L2 Learners' Processing of PP Attachment Ambiguities–A Production Study

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1. Introduction[1]

While some recent studies have investigated second language (L2) learners' syntactic processing by using various types of off-line and on-line methods (see Juffs, 2001; Marinis, 2003; Papadopoulou, 2005 for recent reviews), comparatively little is known about the mechanisms that underlie learners' real-time sentence comprehension and production. There are different accounts of whether and to what extent L2 processing might differ from first language (L1) processing. First, it is possible that learners are influenced by transfer from their L1 to their L2. Second, learners might employ essentially the same processing mechanisms as native speakers. Under this second account, it is still possible that learners show non native-like processing because of cognitive resource limitations. Third, it is conceivable that L2 processing differs more fundamentally from L1 processing. One such possibility for L2-specific processing could entail that learners rely more heavily on lexical and semantic cues than native speakers while at the same time under-using deep structural information (Clahsen & Felser, 2006). It is also possible that learners rely more heavily than native speakers on a principle to attach incoming material to the most recently encountered element of the sentence.[2]

Previous studies investigating L2 sentence processing have mainly tested immersed and highly proficient L2 learners, with heterogeneous results. Many of these studies have found native-like processing in the L2 learners, although the learners were slower than native speakers and they found it more difficult to recover from initial misanalyses (Felser & Roberts, 2007; Juffs, 1998, 2004; Juffs & Harrington, 1996). The issue of L1 transfer by L2 learners has been mostly investigated on relative clause attachment ambiguities such as *Someone shot the servant of the actress who was on the balcony*, for which cross-linguistic processing differences have been reported (e.g., Cuetos, Mitchell, & Corley, 1996 for an overview). Studies with learners from different L1 backgrounds and at different proficiency levels reported by Dussias (2003), Dussias and Sagarra (2007), Frenck-Mestre (2002), and Rah and Adone (2008) found that learners seem to transfer attachment preferences from their L1 to their L2 and that these effects decrease with increasing proficiency. Other studies found more fundamental L1-L2 differences in that learners were not influenced by deep syntactic structure (e.g., Clahsen & Felser, 2006; Felser & Roberts, 2007; Hahne & Friederici, 2001; Marinis; Roberts, Felser, & Clahsen, 2005).

[2] Such a principle has also been proposed for L1 processing, for example as Late Closure (Frazier, 1987) or Recency (Gibson & Pearlmutter, 1998).

Considering these heterogeneous findings, further research on various syntactic constructions using different experimental methods is necessary in this domain in order to obtain a clearer picture of the actual mechanisms that underlie L2 processing. Moreover, the studies introduced so far all concentrate on comprehension. While it is possible that similar mechanisms apply for production, this prediction still requires empirical support. Moreover, few processing studies have addressed the role of proficiency effects. These studies have mainly focused on comparing balanced with unbalanced bilinguals (Fernández, 2003), early learners with late learners (Abutalebi, Cappa, & Perani, 2001; Pallier, 2007; Rossi, Gugler, Friederici, & Hahne, 2006) or different L1 groups (Felser, Roberts, Marinis, & Groß, 2003; Juffs, 1998, 2006; Williams, Möbius, & Kim, 2001). Only a few previous studies have compared unbalanced bilinguals at different proficiency levels (Frenck-Mestre, 2002; Hopp, 2007; Wartenburger et al., 2003). The present study addresses this issue by testing the production of the PP attachment ambiguity with two groups of non-immersed German learners of English as a second language (ESL) at different proficiency levels. This line of research can provide interesting insights not only into how L2 processing works but also how it develops with increasing proficiency.

The paper is organized as follows. The second section presents previous research on L1 and L2 processing of the PP attachment ambiguity. The third section presents the methodology and the results of the present study. The fourth section then discusses these results and their possible implications for L2 processing theories.

2. L1 and L2 processing of PP attachment ambiguities

The preposition phrase (PP) attachment ambiguity can be illustrated by the following example:

(1) The man saw the boy with the binoculars.

The sentence is ambiguous because the prepositional phrase "with the binoculars" could either be attached as an adjunct to the verb phrase (VP) "saw" or to the second determiner phrase (DP) "the boy." Processing studies with monolinguals have generally reported a VP attachment preference (e.g., Altmann & Steedman, 1988; Clifton, Speer & Abney, 1991; Ferreira & Clifton, 1986; Frazier & Rayner, 1982 for English; Hemforth, Konieczny, Scheepers, & Strube, 1992 for German; Frenck-Mestre & Pynte, 1997 for French; Katsika, 2008 for Greek), even in cases where attachment to the DP is pragmatically more acceptable (Rayner, Carlson, & Frazier, 1983). These results are in line with processing models that assume specific processing principles based on phrase-structure information (Frazier, 1987, 1990; Rayner et al., 1983). According to these principle based models, DP attachment of the PP would be more costly, in that it requires more nodes in the syntactic tree structure than VP attachment. However, other studies have found that non-syntactic factors can also influence PP attachment preferences. This is in line with interactionist processing models, which assume that lexical, syntactic and pragmatic cues are considered in parallel during sentence processing (e.g., MacDonald, Pearlmutter, & Seidenberg, 1994; Trueswell, Tanenhaus, & Garnsey, 1994). For example, a DP attachment preference was induced by manipulating the semantics (Taraban & McClelland, 1988), the referential context (Altmann & Steedman, 1988) or the preposition introducing the critical DP (Katsika, 2008). Moreover, manipulating the argument versus adjunct status of the PPs (e.g., Boland 1997; Boland & Boehm-Jernigan, 1998; Britt, 1994; Garnsey, Pearlmutter, Myers, & Lotocky, 1997) seems to have an influence on PP attachment preferences in L1 processing. Length manipulations have also been found to affect PP attachment preferences. In a self-paced reading study, Thornton, MacDonald, and Arnold (2000) observed that their monolingual participants' VP attachment preference decreased when additional material was added between the VP and the PP.

Comparatively little is known about PP attachment preferences in L2 learners. Nevertheless, this structure is interesting for L2 processing research for the following reasons. First, it allows for testing whether learners make use of phrase-structure driven processing strategies and non-syntactic information in the same way as native speakers. Second, the resolution of this ambiguity does not seem to underlie cross-linguistic variation. Thus, in contrast to the widely investigated relative clause

attachment ambiguity, the PP attachment ambiguity allows us to test L2 processing while at the same time excluding the possibility of L1 transfer.

One of the few studies that tested L2 learners' PP attachment preferences is an eye-tracking experiment with English learners of French as well as for French native speakers reported by Frenck-Mestre and Pynte (1997). The authors manipulated verb subcategorization and attachment site in their experimental sentences, as illustrated below:

(2a) Il rate le train de peu/de midi et décide alors de chercher un hôtel.
    'He misses the train by little/of noon and decides thus to look for a hotel.'
(2b) Il accuse l'ambassadeur d'Indonésie/d'espionnage mais il n'est pas certain des faits.
    'He accuses the ambassador of Indonesia/of espionage but he isn't certain of the facts.'

In sentences like (2a), the first verb is transitive (i.e., it subcategorizes for one argument). In sentences like (2b), the critical verb is ditransitive (i.e., it requires two arguments). Processing models differ in their predictions for these types of sentences. Principle-driven models predict a VP attachment preference for both (2a) and (2b) because VP attachment requires fewer syntactic nodes in the tree representation than DP attachment (Frazier, 1987, 1990; Rayner et al., 1983). Lexically-driven models predict differences between the two types of sentences because they assume that lexical information influences initial syntactic analysis (Boland, 1993; Trueswell, Tanenhaus, & Kello, 1993). Accordingly, readers are expected to prefer VP attachment in sentences with ditransitive verbs, whereas the attachment preference for sentences with transitive verbs should depend on the lexical properties of the verb and the noun.

Frenck-Mestre and Pynte (1997) report that both native speakers' and L2 learners' attachment preferences depended on verb argument structure. For sentences with ditransitive verbs as (2b), VP attachment was preferred (i.e., DP attachment took the readers longer to process than VP attachment). The opposite was true for sentences with transitive verbs as (2a). In these sentences, DP attachment was preferred (i.e., participants spent less time reading sentences in which the target segment modified the preceding noun than those in which the target segment modified the preceding verb). This result is surprising as it stands in contrast to studies with English monolinguals. Moreover, the learners regressed more often in the VP than in the DP disambiguation, regardless whether the verb was transitive or ditransitive. Since the native speakers' regressions did not differ across conditions, the authors interpret their results as evidence that learners over-rely on the recency principle. However, there are some methodological problems with this study which call the generalizability of the results into question. First, the authors do not provide sufficient information about the learners' proficiency and it is not certain whether the groups were matched with regard to their acquisition background. Second, the sentences used for the different conditions did not contain minimal pairs. Especially since the authors report that the sentences were not fully matched for length and syllable number, this might have been a confounding factor. Third, and most importantly, many of the DP-attached PPs that were used in this study were very close to idiomatic expressions (for example *salle de séjour* 'living room', *train de nuit* 'night train', or *femme de chambre* 'chamber maid'). Therefore, at least some of these sentences might be inherently biased towards DP attachment.

Rah (2009) reports results from a word-by-word self-paced reading study with intermediate and advanced German ESL learners and an English native speaker control group. Similar to the French materials of Frenck-Mestre and Pynte (1997), the English materials manipulated argument status (ditransitive as in (3a) versus monotransitive verbs as in (3b) and PP attachment (VP versus DP):

(3a) The journalist sent the report to the magazine / about the murder once again.
(3b) The journalist read the report in the evening / about the murder once again.

In contrast to the findings reported by Frenck-Mestre and Pynte (1997), the German learners showed similar patterns as the native speakers. In all conditions, reading times of the PP were statistically significantly shorter for forced VP attachment than for forced DP attachment. In sentences like (3a), this might be related to sensitivity to verb subcategorization information. In sentences like (3b), attachment is not forced by the verb's argument structure requirements. Therefore, the learners'

VP attachment preference in this condition suggests that they were not influenced by an L2-specific recency preference as suggested by Frenck-Mestre and Pynte (1997). With regard to the Shallow Structure Hypothesis (Clahsen & Felser, 2006), the findings were inconclusive. Similar to the relative clause attachment ambiguity (Felser et al., 2003; Papadopoulou & Clahsen, 2003), the shallow structure hypothesis (SSH) would predict no PP attachment preference for the learners because they do not commit themselves to any structural interpretation. However, an alternative prediction of the SSH would be a VP attachment preference, considering that the VP is the most salient discourse entity as well as the most recently encountered theta-assigner. Since the SSH predicts that L2 learners are highly sensitive to such pragmatic factors, they might show a VP attachment preference in this study. However, it is also conceivable that the learners in this study simply process the structures in a native-like way.

To sum up, the results of the few previous studies on the PP attachment ambiguity with L2 learners were heterogeneous and some of the results stand in contrast to previous findings with monolinguals. Therefore, further research in this direction is necessary in order to obtain a better understanding of the mechanisms that underlie L2 learners' processing of the PP attachment ambiguity.

3. The present study

The present study investigates L2 learners' PP attachment preferences in a production task in which participants were asked to complete ambiguous sentence beginnings as spontaneously as possible. The sentences were similar to those used by the previous on-line comprehension studies reported by Frenck-Mestre and Pynte (1997) and Rah (2009). Therefore, the question arises whether ambiguous structures are resolved similarly in production tasks as in comprehension tasks. In order to further explore the possibility that learners over-rely on a recency principle, we manipulated the distance between the PP and the potential attachment sites. Moreover, we tested learners at different proficiency levels. The present study thus addresses the following research questions:

1. Do L2 learners resolve PP attachment ambiguities in a similar way as native speakers?
2. Do L2 learners show similar attachment preferences in comprehension and production tasks?

3.1. Participants

Two groups of German ESL learners and a control group of English native speakers took part in the study. All learners had started learning English at around the age of 10. The intermediate learners ($n = 30$) were all undergraduate students of English at German universities in their first or second semester. Their mean age was 20.5 (range = 19-23 years, $SD = 1.5$) and 77% of them were female. None of them had ever lived in an English-speaking country. They had learned English as their L2 at school for an average of 11.5 years ($SD = 2.9$). The mean age of first exposure was 10.4 years (range = 8-11 years, $SD = 1.9$). Participants of the advanced learner group ($n = 24$) were all graduate students of English at German universities. Their mean age was 25.3 (range = 23-28 years, $SD = 1.6$) and 75% of them were female. All of them had lived in an English-speaking country for at least 2 months (mean = 8.4, $SD = 6.0$, range = 3-24) and all had learned English as their L2 at school for an average of 14.4 years ($SD = 1.7$, range = 13-19). The mean age of first exposure was 10.6 years (range = 8-12 years, $SD = 2.1$).

Preceding the actual study, all learners took part in an English grammar test. This was to make sure that participants within each group were approximately at the same proficiency level. The test was a pencil-and-paper version of the on-line Oxford Placement Test.[3] The intermediate learners scored 76.3% on average ($SD = 7.7$), which corresponds to the second highest level in the placement test (i.e., "English for Social and Academic Purposes"). The advanced learners scored 90.5% on average ($SD = 4.5$), which corresponds to the highest level in the placement test (i.e., "Advanced").

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[3] The test is a standardized cloze test provided by the Oxford University Language Centre as a language assessment tool for foreign language students.

The 20 English native speakers were all students living in Western Germany who were born and had grown up in English-speaking countries. Although they were living in Germany at the time of testing, they reported that English was still their dominant language they used on a regular basis. Their mean age was 21.3 years (range = 19-23, *SD* = 1.3) and 67% of them were female. Participation in the experiment was voluntary. All participants had normal vision (with or without correction) and reported that they were never diagnosed with any learning or other behavioral disorder. None of the participants had ever taken part in a psycholinguistic study and all participants were naïve with respect to the precise purpose of the study.

3.2. Procedure

The target sentences were of the same structure as those used in previous comprehension experiments (i.e., DP1-VP-DP2-PP-DP3), where the PP can either attach to the VP or to DP2. Two versions of each sentence were created, respectively with a ditransitive verb (4a) and a transitive verb (4b). The argument status of the respective verbs was determined based on the criteria for argumenthood developed by Schütze and Gibson (1999). In order to test whether the distance between the PP and its possible attachment site had an effect upon participants' attachment decisions, two additional versions of a sentence were created in which the distance was increased by an additional modifier (4c/4d).[4]

(4a) The salesman offered the apples…
(4b) The salesman ate the apples…
(4c) The salesman offered the delicious looking apples…
(4d) The salesman ate the delicious looking apples…

Eight experimental sentences of the structure illustrated in (4) were created. The sentences were divided into two lists in such a way that each list contained the ditransitive and the transitive manipulation of a sentence in different versions (i.e., either the long or the short version). On each list the 16 experimental sentences were intermingled with 32 filler sentences of different constructions in such a way that no two experimental sentences directly followed one another.

The present study utilized a sentence completion task. Participants saw ambiguous sentence at the beginning of the structure DP1-VP-DP2, which they then had to complete with the first PP+DP combination that came to their mind. The structure of these continuations was illustrated by two examples, which showed both ways of disambiguation in order to avoid any biases or syntactic priming. Although participants were instructed to complete the sentences as spontaneously as possible, they had time to think about their completions and the time was not measured.

3.3. Results

Preceding the data analyses, sentences which were not completed with a PP+DP combination as instructed were excluded from the data set. This procedure affected 2.8% of the intermediate learners' data, 1.3% of the advanced learners' data and 2.5% of the native speakers' data. Participants' attachment choices by group and by condition are illustrated in Table 1.

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[4] The modifiers were matched for length, in that they all consisted of five syllables. The experimental sentences were also matched for length in order to avoid possible biases.

Table 1. *Attachment Choices (in %) and Standard Deviations (in brackets) by Group and by Condition*

		Intermediate learners	Advanced learners	Native speakers	All groups
Short:					
ditransitive	VP attachment	95.9 (7.5)	97.4 (6.3)	95.9 (8.3)	89.9 (19.9)
	DP attachment	3.1 (6.7)	0.0 (0.0)	0.0 (0.0)	8.6 (20.0)
	ambiguous	1.0 (4.1)	2.6 (6.3)	4.1 (8.4)	1.5 (4.9)
transitive	VP attachment	98.8 (4.5)	95.5 (10.8)	91.6 (9.1)	89.7 (22.9)
	DP attachment	1.2 (4.5)	1.5 (5.0)	2.8 (6.8)	5.1 (11.8)
	ambiguous	0.0 (0.0)	3.0 (10.0)	5.6 (8.6)	5.2 (21.9)
Long:					
ditransitive	VP attachment	100.0 (0.0)	98.5 (5.0)	75.9 (41.4)	84.9 (30.8)
	DP attachment	0.0 (0.0)	0.0 (0.0)	33.3 (38.0)	12.4 (26.9)
	ambiguous	0.0 (0.0)	1.5 (85.0)	2.8 (6.8)	2.7 (7.6)
transitive	VP attachment	94.8 (7.9)	96.1 (7.2)	79.1 (20.9)	85.9 (27.9)
	DP attachment	2.1 (5.7)	2.6 (6.3)	12.5 (15.9)	4.0 (8.3)
	ambiguous	3.1 (6.7)	1.3 (4.6)	8.4 (9.6)	10.1 (22.8)

Table 1 indicates that all groups showed a VP attachment preference. However, there were some slight differences across conditions. The combined results of all three groups indicate that in the short sentences, the number of VP attachment choices was higher in the ditransitive than in the transitive conditions. However, a look at the individual groups indicates that this tendency was strongest in the native speakers. The advanced learners, in contrast, showed only comparatively small differences between conditions and a generally strong VP attachment preference. The intermediate learners showed different patterns in the ditransitive and the transitive conditions. In the ditransitive conditions, they showed a stronger VP attachment preference in the long condition than in the short condition, while in the transitive condition their VP attachment preference seemed to be stronger in the short than in the long condition.

In order to further explore these observations, the data were submitted to statistical analyses. We chose to only compare the VP and DP attachment choices. In the case of ambiguous sentence continuations such as *The salesman offered the apples in the shop.* we cannot determine whether participants chose this reading on purpose because they did not want to make any commitment, or whether they were unaware of the ambiguity in the sentence. First, a mixed-design omnibus analysis of variance (ANOVA) with four variables (i.e., Subcategorization (ditransitive, transitive) and Attachment (VP, DP)) as within-subjects variables and Group (intermediate, learners, advanced learners, native speakers) and Length (long, short) as between-subjects variables, was run on the results of all three groups. Second, the complex interactions of the omnibus ANOVAs were investigated by running separate ANOVAs for each group with three variables (i.e., Subcategorization (ditransitive, transitive) and Attachment (VP, DP)) as within-subjects variables and Length (short, long) as a between-subjects variable. For all statistical tests, α was set at .05. In cases where the Mauchly-test of sphericity reached statistical significance, we report Huynh-Feldt adjusted probability values with the original, unadjusted degrees of freedom.

The four-variable omnibus ANOVA on the entire data set yielded a statistically significant effect for Attachment ($F(1, 71) = 2279.189$, $p \leq .0001$). No statistically significant main effects were found for Subcategorization ($F \leq 1$) or Group ($F \leq 1$), but some of the interactions turned out to be statistically significant: Attachment x Group ($F(2, 71) = 690.379$, $p \leq .0001$), Attachment x

Subcategorization ($F(2, 71) = 4.693$, $p \leq .001$); Attachment x Subcategorization x Group ($F(2, 71) = 5.936$, $p \leq .004$). These interactions indicate that the three groups showed different attachment preferences across conditions. There was no statistically significant main effect for Length ($F \leq 1$), but the interactions of Attachment x Subcategorization x Length x Group was statistically significant ($F(2, 68) = 5.675$, $p \leq .001$) and the interaction of Attachment x Subcategorization x Length approached significance ($F(2, 68) = 3.123$, $p \leq .54$). These interactions indicate that the results were influenced by the length manipulation, possibly differently across conditions and groups. Since the complex interactions are somewhat difficult to interpret, we looked at the patterns of the three groups in turn by running separate mixed three-factor ANOVAs with Attachment, Subcategorization and Length.

For the native speakers, these analyses yielded statistically significant main effects for Attachment ($F(1,18) = 698.274$, $p \leq .0001$) and Length ($F(2, 18) = 5.117$, $p \leq .039$). No statistically significant main effect was found for Subcategorization ($F \leq 1$), but the interaction of Attachment x Subcategorization turned out to be statistically significant ($F(2, 18) = 6.338$, $p \leq .009$). This interaction might be due to the fact that the native speakers' VP attachment preference in the short sentences seemed to be stronger in the ditransitive than in the transitive condition, while no such effect became apparent in the long sentences. The statistically significant main effect for Length indicates that the native speakers' VP attachment preference was stronger in the short than in the long conditions, independent of verb subcategorization.

For the advanced learners, there was also a statistically significant main effect for Attachment ($F(1, 22) = 2974.853$, $p \leq .0001$) in the mixed three-factor ANOVA. For this group, none of the other factors reached significance, and there were no statistically significant interactions. The mixed three-factor ANOVA on the intermediate learners' data yielded a statistically significant main effect for Attachment ($F(1, 28) = 5635.347$, $p \leq .0001$). No statistically significant main effects were found for Subcategorization ($F \leq 1$) or Length ($F \leq 1$), but the interaction of Attachment x Subcategorization x Length turned out to be statistically significant ($F(2, 28) = 4.185$, $p \leq .023$). This interaction was not found in the other groups and indicates that the intermediate learners showed differential effects for Length across conditions. This confirms the impression from the data in Table 1. In the ditransitive conditions, the intermediate learners showed a stronger VP attachment preference in the long than in the short condition, while the effect was inversed in the transitive condition, where the VP attachment preference seemed to be stronger in the short than in the long condition.

4. Discussion

The results of the present study parallel the comprehension results reported by Rah (2009), in that all groups showed a VP attachment preference in all conditions. This VP attachment preference was differentially influenced by the length and subcategorization manipulations across groups.

The native speakers in the present study showed a general VP attachment preference. The fact that this preference was also found in the transitive condition, where the PP was not an obligatory argument of the verb, indicates that verb subcategorization information is not the only factor that guides participants' attachment decisions. This finding argues against a purely lexically based processing model.

The learners' results parallel those found in the native speakers, in that they also showed a clear VP attachment preference in all conditions. Hence, neither the advanced nor the intermediate learners had a stronger recency preference than the native speakers in the sentence production task. The general VP attachment preference was also observed in the conditions of increased distance between the VP and the PP. This stands in contrast to the proposal that sentence processing becomes more difficult with increased distance between elements in a sentence (Fodor, 1998; Gibson, 1998; MacDonald, 1999), which would predict a recency preference for the long conditions of the present study.

However, participants were not completely insensitive to the length manipulation, in that at least the native speakers' VP attachment preference in the long conditions was somewhat weaker than in the short conditions, both with the ditransitive and the transitive verbs. The intermediate learners showed an interaction of Length and Subcategorization, which indicates that they seemed to be more sensitive to subcategorization differences in the long than in the short condition. However, this effect is not necessarily related to recency considerations, considering that the length manipulation also introduces

a pragmatic bias. As outlined by Thornton, MacDonald, and Arnold (2000), the modification of the DP in the long condition makes it pragmatically infelicitous to further modify the DP by the PP. Accordingly, a bias towards VP attachment rather than a recency preference would be predicted in this condition. Under this assumption, the fact that the learners show a strong VP attachment preference in the short and long conditions indicates that they might be more strongly influenced by pragmatic considerations than the native speakers. An alternative explanation for the learners' consistent and strong VP attachment preference might be in terms of strength of activation. It is possible that learners who have produced a specific structure several times find it harder than native speakers to produce a different type of structure. Since this potential bias in the learners cannot result from the given examples (which included both VP and DP attachment), such a finding indicates that learners' production can be primed by their own previous utterances. Previous studies using various syntactic priming paradigms with both native speakers (Bock, 1986; Pickering & Branigan, 1999) and language learners (McDonough & Mackey, 2008; Schoonbaert, Hartsuiker, & Pickering, 2007) found evidence for such syntactic priming effects, but future work is needed to determine whether priming is stronger in learners than in native speakers and whether a person's own utterances can elicit such priming effects.

With regard to proficiency effects, we can conclude that there were only comparatively small differences between the two groups. However, the two leaner groups' patterns differed with regard to the subcategorization and length manipulations. While the advanced learners showed a relatively stable and strong VP attachment preference across conditions, the intermediate learners showed some differences between conditions in that they seemed to be slightly more affected by recency considerations in the long than in the short condition. But it must be noted that this recency effect was only very small and in general all groups showed a strong and stable VP attachment preference, which indicates that the non-immersed learners tested in present study showed native-like processing. In order to further explore possible proficiency effects, more research with yet less proficient learners will be necessary.

5. Conclusion

The results of the present study indicate that learners' ambiguity resolution in production tasks parallels the results from previous comprehension tasks (i.e., a VP attachment preference) for all groups. This finding suggests that learners' processing is highly native-like and the learners did not over-rely on a recency principle of attaching new material to the most recently processed element. It remains to be explored whether a recency principle could be observed more clearly in tasks that are more demanding in terms of processing load. The learners seemed to be even less strongly influenced by such a principle than the native speakers. Other possible explanations for the difference observed between learners and native speakers in the present task are that the learners are more sensitive than the native speakers to pragmatic considerations or that they are comparatively less flexible to deviate from previously produced structures. Further research along these lines is necessary to obtain a more complete picture of L2 processing that does not only include comprehension but also production mechanisms.

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