**The Online Processing of 'Complement Coercion' of Foreign Language Learners - The Effect of the Similarity of the Word Order in Native and Target Language**

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In the present study, the online processing of 'complement coercion' of adult foreign language learners was investigated by using electroencephalography (EEG). 'Complement-coerced' sentences such as '*The author began the book*' can be understood as '*The author began writing the book*' due to an additional semantic process, where the semantic type of objects is shifted from ENTITY (e.g. '*the book*') to EVENT (e.g. '*writing the book*') as people try to appropriately interpret the meaning of the sentences (i.e. type-shifting).[1]

Delayed processing time and a larger N400 response have been observed from native speakers during the processing of coerced sentences compared to control ones. These are regarded as an additional cost of the type-shifting process.[2,3] However, this cost was not reported in a previous study, where the subjects consisted of highly proficient Korean learners of English who started learning it at older ages.[4] Considering the recent reports implying that syntactic structures can modulate this processing cost,[5,6] we assumed that the result was due to the negative transfer effect caused by the difference in the order of sentence elements in Korean and English.[7] Since the word order of a specific language system could affect its users' strategies of sentence processing, it is probable that the knowledge of the Korean word order hampered the way the subjects processed the coerced sentences in English. In this sense, whether the target language of language learners and their native language have similar word order might be an influential factor in their online processing of coerced sentences in the target language.

Two experiments were conducted in order to probe the online processing of complement-coerced sentences of adult foreign language learners and the effect of the word order on it. As an experiment language, German was chosen. This is due to the fact that in German, some propositions can be expressed either in a Korean-like (i.e. an object precedes its verb) way or not (i.e. an object follows its verb) without any noticeable change in their meaning.[8] In experiment 1, three types of sentences (*control, complement-coerced*, *semantically violated*) were presented to 20 highly proficient Korean learners of German. As the sentence stimuli belonging to each condition were constructed based on the same scenario, they were identical except for the verbs, and all objects followed their verbs (cf. Table 1). Another 20 highly proficient Korean learners of German participated in experiment 2. Exp. 2 was constructed in the same way as in exp. 1 except that all objects in the experiment sentences preceded the past participle of their verbs (cf. Table 1).

In the ERP analysis, no evidence of the increased N400 amplitude at the CW (critical word; cf. Table 1) in the coerced sentences was found in either experiment. This shows that the online processing of complement-coerced sentences of foreign language learners is distinct from that of natives. However, only in exp. 2 was a marginally significant positive deflection observed at the next word position of the CW in response to the coerced sentences (Figure 1), indicating that knowledge of the word order of their native language affects the processing of the coerced sentences in the target language, although what this positive deflection implied was elusive. Moreover, only in exp. 2 was a stronger power in the beta frequency range (15-25Hz) found at CW in the control and the coerced sentence compared to the semantically violated (Figure 2). Given that the increased beta power could be construed as maintaining the context within a sentence,[9] the participants might not consider the CWs in the coerced sentences as the deviants as those in the semantically violated, only when the German sentences are presented in the Korean-like order.

In conclusion, our findings suggest that the online processing of 'complement coercion' of foreign language learners is different from that in native speakers, and is modulated by the similarity in word order between the target language and the mother tongue.

**Table 1.** Example of sentences used in the experiments

| **Example Sentences** (Control / Complement-Coerced / Semantically Violated) | |
|---|---|
| **Exp. 1** | Ella spielte / begann / empörte das **Lied** zum zweiten Mal.<br>*Ella played / began / outraged the song for the second time.* |
| **Exp. 2** | Ella hat das Lied **gespielt** / **begonnen** / **empört**, obwohl andere das nicht wollten.<br>*Ella has played / begun / outraged the song, although others did not want it.* |

The critical word (CW) position where the participants realized the configuration of the complement coercion is marked in boldface. Underscored words are the content part of the verb phrases. The sentences translated into English are suggested in italics below the original ones.

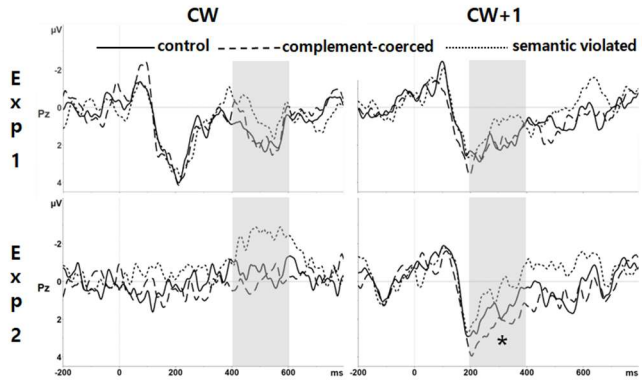


**Figure 1**. Grand average of ERP responses at CW (first column) and CW+1 (second column) position in exp. 1 (first row) and exp. 2 (second row). ERP waveforms to each control, complement-coerced, and semantically violated condition are plotted in solid, dashed and dotted lines, respectively. Shaded areas represent the places where statistical tests were performed. A marginally significant difference between the coerced and the control sentences was found only in exp. 2 at CW+1 ($p$<0.05; denoted as * in the figure).

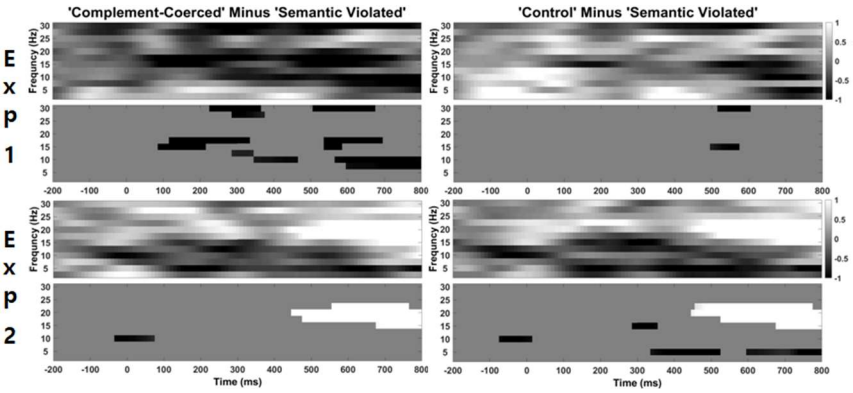


**Figure 2**. Time-Frequency maps of power difference between the conditions at the CW position in exp. 1 (first row) and exp. 2 (third row). The differences in lower frequency range (< 30Hz) are plotted. Lighter colors mean positive values and darker ones negative. Statistically significant clusters ($p$<0.05) as a result of non-parametric permutation tests are shown below each map (second and fourth row, respectively). Powers in response to the coerced sentence are compared to the semantically violated ones in the left column, and the difference between the control and the semantically violated condition is plotted in the second column.

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In a canonical sentence of Korean, an object precedes its verb. Below is an example of Korean sentences, which has a similar meaning to the example sentences suggested in Table 1. The sentence translated into English is also added.

(1) *Ella-ga geu nolae-leul teul-eossda*.
Ella-NOM DEM song-ACC play-PRET
'Ella played the song.'

As shown in (1), in Korean, verbs are usually situated in the sentence-final position. Therefore, complements of the verbs antecede them. Since Koreans have developed schemas of the word order within sentences like above, they might overtly or "covertly (i.e. the increase in cognitive load)" have difficulty in processing sentences in a specific foreign language whose word order deviates the basic sentence order of Korean, if they have not acquired the knowledge of the sentence structure in the target language deeply enough (i.e. at the level of procedural knowledge).

On the other hand, in German, the proposition stated in (1) can be instantiated in two ways with little change in its meaning. One is to use a verb in the simple past tense (in Germ. *Präteritum*), and the other is to adopt the *haben-pp* construction. Example sentences are suggested in (2). The English-translated ones are also offered under each of them.

(2a) *Ella spiel-te das Lied.*
Ella play-PRET.3SG ART:ACC song
'Ella played the song.'

(2b) *Ella ha-t das Lied ge>spiel<t.*
Ella have-PRS.3SG ART:ACC song play<PTCP.PRF>
'Ella has played the song.'

As in English, when the simple past tense is used, an object follows its verb (cf. (2a)). However, when it comes to the *haben-pp* construction, while the auxiliary verb *haben* (*hat* in (2a) is its conjugated form) that carries a grammatical meaning is located in the same position in a sentence as a verb in the past tense, the past participle that is the content part of the verb complex occupies the sentence-final position (cf. (2b)). As a result, the past participle follows its object. Considering that the complement coercion is the phenomenon, in which people shift the semantic attribute of an object from ENTITY to EVENT in order to make sense of the sentence when it is used with a specific type of verbs, it can occur only after one sees both the content part of the verb complex and its object. In this sense, at least in the context of the complement coercion, it can be said that the sentence constructed by using the *haben-pp* has a similar order to Korean sentences, and the sentence in which the simple past tense is used does not.

On top of that, even though the *haben-pp* could be considered as the German counterpart of the *have-pp* construction in English, it has distinct characteristics from the *have-pp*. One of the interesting points is that the *haben-pp* can function as an alternative to the simple past form, and is even preferred.[9] In this regard, (2a) and (2b) could be understood as having the same meaning. Thus, we constructed the sentence stimuli by adopting both the simple past and the *haben-pp* construction on the similar scenario in order to minimize the influence of the different grammatical meanings and to localize the effect of the word order on the processing of the complement coercion in foreign language learners. Nevertheless, since there is a possibility that the distinctive grammatical forms themselves can affect the processing, the order effect was investigated by comparing the results from two experiments, each of which consisted of the same type of stimuli.