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Research Report

Input-based structure-specific proficiency predicts the neural mechanism of adult L2 syntactic processing

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ARTICLE INFO

Article history:
Accepted 23 March 2015
Available online 31 March 2015

Keywords:
Input training
Structure-specific proficiency
Second language

ABSTRACT

This study used Event-Related Potentials (ERPs) to explore the role of input-based structure-specific proficiency in L2 syntactic processing, using English subject-verb agreement structures as the stimuli. A pre-test/trainings/post-test paradigm of experimental and control groups was employed, and Chinese speakers who learned English as a second language (L2) participated in the experiment. At pre-test, no ERP component related to the subject-verb agreement structures violations was observed in either group. At training session, the experimental group learned the subject-verb agreement structures, while the control group learned other syntactic structures. After two continuously intensive input trainings, at post-test, a significant P600 component related to the subject-verb agreement structures violations was elicited in the experimental group, but not in the control group. These findings suggest that input training improves structure-specific proficiency, which is reflected in the neural mechanism of L2 syntactic processing.

1. Introduction

In a world becoming increasingly more bilingual and multilingual, the question of how second language (L2) learners process sentences has become an important research topic. Language processing requires the correct integration of syntactic information across linguistic units within a sentence, which turns out to be especially difficult for adult L2 learners (Herschensohn, 2004).

Some studies have examined the role of general language proficiency in adult L2 syntactic processing, and have found that the neurocognitive mechanism of L2 syntactic processing differs between high and low proficiency learners, with high proficiency learners being more native-like (Friederici et al., 2002; Gillon Dowens et al., 2011; Morgan-Short et al., 2012). In the study of Friederici et al. (2002), syntactic word category violations elicited early anterior negativities followed by a P600 component in high proficient learners. In Osterhout et al. (2006), French subject-verb agreement violations and correct control sentences were

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http://dx.doi.org/10.1016/j.brainres.2015.03.039
0006-8993/

presented to American learners of French in a grammaticality judgment task. A subset of the participants exhibited an N400 to the ungrammatical structures after only one month of French learning. This effect was replaced by a small P600 after four months of learning, the amplitude of which subsequently increased with proficiency. Based on ERP studies of general language proficiency, Steinhauer et al. (2009) put forward a proficiency-based neurocognitive model of L2 development. They proposed that the neurocognitive mechanism of L2 syntactic processing will experience the phases as N400, small P600, big P600, and the biphasic components of LAN and P600, in that order, along with improvements of general language proficiency.

However, the picture painted by general language proficiency is not very clear yet. On one hand, even when proficiency is controlled or well matched, different processing patterns can be observed between groups and within groups (Dussias et al., 2007; Pliatsikas and Marinis, 2013; Sabourin and Stowe, 2008; Tanner et al., 2013). On the other hand, the issue of whether general language proficiency can predict which syntactic structures will be successfully processed by adult L2 learners is still indeterminate. In some studies, low proficiency L2 learners showed on-line processing patterns similar to native speakers (Tokowicz and MacWhinney, 2005; Bowden et al., 2007), while in others, high proficiency L2 learners showed non-native like online processing patterns (Ojima et al., 2005; Chen et al., 2007; Sabourin and Stowe, 2008). In short, although general language proficiency seems to have dramatic impact on L2 syntactic processing, perhaps some factors that are correlated with and thus confounded with proficiency might influence the online-processing patterns of adult L2 learners. It is obvious that L2 proficiency is strongly associated with the amount of L2 input or experience (Bowden et al., 2013). In fact, in adult L2 syntactic processing, some researchers highlighted the role of input in syntactic processing (Muñoz and Singleton, 2011; Hopp, 2013). Therefore, it is possible that there might be certain relationship among input, proficiency, and syntactic processing.

In L2 acquisition, especially in early childhood L2 acquisition, a number of studies have claimed that variation in input to each language could influence bilingual children's acquisition rates, which in turn could be a determining factor of the differences between bilingual and monolingual children. The effects of different input sources, including language use, output, amount of exposure, watching TV, reading, and so on have been observed for a range of different aspects of bilingual children's proficiency, such as morphosyntax (Marchman et al. 2004; Gathercole, 2007; Place and Hoff, 2011) and verbal morphology (Nicoladis et al., 2007; Paradis, 2010). For instance, Marchman et al. (2004) found that Spanish–English bilingual toddlers' input percentage in each language was significantly and positively correlated with their morphosyntactic achievements in that language based on their parent report data. Gathercole (2007) found that children's morphosyntactic abilities were directly related to their exposure to each language at home and at school. Place and Hoff (2011) demonstrated that the properties of language exposure influence 2-year-olds' bilingual proficiency, and children's language development was related to the amount of their language exposure. To summarize, in child L2 acquisition, recent studies seem to suggest that input predicts language proficiency. In the syntactic literature of adult L2 learners, though some studies have highlighted the role of input in L2 syntactic acquisition (Muñoz and Singleton, 2011; Hopp, 2013), this factor has received little attention in this domain. Recently, De Carli et al. (2014) asked Italian–Spanish adult bilinguals to perform a pragmatic bilingual test and a battery of cognitive tests. Their results showed that continued language practice is a major factor influencing bilingual proficiency, and the effects of proficiency may be weakened when bilingual experience becomes occasional or ceases. In fact, compared with monolinguals, adult L2 learners received rare input from their living environment and classroom learning, which may negatively bias their performance on online processing tasks. Therefore, it is necessary to explore the relationship among input, proficiency, and syntactic processing.

Compared with behavioral methods, event-related potentials (ERPs) with their excellent temporal resolution make it possible for researchers to investigate the neural mechanisms of real-time language processing. In L2 syntactic processing, two main components related to syntactic processing have often been found, namely the N400 and the P600. The N400, a central/posterior bilaterally distributed negativity, usually indexing processing of lexico-semantic violations, generally occurs at about 300–500 ms after the onset of the stimulus. In some studies, the N400 was regarded to be associated with syntactic processing of low proficient L2 learners (Steinhauer et al., 2009; Morgan-Short et al., 2012). The P600, a late centro-parietal distributed positivity, has been linked to controlled processing, such as syntactic integration and structural reanalysis (Hahne, 2001; Van Hell and Tokowicz, 2010; Bowden et al., 2013). The presence of a P600 in processing L2 grammatical violations has been taken as evidence that L2 learners have "grammaticalized" the particular structure under investigation, that is, they have incorporated the relevant rule-based grammatical knowledge into their online L2 processing system and engaged in the same neuro-cognitive processes as native speakers (Osterhout et al., 2008; McLaughlin et al., 2010; White et al., 2012).

The present study aimed to explore the role of input-based structure-specific proficiency in adult L2 syntactic processing. First, we focused on the structure-specific proficiency with English subject-verb agreement. White et al. (2012) proposed that proficiency with specific syntactic structure may be a much better predictor than general language proficiency of online L2 syntactic processing. Therefore, we trained the participants to reach high structure-specific proficiency. Second, rather than enrolling participants with high general language proficiency, we selected the participants with relatively low general proficiency and randomly allocated them either to the experimental group or to the control group. Previous studies have found that it was difficult for Chinese (L1) – English (L2) learners with relatively high general language proficiency to process subject-verb agreement structures (Chen et al., 2007; Jiang, 2004). We trained the experimental group with subject-verb agreements and the control group with other structures. If the experimental group could successfully process the subject-verb agreement after intensive training, then we can expect that input-based structure-specific proficiency, rather than general language proficiency, would result in successful syntactic processing and that input may be the important factor mediating proficiency effect.