in on-line processing. We argue that the LA preference in the on-line task results from their processing capacity limitation. The paper is organized as follows. In Section 2, we review the findings on RC attachment preferences from L2 processing studies, paying particular attention to the details as well as the potential problems of P&C's study. Section 3 reports the results from our off-line interpretation task and our on-line self-paced reading task, and Section 4 discusses the implications from these results for the course of L2 processing development. Section 5 concludes the paper.

2. L2 research on relative clause attachment

Some L2 processing studies have found evidence that suggests the presence of transfer or learning of processing strategies. Dussias (2003) tested advanced English-Spanish and Spanish-English L2ers living in the US, and she found that in off-line processing both groups showed an LA preference in their L2, although they showed no clear preference in on-line processing.¹ For the English-Spanish speakers, L1 influence can account for the findings, but the LA preference in the Spanish-English group cannot come from their L1, since Spanish speakers generally prefer HA. This could indicate that these Spanish-English L2ers have acquired target-like processing strategies.² Moreover, Frenck-Mestre (1997, 2002) found clear RC attachment preferences using eye-tracking measures. She tested low-proficient English-French L2ers, high-proficient English-French L2ers, and low-proficient Spanish-French speakers, and found evidence for transfer and learning in French RC attachment. The low-proficient English speakers exhibited a trend for an LA preference, while the Spanish speakers clearly prefered HA. Furthermore, the high-proficient English-French L2 group showed an HA preference, just like the French native speakers did.

On the other hand, some studies found no support for either L1 transfer or L2 learning of strategies. Felser et al. (2003) tested two groups of advanced L2ers of English, whose L1 (Greek or German) is reported to show an HA preference.³ Their L2 group results showed no clear attachment preference in the off-line and on-line experiments, whereas the native speaker controls showed an LA preference in on-line processing. Felser et al. interpreted this to mean that there was no L1 transfer.⁴ Papadopoulou and Clahsen (2003) investigated RC attachment preferences in advanced Spanish, German, and Russian learners of Greek and Greek native speakers, using an off-line acceptability judgment task and an on-line self-paced reading task. Since native speakers of all these four languages have been found to prefer HA in previous studies, a clear HA preference would be predicted when processing in L2 Greek, due to either the transfer of L1 processing strategies or the acquisition of target-like strategies (but see footnote 3). However, their results turned out not to support either possibility: Their L2ers did not show any clear attachment preference.

If P&C's findings are correct, it raises a question as to why there is neither L1 transfer nor L2 learning of processing strategies. As some researchers have suggested that L2ers cannot acquire certain properties of target language grammar (e.g., Hawkins & Chan, 1997), it may be the case that L2ers are not able to learn the target-language processing strategies either. However, there seems to be no a priori reason for assuming that the learners cannot transfer the processing strategies from their L1 when processing L2 input. In this sense, P&C's

¹ Off-line tasks are used to elicit an outcome of parsing (e.g., interpretation) after the whole sentence is processed, whereas on-line tasks are used to examine the time course of parsing during processing.

 $^{^{2}}$ See Dussias (2003) for detailed discussions on alternative interpretations of the data.

³ As evidence for an HA preference in German, Felser et al. and P&C cited Hemforth, Konieczny, and Scheepers (2000) who examined RC attachment to NPs with genitive case markers, but Augurzky, Alter, and Pechmann (2004) found an LA preference in German using NPs with genitive prepositions, which are the equivalent of constructions used in other languages such as English. This finding casts doubt on their predictions regarding L1 transfer.

⁴ As the authors themselves discuss, these results do not necessarily show that L1 transfer never occurred. Given that their participants were quite advanced in their L2, they may have simply passed the L1 transfer phase.

findings appear to constitute strong evidence against L1 transfer of processing strategies, but they also raise rather peculiar problems. First, given the robust empirical evidence for L1 transfer in L2 grammar development (e.g., Schwartz, 1998), one needs to account for why the transfer occurs only in the grammar component but not in the processing component of the language system. Given that the processing system needs to draw on grammatical knowledge in parsing, it is rather strange if these two components are dissociated in such a way that one is transferred and the other is not. Second, P&C's findings are incompatible with Frenck-Mestre's (1997, 2002) findings, since her low-proficient Spanish-French L2ers showed a clear HA preference, just like native speakers of French or Spanish.

On the other hand, it is also possible that there were some methodological problems in P&C's study and that their findings are an experimental artifact. With respect to the off-line acceptability judgment task, for example, it is certainly not clear that the task truly reflects the initial attachment preference. The participants read fully grammatical sentences that were disambiguated to either HA or LA by gender agreement between one of the preceding NPs and the embedded verb. P&C assumed that participants' judgments of acceptability should reflect their 'initial' analysis of the sentences according to the following logic: In the LA condition, the readers would need to reanalyze their initial HA analysis due to incorrect gender agreement at the verb region in the RC; but because reanalysis is costly, participants may not reanalyze their initial parse and hence rate the sentence as less acceptable. However, the problem is that the off-line tasks allow participants to parse and revise their analysis rather easily because there is no time limit. It seems natural to say that once the reanalysis happens, the participants' attachment preferences are no longer reflected in the scores of acceptability since the scores for equally grammatical sentences in the forced HA condition and the forced LA condition should not differ from each other. Therefore, there appears to be a conceptual advantage to an off-line experimental task that is likely to preserve participants' initial attachment preferences.

With respect to the on-line experiment, when analyzing the L2ers' reading time (RT) data, P&C first collapsed their three L2 groups into one, as they found no significant difference in mean RTs between the three separate groups. However, the null difference between the three groups does not justify treating the separate L1 groups as the same population; the null findings may simply be due to the small sample sizes, rather than the qualitative similarity in their reading behavior. Moreover, given that RC attachment is affected by various factors across languages such as the distribution of genitive constructions (Frazier & Clifton, 1996) or default prosody (Fodor, 2002), treating participants with different L1 backgrounds as one group may introduce many uncontrolled language-specific factors that could influence RC attachment preferences of the group in various ways (e.g., an HA preference in one language group and an LA preference in the other may cancel each other out, leading to no result). For these reasons, it seems possible that P&C's interpretation of the RT data may have been rather distorted. Given these potential methodological flaws, more empirical findings are needed to examine whether L1 transfer or L2 learning really exists in L2 processing development.

In order to address this issue, the present study tested off-line and on-line RC attachment preferences in Korean-Japanese L2ers with an improved methodology (see Section 3 for details). We chose to investigate Korean-Japanese L2ers, since they are ideal for testing for the presence or absence of L1 transfer and for the L2 learning of processing strategies. Previous studies have shown that in off-line processing Japanese and Korean native speakers both show an HA preference, but that in on-line processing, Japanese speakers prefer LA (Kamide & Mitchell, 1997; Miyamoto, Nakamura, & Takahashi, 2004) and Korean speakers prefer HA (Lee & Kweon, 2004). If the L2ers show an HA preference in off-line processing, it is not clear whether it is due to L1 transfer or L2 learning; but if they also prefer HA in on-line processing, then it seems natural to conclude that they transferred their L1 attachment preferences in both off-line and on-line processing. On the other hand, if they show an HA preference in off-line processing and an LA preference in on-line processing, then this would constitute evidence for L2 learning of target processing strategies.

3. Present study

3.1 Experiment 1 – Off-line interpretation task

Experiment 1 was conducted to examine whether Korean L2ers of Japanese would show a clear HA preference as Japanese native speakers do in off-line processing, using an off-line interpretation task. In this task, participants read globally ambiguous sentences with RC attachment ambiguity and indicated which of the two attachment sites they interpreted to be modified by the RC. This task appears to be more likely to elicit their attachment preferences than P&C's acceptability judgment task, in that our experimental stimuli all allow both HA and LA interpretations and do not force participants to reanalyze their initial analysis.⁵

3.1.1 Participants

Fifteen intermediate to advanced Korean-Japanese L2ers and 17 Japanese native speakers participated in this study. At the time of the experiment, three Korean learners and nine Japanese native speakers were in Hawai'i, and the remaining participants were in Japan.

3.1.2 Materials

The off-line questionnaire consisted of 12 experimental sentences and 24 fillers. We used Kamide & Mitchell's (1997) experimental sentences, exemplified in (2), which were all well formed and globally ambiguous:



"Someone shot the servant of the actress who was on the balcony."

Since Japanese as well as Korean has a head-final RC, the RC precedes the two attachment sites (NP2 and NP1), as in (2). In order to help the L2ers read the Chinese characters, furigana (phonetic transcription in hiragana) was added above each character to show how it is read in Japanese. A comprehension question followed each sentence (e.g., *Dare-ga barukonii-ni imasita-ka?* "Who was on the balcony?") so as to examine their interpretation, and they were asked to answer the questions by choosing one of the two options (e.g., 1. *joyuu* "actress" and 2. *mesitukai* "servant").

Eight of the 24 fillers were unambiguous sentences with a subject RC (e.g., *Ryota-ga Rika-o nagamete ita Ken-ni denwasita* "Ryota called Ken who was gazing at Rika"). The purpose of these fillers was to test whether participants have problems in parsing the Japanese RCs themselves and to ensure that the data from the experimental sentences are not affected by their incapability of parsing RCs. One point was given to each

⁵ Felser et al. (2003) tested German and Greek learners of English on similar RC sentences using an off-line interpretation task and an on-line self-paced reading task. They analyzed the data from the two L2 learner groups separately, but found that their L2ers did not show clear attachment preferences. As the authors themselves note, however, this could indicate that those L2ers are in the process of shifting their preference from their HA (transferred from their L1s) to LA (target-like preference).

correct answer on the fillers, and the cut-off point was set at six out of the eight points. Only data from the participants who had six or more points were included in the data analysis.

The interpretation task was followed by a short multiple-choice cloze test to assess participants' current proficiency in Japanese. The test consisted of 30 items, and was taken from the textbook for Japanese Language Proficiency Test Level 2, which is generally considered an intermediate level (Matsumoto, Ichikawa, Kinugawa, Ishizaki, & Setoguchi, 2001).

3.1.3 Predictions

The No Transfer/No Learning Hypothesis put forth in P&C predicts that our Korean-Japanese L2ers would show no clear HA preference and choose HA responses at a chance level, whereas the Transfer/Learning Hypothesis predicts that they would show a clear HA preference and hence choose HA responses at above-chance level.

3.1.4 Results

All participants chose the correct answers for six or more out of the eight unambiguous filler sentences with RCs and therefore no data were excluded. All participants, including Japanese native speakers, took the proficiency test, and the mean test scores were 22.87 (SD = 4.81, range = 15-29) for Korean L2ers and 28.00 (SD = 1.46, range = 25-30) for Japanese native speakers. We consider these L2ers as intermediate to advanced learners of Japanese, using the following two criteria: (a) those who scored within native-speaker range are advanced, and (b) those who scored around 50% are intermediate, since the Japanese Language Proficiency Test level 2 was designed to assess intermediate-level Japanese and therefore scores of this range seem to be a representative sample for this level.

The mean HA responses in the experimental sentences were 88.73% (SD = 15.01) for Japanese native speakers and 84.44% (SD = 18.60) for Korean L2ers. A one-sample t-test shows that the HA responses were significantly different from chance (i.e., 50%) in both groups (for Japanese, t (1, 16) = 10.64, p < .001; for Korean L2ers, t (1, 14) = 7.17, p < .001), indicating that both Japanese native speakers and the Korean L2ers of Japanese have a clear HA preference in off-line processing.

3.2 Experiment 2 – On-line self-paced reading task

Experiment 2 was an on-line self-paced reading task, and we attempted to examine whether Korean-Japanese L2ers show an HA preference not only in the off-line task but also in an on-line processing task, since on-line techniques can reveal the time course of parsing and are hence better measures of initial attachment preferences. Previous on-line studies on L1 Japanese and Korean RC attachment have shown that these two languages may differ in their on-line RC attachment preference, i.e., Japanese speakers prefer LA (Kamide & Mitchell, 1997; Miyamoto et al., 2004), while Korean speakers prefer HA (Lee & Kweon, 2004). Since these findings set up a nice design for investigating the development of the L2 processing mechanism, we investigate whether Korean L2ers (a) transfer their HA preference, (b) acquire the target-like LA preference, or (c) show no clear attachment preference (as in P&C's findings).

3.2.1 Participants

Fourteen Korean-Japanese L2ers and 18 Japanese native speakers participated in Experiment 2.⁶ The mean proficiency score of the L2ers was 19.79 (SD = 7.0, range = 11-29). They are considered intermediate to advanced learners according to the criteria stated in Section 3.1.4. All Korean L2ers and 12 Japanese native speakers were in Hawai'i and the remaining six native speakers were in Japan at the time of the experiment.

3.2.2 Materials

We constructed 16 experimental sentences with (pragmatically) forced HA and LA conditions, following the design of the stimuli used in Kamide & Mitchell (1997). The experimental sentences were divided into four regions as shown in Table 1.

e		U		
Region 1	Region 2	Reg	ion 3	Region 4
(RC)	(Attachment sites: critical region)	(Adv	verb)	(Main Verb)
Forced HA condition				
Kaban-ni haitteita	/ [[tomodati-no (NP2)] kagi-ga (NP1)]	/ totu	zen /	nakunatta.
Bag-Loc was	friend-Gen key-Nom	sude	lenly	disappeared
"The key of the friend	which was in the bag suddenly disappeared."			
Forced LA condition				
Isoide hasitteita	/ [[tomodati-no (NP2)] kagi-ga (NP1)]	/ totu	zen /	nakunatta.
Hastily was running	friend-Gen key-Nom	sudo	lenly	disappeared
"The key of the friend	who was hastily running suddenly disappeared	d."		

Table 1. Regions used in the self-paced reading task (slashes indicate the region boundaries)

The first region consisted of an RC with a gap in subject position. The second region consisted of a complex NP with two attachment sites (e.g., NP2 *tomodati-no*; NP1 *tomodati-no kagi-o*).⁷ The third region consisted of an adverb, and the fourth the main verb. Regions 2 to 4 are identical in each HA-LA pair across experimental stimuli, but the RC region in HA and LA conditions was manipulated so as to only (reasonably) modify either NP1 or NP2, respectively. For example, in the forced HA condition, the RC *Kaban-ni haitteita* ("was in the bag") modifies only NP1 since it is implausible for NP2 *tomodati* ("friend") to be in the bag. In the forced LA condition, on the other hand, the RC can only modify NP2 since the inanimate *tomodati-no kagi* ("friend's key") cannot run. This plausibility manipulation allows us to observe the RC attachment preferences in Region 2, where the initial attachment may lead to semantic implausibility. If participants have an HA preference, then the reading time (RT) at the critical region (Region 2) should be significantly faster in the HA condition than in the LA condition their preferred HA analysis would induce semantic implausibility and require a subsequent reanalysis that increases the RT, whereas in the HA condition there is no need for

⁶ Three of the L2ers and five of the native speakers had participated in Experiment 1, and their on-line data were collected a few months after Experiment 1. The remaining 11 L2ers in Experiment 2 also took the same off-line test used in Experiment 1 after the on-line self-paced reading task, so that on-line reading time data would not be affected by familiarity with the RC attachment constructions.

⁷ Kamide & Mitchell (1997) divided Region 2 into two regions and presented the first and second nominals separately. In this case, the apparent LA preference may simply be due to the fact that the readers could not access the second nominal as a potential attachment site. However, Miyamoto et al. (2004) used the same stimuli but presented the two NPs together (as in our current study), and still found a clear LA preference in the RT data, suggesting that the "preview" of the second nominal did not change the initial attachment preference.

revision and therefore no such RT delay. Region 3 is also of a potential interest, since a spill-over effect may be observed here.⁸

We used as few Chinese characters as possible since (a) L2ers may not recognize some of them and (b) the kanji recognition trouble may inflate RTs, making it difficult to infer initial attachment preferences from the RT data. The list of experimental stimuli constructed for Experiment 2 will be available at http://www.ling.umd.edu/~omaki/papers.html. The experimental sentences were distributed across two lists based on a Latin Square design, such that each participant saw only one version of each experimental sentence (i.e., each participant saw eight HA and eight LA experimental items). In each list, the experimental items were combined with 48 fillers of various constructions, and the stimuli were presented in a pseudo-randomized order.

3.2.3 Procedure

A non-cumulative, phrase-by-phrase, moving-window self-paced reading technique was used (Just, Carpenter, & Woolley, 1982). The experiment was conducted on a Windows computer running the Linger software developed at MIT (http://tedlab.mit.edu/~dr/Linger/), and sentences were presented on a 12" screen in black letters on a white background. All sentences were divided into four to six regions, and each region initially appeared in a serious of dashes. As participants pressed the space bar, the dashes were replaced by the actual words, region by region from left to right, and the words went back to dashes as soon as the readers move on to the subsequent region. After each sentence, a comprehension question (e.g., *Tomodati-no kagi-wa mitukarimasita-ka* "Was the key of the friend found"?) was presented, and comprehension accuracy was used to check whether the participants were paying attention to the task.

3.2.4 Predictions

Assuming that the previous findings regarding on-line RC attachment preferences in L1 Japanese and L1 Korean hold true (viz., Japanese prefer LA and Koreans prefer HA) hold true, the Transfer Hypothesis predicts that the Korean L2ers of Japanese would show a clear HA preference, i.e., that the critical region of the HA condition will produce a significantly shorter RT than that of the LA condition, whereas the Learning Hypothesis predicts that the L2ers would show a clear LA preference, i.e., that the critical region of the LA condition will produce a significantly shorter RT than that of the HA condition. The No Transfer/Learning Hypothesis predicts that the L2ers would show no clear HA or LA preference, i.e., no significant difference in RTs between the two conditions, as P&C found in their self-paced reading experiment.

3.2.5 Results

The comprehension accuracy was 96.06% (SD = 5.15) for Japanese native speakers and 94.79% (SD = 4.88) for Korean L2ers in the experimental sentences, and 92.82% (SD = 4.30) for Japanese native speakers and 89.57% (SD = 8.85) for Korean L2ers in the filler sentences. This indicates that participants paid attention to the task fairly well. The RT data from the two groups are summarized in Figures 1 and 2, and the region where we observed a main effect is highlighted with a circle.

⁸ In reading time studies, the main effect of the condition can sometimes 'spill over' to the following region, as the processing difficulty may not be immediately reflected in the reading behavior.



Figure 1. Reading time data of the Japanese native speakers.

Figure 2. Reading time data of the Korean L2ers.



In the Japanese RT data, no main effect of attachment condition was observed in Regions 1, 3 and 4 (for Region 1, F_1 (1, 17) and F_2 (1, 15) < 1; for Region 3, F_1 (1, 17) = 1.84, MS = 80987.67, p > .1, and F_2 (1, 15) = 2.70, MS = 72094.48, p > .1; for Region 4, F_1 (1, 17) and F_2 (1, 15) < 1), which is not surprising since no effect of the factor manipulation was expected to influence RTs in these regions. In Region 2, where the attachment preference was expected to affect the RT, the mean RT in the HA condition was significantly shorter than the RT in the LA condition by participant analysis (F_1 (1, 17) = 6.53, MS = 807564.33, p < .05), but the difference was marginally significant by item analysis (F_2 (1, 15) = 3.261, MS = 717834.96, p = .091). The marginal significance in the item analysis may suggest that the main effect of condition observed by participant analysis is possibly an experimental artifact, but it may also be due to the relatively small number of items used. Therefore, it seems reasonable to interpret the results to mean that the Japanese native speakers showed an HA preference in on-line processing.

In the Korean L2ers' RT data, no main effect of attachment was observed in Regions 1 and 4 (for Region 1, $F_1(1, 13) = 4.41$, MS = 1396708.06, p > .05, and $F_2(1, 15) = 1.32$, MS = 1596237.78, p > .1; for Region 4, $F_1(1, 13) = 1.34$, MS = 281527.07, p > .1, and $F_2(1, 15) = 1.24$, MS = 321745.23, p > .1), as in the Japanese speaker data. In Region 2, where the attachment preference was expected to affect the RT, the mean RT was numerically shorter in the HA condition than in the LA condition (3516.73ms vs. 4106.29ms) but no main effect of condition was observed ($F_1(1, 13) = 2.50$, MS = 2433013.90, p > .1, and $F_2(1, 15) = 3.87$, MS = 2780587.31, p > .05). However, in the following Region 3, the LA condition produced a significantly faster RT than did the HA condition by both participant and item analyses ($F_1(1, 13) = 7.17$, MS = 406115.25, p < .05, and $F_2(1, 15) = 5.39$, MS = 464131.72, p < .05), presumably due to a spill-over effect from Region 2.

In sum, the results show that the Korean L2ers and the Japanese natives have clear but distinct attachment preferences: the RT advantage for the HA condition observed for the Japanese speakers suggests they have an HA preference, while the RT advantage for the LA condition observed for the Japanese-Korean L2ers suggests they have an LA preference. We next discuss the implications of these results.

4. General discussion

Let us first summarize the findings from the two experiments. Experiment 1 tested the off-line RC attachment preference of Japanese native speakers and Korean L2ers of Japanese by using an off-line interpretation task. The off-line data showed that both Japanese natives and Korean L2ers had a clear HA preference. Experiment 2 examined the on-line RC attachment preference in the two groups using a self-paced reading task. The results showed, however, that (a) the Japanese natives have an HA preference, contrary to previous L1 Japanese on-line processing studies which found an LA preference, and (b) the Korean-Japanese L2ers have an LA preference, contrary to their HA preference observed in Experiment 1.

The combined results of Kamide and Mitchell (1997) and our Experiment 1 indicate that Japanese speakers consistently show an HA preference in off-line processing. Given Lee and Kweon's (2004) findings that Korean native speakers also preferred HA in off-line processing, the fact that our L2ers had a clear HA preference supports the hypothesis that the L2ers either transferred their L1 processing strategy and did not change it, or started out without L1 transfer but learned and used the target-like strategy that results in the HA preference. These results therefore do not support the predictions of the No Transfer/No Learning Hypothesis derived from P&C's study, namely, that L2ers would show neither L1 transfer nor L2 learning of processing strategies. Our off-line findings also suggest that the acceptability judgment task used in P&C's study was probably not the best way to tap into the L2ers' RC attachment preference.

On the other hand, the results of the on-line experiment were rather complicated; first of all, unlike Kamide and Mitchell (1997) and Miyamoto et al. (2004), our Japanese native speakers showed a clear HA preference in on-line processing. It is not clear why our Japanese natives behaved differently, especially since we followed the overall material designs used in the previous studies. One possible explanation is to take the relatively long RTs seriously and argue that what we actually observed in the RT data was already a reflection of off-line processing, as we have independent evidence for an HA preference in off-line processing. Another possible explanation is that the stimuli used in the previous studies were somehow artificially biasing an LA preference. After all, it has been quite mysterious why the previous studies observed an asymmetry between on-line and off-line preferences, the presence of which suggests, strangely, that Japanese speakers somehow prefer to reanalyze their initial LA analysis to an HA analysis in the off-line stage, even though reanalyses are generally costly. The present findings that Japanese natives have the same preference in on-line and off-line processing appear rather natural in this sense. Also, the fact that speakers of the typologically related Korean also have an HA preference in on-line processing renders our findings more likely to be valid. Nevertheless, we need further empirical research to identify what exactly caused the difference between the previous findings and the present findings. For the sake of discussion with respect to the L2ers' data, however, let us assume now that Japanese speakers do indeed have an HA preference in on-line processing.

Given the on-line HA preference observed for the Japanese native speakers, the LA preference observed for our intermediate to advanced Korean-Japanese L2ers now seems incompatible with either L1 transfer or L2 learning of the target-like processing strategy. However, it is not obvious why the L2ers ever 'learned' to prefer LA in on-line processing, since it is in neither their L1 nor their target language. We argue, following the suggestion in Dussias (2003), that our Korean-Japanese L2ers showed an LA preference since (a) local integration is computationally less costly, and (b) the developing L2 parser is not very efficient yet and therefore chooses parsing strategies that minimize the processing burden. However, in the off-line processing stage, L2ers can re-parse the sentences without time pressure, thereby allowing their interpretation to be influenced by L1 transfer or L2 learning of target-like processing strategies. What is important is to minimize the burden during on-line processing.

One problem with this interpretation is that it seems to contradict Frenck-Mestre's (1997, 2002) L2 on-line findings that the low-proficient Spanish-French L2ers (both Spanish and French are HA-preference languages) showed an HA preference (i.e., L1 transfer) and high-proficient English-French L2ers (English is an LA-preference language) showed an HA preference (i.e., L2 learning). If it is true that L2ers have to minimize the burden, then at least the low-proficient learners should have demonstrated an LA preference. One way to reconcile these divergent results is to hypothesize that L2 grammar and processing development, grossly speaking, consists of L1 transfer phase, intermediate phase, and target-like phase, as illustrated in Table 2.⁹

	Stage 1 L1 transfer phase	Stage 2 Intermediate phase	→ Stage 3 Target-like phase			
Grammar	Full L1 transfer	Developing L2 grammar (non-target like, include L1 properties)	Target-like grammar			
Processing	Full L1 transfer	Developing L2 parser (not efficient, minimize cost)	Target-like parser			
	Low-proficient	Intermediate to advanced	High-proficient			
Example:	Spanish-French L2ers	Korean-Japanese L2ers	English-French L2ers			
RC attachment	prefer HA	prefer LA	prefer HA			
	(Frenck-Mestre, 1997)	(present study)	(Frenck-Mestre, 2002)			

Table 2. Three developmental stages in L2 processing development

In the L1 transfer phase, L2ers completely transfer their grammar and their parser (Full Transfer; Schwartz, 1998), and therefore the parsing is rather efficient and expected to show all properties of their L1 processing system. This would explain why the low-proficient Spanish-French L2ers in Frenck-Mestre (1997) preferred HA, according to their L1 (Spanish) processing strategies. In the Intermediate phase, however, the L2ers develop their L2 grammar and parsing system which derives from their L1 systems. These developing L2 linguistic systems are nevertheless 'incomplete' in a sense: the L2 grammar would still contain properties transferred from their L1 grammar and the L2 parser would likewise contain strategies transferred from their L1 moreover, is not very efficient yet. At this stage, the parser, due to its inefficiency, is mainly concerned with minimizing the processing burden during on-line processing. This would

⁹ We put aside the null findings in previous L2 on-line experiments (e.g., Dussias, 2003; Felser et al., 2003; Papadopoulou & Clahsen, 2003), since it is impossible to identify what caused the null results.

account for why the L2ers in the present study showed an LA preference, which is neither in their L1 nor in the target language but, as the result of a locality constraint, is the manifestation of a more economical processing strategy observed across natural languages. In the target-like phase, L2ers possess a (roughly) target-like grammar and a (roughly) target-like parser. This explains why the high-proficient English-French L2ers in Frenck-Mestre (2002) showed an HA preference.

Obviously, this is merely a speculation, and we need carefully controlled cross-sectional or longitudinal studies to investigate the course of L2 processing development, keeping constant other factors that may influence RC attachment preferences (e.g., L1 background). However, the idea that processing capacity limitations affect L2ers' linguistics and parsing behavior is becoming more and more prominent (e.g., Pienemann, 1998; Schulz, to appear), and it seems promising to investigate to what extent processing capacity can affect RC attachment preferences (see Juffs, 2005; Omaki, 2005, for attempts in this direction).

5. Conclusion

We tested the resolution of RC attachment ambiguity in Korean L2ers of Japanese and Japanese native speakers by way of two experiments. Our results from the off-line sentence interpretation task showed that both Korean L2ers and Japanese natives prefer HA, contrary to the findings in Papadopoulou and Clahsen (2003). The on-line self-paced reading task showed that Japanese natives preferred HA while Korean-Japanese L2ers preferred LA. Comparing our on-line findings with Frenck-Mestre's (1997, 2002), we argued that (a) there may be three different stages of L2 processing development (i.e., L1 transfer phase, intermediate phase (with many substages), and target-like phase), and (b) that our L2ers are in a substage of the intermediate phase, where the developing (and inefficient) L2 parser resorts to parsing strategies that minimize processing burden (i.e., locality, resulting in LA). We suggest that in order to further our understanding of L2ers' RC attachment preferences, future research should focus on cross-sectional or longitudinal designs that keep all the factors but proficiency level constant.

Acknowledgments

We are indebted to Bonnie D. Schwartz for her insightful comments and advice on our study. Thanks also go to Colin Phillips and the audience at BUCLD 30, Harald Clahsen in particular, for their helpful comments. We also thank Yuki Kamide for providing us with the stimuli used in her study, as well as the participants in Hawai'i and Japan for their cooperation. We owe thanks to Priti Sandhu and Tim Hunter for their editorial assistance. This research was supported by a Paula Menyuk Student Travel Award to the first author, for which we are grateful.

References

- Augurzky, P., Alter, K., & Pechmann, T. (2004). Prosodic principles guide parsing preferences while reading: An ERP investigation of relative clause attachment. Poster presented at the 17th Annual CUNY Conference on Sentence Processing, College Park, MD.
- Cuetos, F., & Mitchell, D. C. (1988). Cross-linguistic differences in parsing: Restrictions on the use of the Late Closure strategy in Spanish. *Cognition*, *30*, 73-105.
- Dussias, P. E. (2003). Syntactic ambiguity resolution in L2 learners: Some effects of bilinguality on L1 and L2 processing strategies. *Studies in Second Language Acquisition*, *25*, 529-557.

- Felser, C., Roberts, L., Marinis, T., & Gross, R. (2003). The processing of ambiguous sentences by first and second language learners of English. *Applied Psycholinguistics*, 24, 453-489.
- Fodor, J. D. (2002). Prosodic disambiguation in silent reading. In M. Hirotani (Ed.), *NELS 32* (pp. 113-132). Amherst, MA: GLSA Publications.
- Frazier, L., & Clifton, C. (1996). Construal. Cambridge, MA: MIT Press.
- Frenck-Mestre, C. (1997). Examining second language reading: An on-line look. In A. Sorace, C. Heycock, & R. Shillcok (Eds.), *Proceedings of the GALA 1997 Conference on Language Acquisition* (pp. 474-478). Edinburgh: Human Communications Research Center.
- Frenck-Mestre, C. (2002). An on-line look at sentence processing in the second language. In R. R. Heredia & J. Altarriba (Eds.), *Bilingual sentence processing* (pp. 217-236). New York: Elsevier.
- Gibson, E., & Pearlmutter, N. (1998). Constraints on sentence comprehension. *Trends in Cognitive Sciences, 2,* 262-268.
- Hawkins, R., & Chan, C. (1997). The partial availability of Universal Grammar in second language acquisition: The "failed functional features hypothesis." *Second Language Research*, *13*, 187-226.
- Hemforth, B., Konieczny, L., & Scheepers, C. (2000). Syntactic attachment and anaphor resolution: Two sides of relative clause attachment. In M. Crocker, M. J. Pickering, & C. Clifton (Eds.), Architectures and mechanisms for language processing (pp. 259-282). Cambridge: Cambridge University Press.
- Juffs, A. (2005). The influence of first language on the processing of *wh*-movement in English as a second language. *Second Language Research*, 21, 121-151.
- Just, M. A., Carpenter, P. A., & Woolley, J. D. (1982). Paradigms and processes and in reading comprehension. *Journal of Experimental Psychology: General, 3,* 228-238.
- Kamide, Y., & Mitchell, D. C. (1997). Relative clause attachment: Nondeterminism in Japanese parsing. Journal of Psycholinguistic Research, 26, 247-254.
- Lee, D., & Kweon, S. (2004). A sentence processing study of relative clauses in Korean with two attachment sites. *Discourse and Cognition*, 11, 126-141.
- Matsumoto, T., Ichikawa, A., Kinugawa, T., Ishizaki, A., & Setoguchi, A. (2001). *Nihongo nouryoku shiken* 2kyuu juken mondaisyu (Practice questions for the Japanese Language Proficiency Test level 2). Tokyo: Alc.
- Mitchell, D. C., & Brysbaert, M. (1998). Challenges to recent theories of language differences in parsing: Evidence from Dutch. In D. Hillert (Ed.), Sentence processing: A crosslinguistic perspective (pp. 313-335). San Diego, CA: Academic Press.
- Miyamoto, E. T., Nakamura, M., & Takahashi, S. (2004). Processing of relative clauses in Japanese with two attachment sites. In K. Moulton & M. Wolf (Eds.), *Proceedings of NELS 34* (pp. 441-452). Amherst, MA: GLSA Publications.
- Omaki, A. (2005). Working memory and relative clause attachment in first and second language processing. Unpublished MA thesis, University of Hawai'i.
- Papadopoulou, D., & Clahsen, H. (2003). Parsing strategies in L1 and L2 sentence processing: A study of relative clause attachment in Greek. *Studies in Second Language Acquisition, 25*, 501-528.
- Pienemann, M. (1998). Language processing and second language development: Processability theory. Amsterdam: John Benjamins.
- Schulz, B. (to appear). Wh-scope marking in German-English and Japanese-English interlanguage grammars: An investigation of clustering syntactic properties. In K. U. Deen, J. Nomura, B. Schulz, & B. D. Schwartz (Eds.), Proceedings of the Inaugural Conference on Generative Approaches to Language Acquisition - North America, Cambridge, MA: MIT Press.
- Schwartz, B. D. (1998). The second language instinct. Lingua, 106, 133-160.