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An ERP study on Chinese natives' second language syntactic grammaticalization

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HIGHLIGHTS

- There are L1–L2 similarity effects on the rate of L2 grammaticalization in Chinese–English bilinguals.
- A novel structure in the L2 is acquirable both implicitly and explicitly.
- Chinese natives are likely to accommodate the neural system on the demands in L2 grammaticalization.

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ABSTRACT

The present study is concerned with how the Chinese learners of English grammaticalize different English syntactic rules. The ERPs (event related potentials) data were collected when participants performed English grammatical judgment. The experimental sentences varied in the degree of the similarity between the first language Chinese (L1) and the second language English (L2): (a) different in the L1 and the L2; (b) similar in the L1 and the L2; (c) unique to the L2. The P600 effect was found in L2 for structures that are similar in the L1 and the L2 and that are unique in L2, but there was no P600 effect of sentence type for the mismatch structures. The results indicate L1–L2 similarity and L2 proficiency interact in a complex way.

1. Introduction

Traditionally, age of exposure and language proficiency are regarded as the two most important factors explaining the distinct processing patterns between the native language (L1) and the second language (L2) [9]. Recent studies indicate L1–L2 similarity determines the possibility of transfer and thus facilitates the learning at the grammatical aspects of an L2, including on-line computation of morphosyntactic information [7,12,13,17,18,21]. But there are fewer consensuses for features that are present in the L2 but absent in the L1. Some argue the novel L2 rules are not acquirable after puberty [3,8]. Others claim that these features could be acquired, although more slowly. The present study concerns how the Chinese learners of English grammaticalize different L2 English syntactic rules.

Grammaticalization is "the instantiation of rule-based knowledge into the learner's real-time language processing system" [12]. The grammaticalization processes should be accompanied by concomitant changes in learners' neural systems. The sensitivity of ERPs (event-related potentials) to syntactic processes makes them appealing for examining the stages of grammaticalization. In the context of an L2 grammaticalization, two ERP components are observed robust. (1) The P600, a positive-going deflection elicited during 500–700 ms period, is attributed to processes of syntactic integration, reanalysis, and repair [6]. The P600 effect has been used with great success to study the degree to which individuals are sensitive to syntactic anomalies, and hence is regarded as an indicator for the grammaticalization process [21]. In an L2, the P600 effect has been reported to be delayed [6], reduced [17], or altogether absent in the beginning learners [7]. (2) The N400, the negativity often elicited in middle-posterior sites approximately 400 ms after stimulus onset, is attributed to the integration of semantic and morphosyntactic information. The N400 observed in L2 syntactic anomalies are interpreted as weaker or slower morphosyntactic processes in beginning stages of grammaticalization [22] or increased semantic integration (wrap-up) demands in L2 [15]. Longitudinal studies revealed that learners' brain response varied systematically along the N400/P600 continuum [12]. Generally, P600 is thought to replace N400 in reasonably fluent bilingual years following the onset of L2 learning. On the other, those who showed faster learning of the syntactic rule would be quicker to progress from the N400 to the P600 stage.

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Table 1
Examples of the three experimental conditions.

Condition (similarity)	Type	Example
SV (different)	Acceptable	*The cats eat the food that Mary gives them.*
	Unacceptable	*The cat eat the food that Mary gives them.*
SN (similar)	Acceptable	*Several rules were difficult to understand.*
	Unacceptable	*One rule were difficult to understand.*
AO (unique)	Acceptable	*These grapevines grow well in sandy regions.*
	Unacceptable	*These grapevines growing well in sandy regions.*

Note: The underlined parts are the critical words.

An intriguing neuroimaging outcome from Chinese/English bilingual studies is the different patterns of developmental change between Chinese learners of English as a foreign language and English learners of Chinese as a foreign language in sentence processing transfer [10,11,19,20]. The asymmetrical hypothesis proposes that, "alphabetic readers have a neural network that accommodates the demands of Chinese by recruiting neural structures less needed for alphabetic reading. Chinese readers have a neural network that partly assimilates English into the Chinese system, especially in the visual stages of word identification" [16]. Accordingly, no matter whether the language rules are shared or conflicting or unique in the two languages, Chinese natives are expected to transfer L1 neurological patterns during processing L2 English.

It is well established that the N400 (not P600) is elicited in L1 Chinese morphosyntactic violation for structures that mismatch in English [1,2]. The robust N400 effect in L1 Chinese is conflicting with the divergent findings in an L2. There is no consensus, especially for properties that exist in an L2 but are absent in Chinese. Some reported an N400 effect in L2 English morphosyntactic violation [1,5], while some found an P600 effect in Chinese learners of Spanish when processing gender and number (the two Spanish structures are absent in L1 Chinese) [2]. The former argues for the transfer effect, while the latter indicates an accommodation effect. Thus, the effect of the asymmetrical hypothesis on Chinese natives' L2 grammaticalization is far from clear.

Focusing on the comparison between L1 Chinese and L2 English, the present study examined three structures: first, different structures (subject–verb agreement, SV) for which the L2 pattern directly conflicts with or competes against the L1 pattern; second, similar structures (subject–number–verb agreement, SN) for which the L1 pattern supports and matches the L2 pattern; and third, unique structures (auxiliary omission, AO) that differ between the two languages without any direct competition or mismatch. Samples for these three structure types were shown in Table 1.

1.1. Subject–verb agreement (SV)

Chinese and English are different in the situation of subject–verb agreement. English verbs must always agree with the number of the subject. Chinese verbs do not have grammatical morphology for marking number, gender, and case. The same verb is used for different tenses and for both plural and singular nominal subject. Learning to apply the subject–verb agreement system is a challenge for Chinese native learners of English.

1.2. Subject–number–verb agreement (SN)

In the case of some collective verbs such as "讨论" (discuss), Chinese and English are similar. Because the collective verb provides information regarding the number of subject, Chinese natives learn to activate the expectations that the subject noun should be in plural forms. In this perspective, the subject–verb agreement rule in Chinese is identical to that in English.

1.3. Auxiliary omission (AO)

Generally speaking, the using of auxiliary is unique in English. English forms the progressive tenses by placing the auxiliary before the participle. For most Chinese sentences, they make no grammatical use of the auxiliary verbs. Chinese native learners of English should learn the grammatical rule explicitly.

Numerous studies proved the P600 effect in syntactic violations for SV, SN and AO structures in English natives [11,12,14,15]. In order to maximize the comparison between English natives and L2 English, we adapted the materials from the above mentioned studies and examined only L2 English processing patterns by following Tokowicz and MacWhinney's study [21]. From the perspective of the language similarity effect and transfer hypothesis, we predict a significant P600 for SN or AO but not for SV. Alternatively, according to the asymmetrical hypothesis, we predict an N400 effect (with or without P600) will be elicited across the three structures.

2. Methods

2.1. Participants

The present study included nineteen English majors (seven men, average age 22.5 years, range 20–26 years) from Beijing International Studies University of China. All reported Chinese as L1 and English as L2. They were exposed to L2 English after age 9.5 and had history of English learning for an average of 14 years. They had English Immersion classes for more than 2 years (range from 2 to 5 years) and all passed the national test for English majors, Level 4. According to a 10-point self-rating scale, the means for their English reading, writing, speaking and speech comprehension were, respectively, 7.75, 7.06, 6.56, and 6.94. All participants had normal or corrected to normal vision and got compensation for their participation.

2.2. Procedure

By following the similar procedure used in Tokowicz and MacWhinney's [21], the sentences were presented in a random order determined by the computer program E-Prime, which also recorded the accuracy and reaction times and sent critical word onset information to the ERP acquisition software. The block of English sentences was counterbalanced. Participants read sentences on a computer screen; half the sentences were well formed and half were not. The participants responded by pressing buttons on a computer keyboard; they pressed a button marked "1" with their left hand to indicate if they thought the sentence was acceptable and a button marked "2" with their right hand if they thought the sentence was unacceptable. During a trial prior to each sentence, a fixation cross appeared at the center of the computer screen. Participants were asked to blink when the fixation was on the screen. Sentences were presented words by words, at the center of the computer screen. Each stimulus remained on the screen for 300 ms with a blank screen appearing for 350 ms between words. After the offset of the final word of the sentence, a blank screen appeared for 200 ms, followed by a question mark "?" that served as