

The influence of language transfer and L2 proficiency on the acquisition of argument structure constructions: An ERP study

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ABSTRACT. In this paper we report an event-related potential (ERP) experiment investigating the role of L1 constructions and L2 proficiency in the acquisition of L2 constructions. The subjects took a Grammaticality Judgment Test (GJT) of grammatical and constructional violating sentences that are similar (ditransitive constructions), different (resultative constructions) in first and second languages or unique (caused-motion constructions) in the second language. Both High proficiency group (H-group) and Low proficiency group (L-group) demonstrated different patterns in processing the three different constructions, which indicates the influence of language transfer. The comparative analysis of two groups shows the influence of L2 proficiency on the syntactic and semantic processing of constructions.

Keywords: argument structure constructions, ERP experiment, L2 proficiency, language transfer

1. INTRODUCTION. Construction grammar is the general term for a number of models of grammar (Berkeley construction grammar, cognitive grammar, radical construction grammar, embodied construction grammar, etc.) that all subscribe to the idea that knowledge of a language is based on a collection of “form and function pairings” (Croft 2007:463).

ARGUMENT STRUCTURE CONSTRUCTIONS are form-meaning/function pairings with comparatively complex structures. Goldberg (1995) points out that “simple clause constructions are associated directly with semantic structures which reflect scenes basic to human experience.” Different languages may have different ways of expressing the same scenes. So will a learner’s first language constructional knowledge influence their acquisition of second language constructions? This study addresses two research questions. First, is there an L1 transfer effect in the acquisition of L2 constructions in adult second language acquisition? Second, what is the relationship between language proficiency and L2 construction acquisition?

We use EVENT-RELATED POTENTIALS (henceforth ERPs) to investigate the influence of L1 constructions and L2 proficiency on the acquisition of L2 constructions. In ERP research of language acquisition ELAN (early left anterior negativity)/LAN (left anterior negativity) and P600 are the main components considered to index syntactic processing of adult native-language (Caffarra et al. 2015, Friederici 2002, van Hell & Tokowicz 2010, Kotz 2009). Some ERP experiments find that similar to native speakers, highly proficient learners show ELAN/LAN and P600. The lack of LAN of low proficient learners is considered to indicate the corresponding language processing (Hahne 2001, Ullman 2005) or indicate that learners

cannot achieve native-like processing (Clahsen & Felser 2006).

2. LANGUAGE TRANSFER EFFECT AND L2 PROFICIENCY INFLUENCE. Language transfer effects and L2 proficiency influence are well studied in ERP research of second language acquisition. Tokowicz and MacWhinney (2005) did an ERP experiment testing 20 low proficient Spanish L2 learners with three different constructions: tense-marking (similar in L1 English and L2 Spanish), determiner number agreement (different in L1 and L2) and determiner gender agreement (L2 unique). The learners were found to be sensitive to violations of similar constructions but not sensitive to violations of different constructions. There was a robust grammaticality effect in the ERP data for the construction that was unique to the L2. The researchers take this as the evidence of language transfer.

Sabourin and Stowe (2008) had similar findings in an ERP experiment comparing L1 and L2 speakers. Native Dutch speakers showed a P600 effect for both constructions tested. But, this effect only occurred in L2 speakers if L1 and L2 were similar. Kotz et al. (2008) examined L2 syntactic processing of a language-specific phenomenon of L2 and a construction similar in L1 and L2 in highly proficient L1 Spanish-L2 English readers. Kotz and colleagues found a comparable picture emerged in the non-native readers of English. Both critical syntactic conditions elicited a P600 only with the distribution and latency varied in the syntactic anomaly condition.

L2 proficiency also has an impact on L2 processing, especially for those constructions that are different in L1 and L2. Rossi et al. (2006) investigated the role of proficiency in late

second-language processing and concluded that late L2 learners with a high proficiency can show native-like neural responses with the timing approximating that of native speakers. In their experiments highly proficient L2 learners in both German and Italian showed ELAN and P600 for all syntactic violations but Low-proficiency L2 learners showed no LAN and delayed P600.

Tanner et al. (2010) investigated the processing of subject-verb agreement anomalies in native speakers of German and beginning and intermediate Anglophone L2 learners of German. They found that learners enrolled in third-year classes showed qualitatively similar brain responses to those found in native speakers. Learners enrolled in first year courses who performed well judging sentence grammaticality showed a P600, though with a later onset and smaller scalp distribution relative to native speakers; first year learners who performed poorer (but still better than chance) at judging sentence grammaticality showed a small N400 effect. They take these findings to indicate that learners pass through discontinuous stages during the acquisition of L2 agreement morphology: Learners process inflected verbs as unanalyzed units in the early stages of L2 acquisition, subsequently decomposing them into stem plus affix sequences and inducing a productive morphosyntactic rule. Since it is hard to separate the effect of language transfer and L2 proficiency, many experiments combine the factors and examine both the transfer effect and L2 proficiency and how they interact.

3. A COMPARISON OF ENGLISH AND CHINESE CONSTRUCTIONS. We chose three argument structure constructions in our experiment: ditransitive construction, resultative construction and caused-motion construction.

3.1. DITRANSITIVE CONSTRUCTIONS. Ditransitive constructions or double-object constructions are very common in both Mandarin Chinese and English with the same structure “SVN1N2”.

According to Goldberg the core constructional meaning of ditransitives is defined as “the agent argument acts to cause transfer of an object to a recipient” (1995:32) with some peripheral meaning such as ‘Agent enables recipient to receive patient (permit, allow),’ ‘Agent acts to cause recipient to receive patient at some future point in time (guarantee, promise),’ ‘Agent causes recipient not to receive patient (refuse, deny),’ etc.

Chinese ditransitives are more complicated than their English counterparts. Besides ‘recipient receiving the patient’ the basic sense of Chinese ditransitives includes ‘recipient losing the patient’ or ‘agent getting the patient’. See the examples below.

(1) a. 他 给了 我 一本书。

He gave me a book.

‘He gave me a book.’

b. 他 偷了 我 一本书。

He stole me a book.

‘He stole a book (from me).’

Sentence 1b does not mean that the person stole a book and gave it to me. On the contrary, it means that he stole a book from me (I lost my book because of his stealing). But some Chinese researchers argue that both the ‘recipient receiving the patient’ and ‘recipient losing the patient’ can be the polysemies of ‘transfer’ (Zhang 2006:32). Chinese and English ditransitives are similar constructions with similar syntactic form and constructional meaning.

3.2. RESULTATIVE CONSTRUCTIONS. Chinese and English resultatives are different in their structures, types and the specific constraints for sentence components. The English resultative construction has two types of formation: [Subj V Obj Comp] and [Subj V Comp]. See the following examples:

(2) a. He hammered the metal flat.

b. The river froze solid.

The central meaning is ‘X causes Y to become Z by Ving’. Goldberg (1995:180) found that “the resultative can only apply to arguments that potentially (although not necessarily) undergo a change of state as a result of the action denoted by the verb.” Goldberg and Jackendoff (2004) posited 4 major types of resultative constructions as follows:

Type	Example
a. Causative property resultative	Bill watered the tulips flat.
b. Noncausative property resultative	The pond froze solid.
c. Noncausative path resultative	The ball rolled down the hill.
d. Causative path resultative	Bill rolled the ball down the hill.

TABLE 1. Major types of English resultative constructions

Chinese resultatives are even more complex. The syntax of Chinese resultatives can be [Subj V Comp Obj] or [Subj V Comp], for example:

(3) a. 妈妈 洗 干净了 衣服.

Mom wash clean clothes.

‘Mom washed the clothes clean.’

b. 小明 玩 累了.

Xiaoming play tired.

‘Xiaoming played himself tired.’

Many Chinese resultative clauses have been lexicalized such as 打死 (‘beat and dead’), 听懂 (‘listen and understand’), 学会 (‘learn and master’). See an example:

(4) 他 砍倒了 大树。

He hack-fall a big tree.

‘He hacked the big tree and the tree fell (as a result).’

A tricky feature of Chinese resultatives is that the subject and the object in a resultative construction can interchange their positions with only slight change in style and no change in the constructional meaning. See the following examples:

(5) a. 老王 喝醉了 酒。

Laowang drink drunk the wine.

‘Laowang was drunk.’

b. 酒 喝醉了 老王。

The wine drink drunk _Laowang.

‘Laowang was drunk.’

3.3. CAUSED-MOTION CONSTRUCTIONS. Causing something/somebody to move is a common

scene in daily life. But Chinese and English have very different ways to express it. The caused-motion construction is common in English with the syntax [Subj [V Obj Obl]], and the basic semantics of this construction is ‘X causes Y to move Z’. The extension of caused-motion construction can mean ‘X enables Y to move Z’ or ‘X helps Y to move Z’, etc. See the following examples.

(6) a. Frank pushed it into the box.

b. Frank kicked the dog into the bathroom.

(7) a. Sam allowed Bob out of the room.

b. Sam helped him into the car. (Goldberg 1995:161)

However, there is no such a construction in Chinese. Alternatively there are several constructions in Chinese such as ‘BA-construction’. To Chinese learners of the English caused-motion construction is a L2 unique construction.

(8) 她 把 书 放 到 了 书 架 上。

She BA- the book put to the shelf on.

‘She put the book onto the shelf.’

4. THE PRESENT STUDY. The present study examines the language transfer effect and the influence of second language proficiency on the acquisition of English argument structure constructions. We use ERPs to find out how high and low proficient L2 learners process English constructions. We hypothesize that both language transfer and L2 proficiency have an

impact on acquisition.

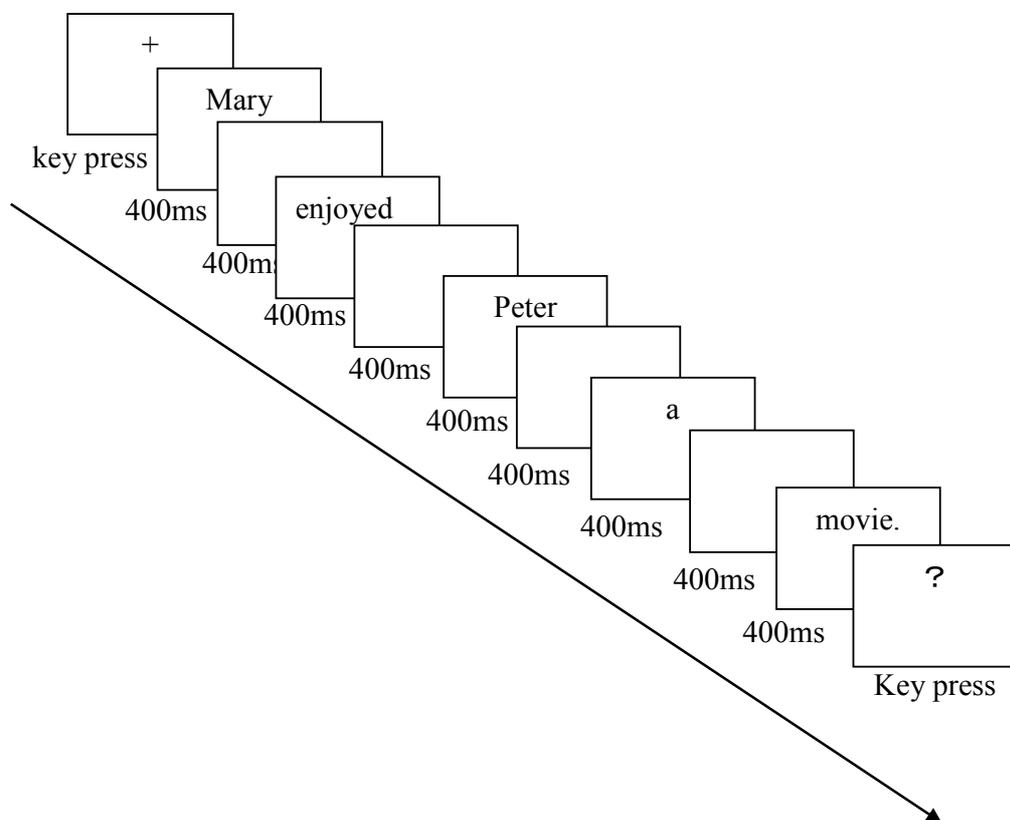
4.1. PARTICIPANTS. The participants in this experiment were 18 graduates (High-proficiency group, henceforth H-group) and 17 second-year undergraduates (Low-proficiency group, henceforth L-group) from the same university in China. They are all native speakers of Chinese and L2 English learners. Two participants from L-group were discarded because of too many artifacts (caused by blinks, muscle activity, etc.) in their neural records. In order to keep the number even we randomly deleted 3 participants from the H-group, thus making 15 participants for each group.

4.2. STIMULI. We examined 3 types of constructions: ditransitive construction (similar in L1 and L2), resultative construction (different in L1 and L2) and caused-motion construction (L2 unique). Every construction contains two versions: grammatical sentences and constructional violating sentences. There are altogether 360 trials for the subjects to make GJT. See the examples of the constructions in Table 2 (* indicating violation):

Construction	Similarity	Example
ditransitive	similar	*Ted runs Owen a hotel. Lily made Vivian a dress.
resultative	different	*Mary designed the clothes clean. She breaks the nut apart.
caused-motion	L2 unique	*Larry printed the file off the table. He hit the ball over the fence.

TABLE 2. Sample stimuli.

4.3. PROCEDURE. As shown in Figure 1, sentences were presented at the center of the computer screen, one word at a time. Each word remained on the screen for 400 milliseconds (ms) with a blank screen appearing also for 400 ms between words. The sentences were presented in a random order determined by the computer program E-Prime. The block of English sentences was counterbalanced. Participants read sentences on a computer screen. The participants indicated whether they thought the sentence was acceptable or not by pressing the buttons, “1” for acceptable, “3” for unacceptable.



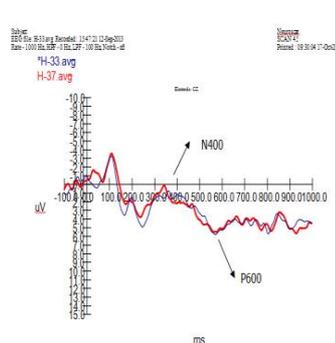
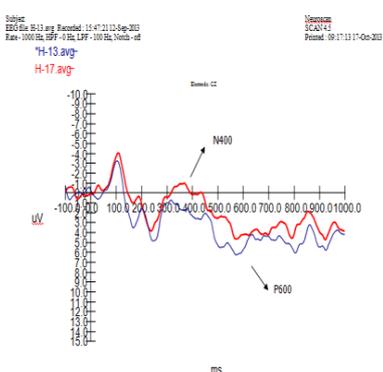
*Mary enjoyed Peter a movie.

FIGURE 1. Time line of events

4.4. RESULTS: BEHAVIORAL DATA. Accuracy for each condition was calculated for each

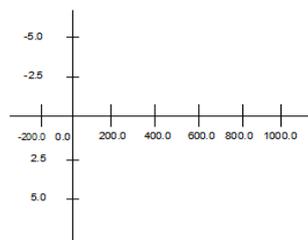
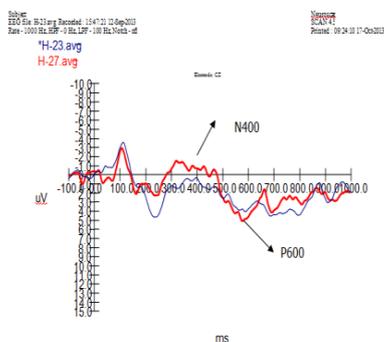
participant. These data were analyzed with ANOVA using acceptability and type of construction as factors. The accuracy of both groups of grammatical sentences is higher than that of constructional violating ones. Overall, L-group has a lower accuracy and longer reaction time than H-group. However, the difference between two groups is not statistically significant in acceptability and reaction time.

H-GROUP ERP DATA:



1. ditrasitives

3. caused-motion



2. resultatives

 constructional violating
 grammatical

FIGURE 2. Grand average wave-forms for the grammatical and constructional violating sentences of H-group

(1) DITRANSITIVES. Both grammatical and violating sentences elicit N400 and P600. Violating sentences have larger N400 but smaller P600. We expected that violating ditransitives should elicit larger P600 because they are similar in L1 and L2 and the subjects are familiar with them, but the results are different. The possible explanation is that it is caused by the simplicity of the GJT task. N400 comes from the mismatch of semantics and subjects' expectation of ditransitives constructions. Once they perceive the violation they can make the decision without finishing reading the whole sentence, thus lowering the complexity of syntactic processing, which leads to the smaller P600.

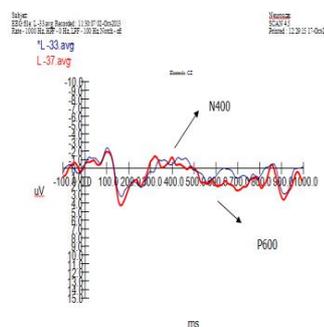
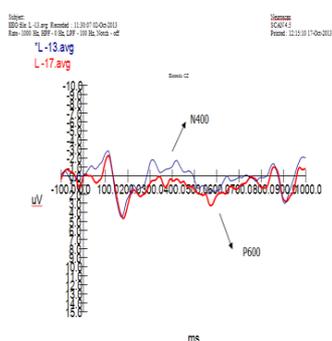
(2) RESULTATIVES. Both grammatical and violating sentences elicit N400 and P600, but the N400 effect is small and the P600 effect is large. The N400 effect, although small, indicates the perception of semantic mismatch. The P600 effect is quite obvious. The constructional violating sentences elicit P600 much larger than grammatical ones, which indicates the difficulty in syntactic processing. The fact that both grammatical and violating sentences have quite large P600 shows that even grammatical resultatives are hard for subjects to process. This is in accord with our understanding of the differences between Chinese and English resultative constructions. The differences lead to the difficulty in understanding and processing even for the grammatical sentences.

(3) CAUSED-MOTION CONSTRUCTIONS. Both grammatical and constructional violating sentences have very small N400 effect and very large P600 with very little difference under both conditions. The N400 effect of caused-motion constructions is much smaller than the other two constructions. This indicates that the subjects have a worse command of the constructional meaning. Both grammatical and violating sentences have large P600, showing the difficulty in processing. The tiny difference under both conditions shows that the subjects

are not sensitive to violation which is possibly from the fact that they do not master the construction and are not familiar with both the structure and meaning.

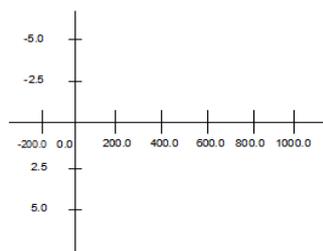
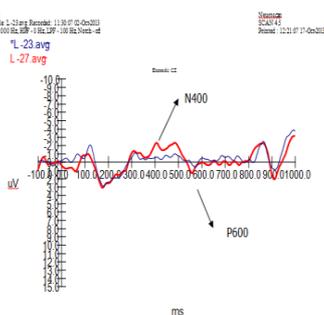
The comparison of three constructions shows that a similar construction (ditransitives) is easy to process and make accurate grammatical judgments about while the syntactic processing of a different construction (resultatives) is difficult. L2 unique construction is hard to master.

L-GROUP ERP DATA:



1. ditransitives

3. caused-motion



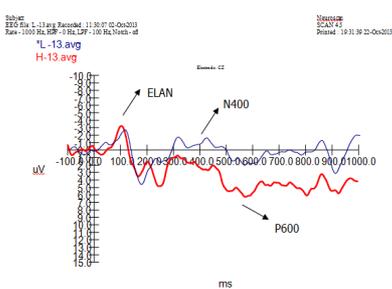
2. resultatives

FIGURE 3. Grand average wave-forms for the grammatical and constructional violating sentences of L-group

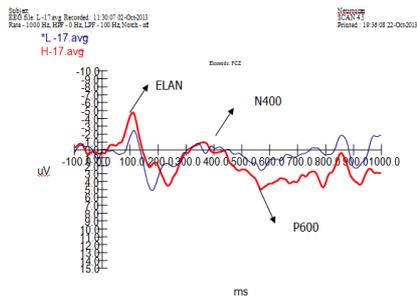
(1) DITRANSITIVES Grammatical sentences elicit N400 but violating ones elicit no N400 and very small P600, which indicates that L-group subjects are not sensitive to violation, the possible reason is that they depend more on lexical semantics and cannot understand and process the construction as a whole.

(2) RESULTATIVES. Resultatives elicit very large N400 but no P600, which means the subjects are not sensitive to the construction and depend on lexical semantics.

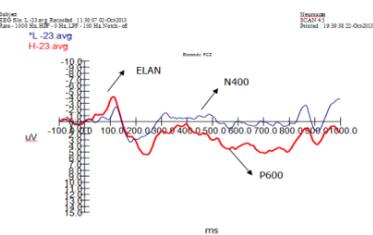
(3) CAUSED-MOTION CONSTRUCTIONS. The comparison of grammatical and violating sentences shows very small difference of N400 and P600. We can conclude that subjects have not mastered the construction.



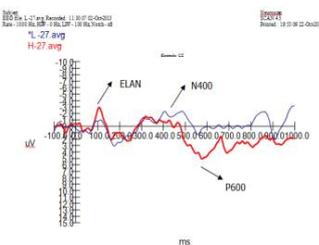
ditransitives (grammatical)



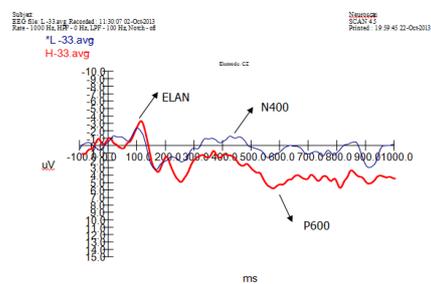
ditransitives (violating)



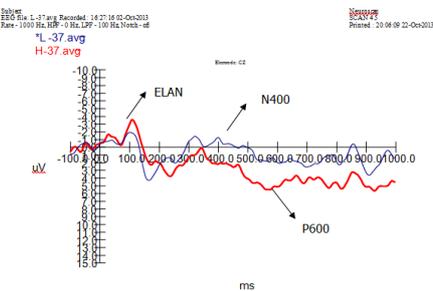
resultatives (grammatical)



resultatives (violating)



caused –motion construction (grammatical)



caused –motion constructions (violating)

FIGURE 4. Grand average waveforms for H-group and L-group. (H-group VS L-group)

When we compare the ERP data of three constructions of L-group we find that similar construction has N400 and P600, different construction has large N400 but no P600, L2 unique construction has no obvious N400 and no P600. L-group shows N400 in most sentences, which indicates their dependence on lexical semantics and lack of syntactic processing ability.

(1) DITRANSITIVES. For the grammatical sentences, H-group and L-group have a similar ELAN component while L-group elicits much larger N400 and much smaller P600. Violating sentences vary much in ELAN but little in N400. H-group elicits much larger P600 than L-group.

(2) RESULTATIVES. Grammatical sentences do not show much difference in two groups for ELAN and N400, with H-group having a slightly larger ELAN and smaller N400. But, H-group elicits much larger P600. Violating sentences have much larger ELAN and P600 but smaller N400 in H-group.

(3) CAUSED-MOTION CONSTRUCTIONS. The two groups show little difference in ELAN of grammatical sentences while H-group has a much larger ELAN for violating sentences. L-group has much larger N400 and smaller P600 under both conditions.

H-group shows ELAN-P600, which is similar to native speakers. P600 of H-group is much larger than L-group, indicating that H-group is much more sensitive to syntactic factors. L-group has only N400 effect under most conditions and shows no ELAN-P600, especially with the constructional violating sentences. This can be caused by the dependence on lexical semantics and lack of syntactic processing ability.

5. GENERAL DISCUSSION. Both language transfer and L2 proficiency have been the focus in second language research. This study uses ERPs to examine the influence of these two factors in

the acquisition of L2 constructions. The results obtained in this study provide proof of language transfer effect and L2 proficiency influence in L2 construction acquisition.

5.1. LANGUAGE TRANSFER EFFECT. First, in H-group we observed both N400 and P600 effects in three types of constructions under both conditions, but there are some differences among these constructions. Constructional violating ditransitives elicit larger N400 but smaller P600 than grammatical ones. We reason that H-group subjects do not need to complete syntactic processing to make the right decisions due to the simplicity of the task. Thus, we infer that H-group has already mastered this construction. Resultatives elicit similar N400 and larger P600 under two conditions, and the violating sentences elicit much larger P600 than grammatical ones, which indicates the processing difficulty even with the grammatical sentences. Being different constructions in L1 and L2, resultatives have different structures in Mandarin Chinese and English, which should be the main reason of L2 learners' processing difficulty. Caused-motion constructions elicit very small N400 but very large P600, even the grammatical sentences have large P600 effect, indicating the processing difficulty. Caused-motion is an L2 unique construction, and only when learners have mastered their form/meaning pairing (constructional meaning), can they process the construction with ease. We found that subjects are sensitive to violating ditransitives and resultatives but not to caused-motion constructions. From the results we can conclude that even the H-group subjects have not mastered caused-motion construction very well.

The processing patterns for the three constructions are different from one another. Ditransitives have N400 and small P600, and thus differ much from the other two. There are differences in processing patterns of resultatives and caused-motion constructions: the former shows different P600 effect for grammatical and violating sentences while the latter has none.

We attribute the different patterns to the constructional distance in L1 and L2, or language transfer effect. Although some behavioral research shows that L2 learners (especially highly proficient learners) can apply strategy similar to native speakers to process L1 and L2 different constructions and L2 unique constructions (see Hoover & Dwivedi 1998), online research on the processing of different constructions can help us determine language transfer effect. Chinese and English ditransitives are structurally and mechanistically similar, which is very helpful for learners. Resultatives in two languages differ in structure, usage and constructional meaning, which leads to the difficulty in acquisition. Caused-motion constructions are L2 unique. There are other constructions in Chinese to express the same constructional meaning, so it is the hardest one to acquire. The results of H-group demonstrate that even grammatical caused-motion constructions require processing effort. Dowens et al. (2010) had similar findings: similar constructions and L2 unique constructions have significant difference in ERP.

L-group also has three different processing patterns for three types of constructions. What is in common is the lack of P600 (only violating ditransitives have very small P600 effect). Grammatical ditransitives have large N400 while violating ones have none. Violating resultatives have very large N400 while both grammatical and violating caused-motion constructions have very small N400. The different patterns can also be explained by language transfer. L1 and L2 similar constructions are easy to acquire even for L-group subjects. There are the usual N400 and P600 effects for violating ditransitives. L1 and L2 different and L2 unique constructions are more difficult to process, which can be seen from the lack of P600. When we compare different and unique constructions we find the differences in processing. The subjects are more sensitive to violating resultatives (eliciting N400) than violating caused-motion constructions (showing almost no difference in violating and grammatical sentences). We believe this reflects the fact

that subjects have a better command of resultatives than caused-motion constructions. The acquisition of L2 constructions are correlated with the language distance.

ERP studies on L2 learners usually do not get as consistent results as native speaker subjects, which is due to the differences in tasks, materials, language proficiency and language distance, etc. Our findings are different from some other language transfer experiments, for example, Tokowicz and MacWhinney (2005) found that low proficiency learners have P600 in violating L1 and L2 similar and L2 unique constructions while no effect in different constructions. We think that the possible reason might be the difference in language proficiency. We infer that in Tokowicz and MacWhinney (2005) the L2 proficiency is higher than our L-group subjects. In Rossi et al.'s (2006) experiment high proficient subjects have LAN/P600, and low proficient subjects have similar response in morphosyntactic violating but violating agreement has only P600. Our L-group results are quite different from Rossi et al.'s, especially the P600 component. We infer that the language distance is a crucial factor. Chinese and English are much more different than German and Italian in language type.

5.2. L2 PROFICIENCY INFLUENCE. ERP data show the influence of L2 proficiency on learners' understanding and processing of L2 constructions. When we compare the ERP data between H-group and L-group, we find that violating sentences have ELAN-P600 in H-group but not in L-group, as can be seen in Figure 4. The latter has a large N400 effect. According to the current understanding of N400, we infer that L-group subjects rely more on lexical semantics and they do not have the corresponding syntactic processing ability. While H-group's processing pattern is quite similar to that of native speakers. Thus we conclude that L2 proficiency has a great impact on learners' processing and acquisition of L2 constructions.

6. CONCLUSION. The results of our ERP experiment indicate that H-group demonstrates ELAN/P600 which is the typical native speakers' response to syntactic violation. We conclude that subjects with high L2 proficiency have the syntactic and semantic processing ability. While the lack of ELAN and P600 shows that L-group subjects do not have the corresponding syntactic processing ability. From the N400 effect we conclude that low proficiency subjects rely more on lexical semantics and probably have not formed the concept of some constructions. Based on the previous ERP studies on language processing, we draw the following conclusions from the present study:

(1) The different processing patterns of three types of constructions indicate that H-group has good command of resultative constructions and better command of ditransitive constructions but probably no command of caused-motion constructions. We think that the language transfer effect can explain the different processing patterns, i.e., Ditransitives are similar in two languages and the similarity in structures and meaning can help learners in acquisition. Resultatives are different in two languages and the differences in form, meaning and usage are advantageous for learners to acquire English resultatives. Caused-motion constructions are L2 unique and without explicit instructions learners cannot acquire them (Littlemore 2006).

(2) The different processing patterns of different constructions of L-group also show the influence of language transfer. As H-group subjects, they have better command of ditransitives than resultatives and they do not acquire caused-motion constructions.

(3) The comparison between the two groups shows the influence of L2 proficiency. The ELAN/P600 helps us to infer that the H-group subjects have the semantic and syntactic processing ability similar to native speakers while the lack of ELAN/P600 in the L-group indicates the lack of corresponding processing ability. The N400 effect shows that L-group

depends on lexical semantics and has not formed the construction.

It is hard to determine the influence of language transfer and L2 proficiency from the behavioral data only. With the ERP data we find evidence of implicit language processing and come to more convincing conclusions.

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