Cognitive Neural Mechanism in Second Language Learning

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Mini review

This paper sums up the existing studies on the neural features of second language (L2) from the perspective of learning experience. After combing and analyzing the cognitive neural mechanism of L2 learning, it is concluded that: [1] L2 learners rely on the neural network of the native language (L1) to learn and process L2; [2] The L2 proficiency is positively correlated with the use of L1 neural network in the processing of L2; [3] L2 is learned through its interaction with L1. In future, modern cognitive neuroscience techniques like functional magnetic resonance imaging (fMRI), event-related potential (ERP) and transcranial direct current stimulation (tDCS) should be applied more frequently to discuss the cognitive neural mechanism of L2 learning in natural and lab environments. This research sheds new light on the promotion of L2 learning. Second language (L2) refers to a language that is not the native language (L1) of the speaker, but that is used in the locale of that person.

The number of L2 learners is increasing day by day across the world. The European Commission once conducted a survey on L2 learning, revealing that 56% of Europeans can communicate in two languages. China also boasts a huge number of L2 learners. Against this backdrop, it is very meaningful to promote the research into the variation in L2 neural features with the learning experience on L2 neural features through comparison between proficient bilinguals [2-4]. Their research reveals the positive correlation between that the cognitive efforts in L2 processing and the proficiency of the bilinguals. For instance, lower-proficiency bilinguals are more active in the frontal cortex and parietal cortex than high-proficiency ones, because they have to pay more cognitive efforts to complete vocabulary reading tasks [5]. It is also found that low-proficiency bilinguals are more activated in the posterior visual cortex during the processing of L2 vocabulary [6]. In addition, the involvement of L1 neural network in L2 processing and learning depends on the age of L2 acquisition. Kim et al. contrasted the neural mechanisms of early bilinguals (those who start to learn L2 in infancy) and late bilinguals (those who start to learn L2 after the age of 10). The results show that the L1 and L2 of late bilinguals are isolated from the Broca's area, while those of early bilinguals share similar neural features in that area [7]. Some other scholars directly examined the acquisition of L2 neural features through learning, using the language learning paradigm in the lab environment [8-12]. In this way, they managed to observe the variation in L2 neural features with the learning experience in the short term and separate the cognitive neural mechanism of learning from the different aspects of the L2.

In terms of auditory and verbal learning, Wang et al. investigated the cognitive neural mechanism of native speakers for the learning of and differentiation between Chinese tones [13] and learned that the tone processing activates the brain areas related to auditory processing, including Broca, Wernicke, auditory cortex and accessory motor areas. Wong et al. examined the cognitive neural mechanism of native speakers learning English pseudo tones with Chinese tones [14] and concluded that those with higher learning scores are more active in the speech processing brain (left posterior temporal gyrus), while those with lower scores are more active in the right lateral temporal gyrus and the right lower frontal gyrus. Besides tone learning, the scholars also studied the cognitive neural mechanism of L2 phoneme learning. Callan et al. probed into the

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studies on language learning in the lab environment reveal that similarity is regulated by the age of L2 acquisition. In addition, the shares more and more neural features with the L1; of course, the studies agree that, with the improvement of L2 proficiency, the L2 of the cognitive neural mechanism of L2 learning. The bilingual in the lab environment have greatly deepened the understanding conclusions. In summary, bilingual research and language learning averaging and individual differences, leading to many important and experimental paradigms have been adopted to study the and the ventral temporal gyrus.

Further research on reading shows that the neural mechanism differs with the aspect of L2 vocabulary. Based on the phased artificial language training paradigm, Xue et al. looked into the cognitive neural mechanism of the L2 font, speech and semantic learning [8], and observed that spindle gyrus on both sides were less activated due to glyph learning but enhanced after speech and semantic learning. These results show that the L2 learning experience in grapheme, voice and semantics plays different roles in the activity of spindle regions in critical brain regions. In addition to the different aspects of vocabulary, it is also found that the neural mechanism differed with the learning of different word systems in depth of orthography. Using the artificial language training paradigm, Mei et al. trained two groups of matched native speakers to learn the same artificial language in alphabetic script and graphic text, respectively. It is learned that phonetic alphabet learning activated the upper left margin of the left margin, and the graphic and literal learning activated the right orbitofrontal cortex and the ventral temporal gyrus.

The results provide evidence of brain science for dual routes model [19]. A variety of modern brain imaging techniques and experimental paradigms have been adopted to study the cognitive neural mechanism of L2 learning, and the interaction between L1 processing and L2 learning from the angles of group averaging and individual differences, leading to many important conclusions. In summary, bilingual research and language learning in the lab environment have greatly deepened the understanding of the cognitive neural mechanism of L2 learning. The bilingual studies agree that, with the improvement of L2 proficiency, the L2 shares more and more neural features with the L1; of course, the similarity is regulated by the age of L2 acquisition. In addition, the studies on language learning in the lab environment reveal that L2 learners rely on the L1 neural network to learn L2. In future, modern cognitive neuroscience techniques like functional magnetic resonance imaging (fMRI), event-related potential (ERP) and transcranial direct current stimulation (tDCS) should be applied more frequently to discuss the cognitive neural mechanism of L2 learning in natural and lab environments.

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References


