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研究課題名(和文) Neurocognitive basis of Japanese learning as a second language

研究課題名(英文) Neurocognitive basis of Japanese learning as a second language

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研究成果の概要(和文)：本研究では、中国語(表語文字)を母国語としおよびベトナム語(表音文字)を母国語としの参加者の2つのグループが日本語を外国語(L2)として習得した年齢と日本語の熟練度で一致していたが、日本語の言語課題の正答率行動に差はないにもかかわらず、それらの間では依然としてかなり異なる脳活動パターンがありました。

上記の結果から、外国語学習で重要な役割を担うと考えられる、母国語の表記体系が、文字言語だけでなく、音声言語の表出と理解に影響し、その神経基盤が左頭頂側頭葉に分布することが示された。

研究成果の学術的意義や社会的意義

Unlike the native language (L1), which is considered to be an innate ability and acquired universally in the evolutionary process of human being, the nature of the second language (L2) is a kind of skill and the neural system involved in the operation of L2 may express the cultural influence of L1.

研究成果の概要(英文)：The present study shows that although two group of participants of Chinese (morphemic) and Vietnamese (phonetic) native speakers had been matched in age of acquisition and Japanese language (L2) proficiency level and despite having no differences in behavioral performance (reaction time and accuracy) on demanded Japanese language tasks, which indicated there is no difference in their L2 proficiency level on task performance, there still were significantly different patterns of brain activities between them.

Our results strongly demonstrated that cultural difference of L1 influences how our brain processes the L2, not only the reading process but also the comprehension and speaking out. This in turn may reflect the nature of acquisition of L2 is a kind of skill of our human being, which can be interfered by educational strategies.

研究分野：Neuroscience

キーワード：bilingual fMRI language function cognitive neuroscience

様式 C-19、F-19-1、Z-19、CK-19 (共通)

1. 研究開始当初の背景

Today, approximately 80% of the world population is estimated as being able to read and write in their native language. The acquisition of such literacy skills is essential for long-term success in academic and professional life and known to impact a broad range of human activity throughout lifespan. On the other hand, speaking and understanding one or more non-native languages (L2) are also becoming an increasingly important skill in the globalization era, It is unknown, however, how these two different skills interact with each other, that is, whether and how the acquired knowledge about native writing systems affect the way people speak and understand in their non-native languages.

Although the influence of first language (L1) writing system on how the brain processes a non-native language (L2) has been suggested, it is not yet clear whether definitive effect exists and to which extent. Japanese language provides the opportunity to tackle this question, for having both morphemic (kanji) and phonetic (kana) scripts in it. When learning Japanese as a foreign language, learners may use different cognitive and learning strategies which are influenced by the characteristics of their native language writing systems. For example, in the case of a Chinese speaker who uses a writing system with high homology with Japanese kanji, Japanese vocabulary learning is expected to depend on a strategy through semantic memory strongly associated with kanji. On the other hand, in the case of learners using alphabetical system such as Vietnamese, it can be inferred that vocabulary learning depends on phoneme memory differently. Such influence of native language literacy on learning strategy of foreign languages may continue to work even after vocabulary knowledge has established as a long-term memory. We predict that the cultural influences of native language writing system as described above act not only in reading and writing but also in expression and understanding of spoken language. This study is designed to examine our prediction and explore the associated neural substrates.

2. 研究の目的

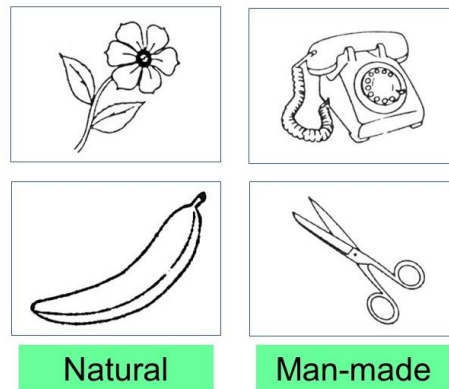
This study is designed to examine the influence of native language (L1) literacy background on neural processing of non-native language (L2) and explore the associated neural substrates by comparing brain activation while native speakers of Chinese (morphemic) and Vietnamese (phonetic) languages produce and recognize speech sounds in their L2 (i.e., Japanese)

3. 研究の方法

Two groups of late and highly proficient Japanese learners with different writing systems for their L1, one morphemic (Chinese) and the other phonetic (Vietnamese) were examined. Study criteria for the Chinese and Vietnamese speakers included high proficiency for Japanese language as proven by N1 certification of the Japanese Language Proficiency Test (JLPT) and/or the participation of them in undergraduate programs carried out in Japanese universities, and have been living in Japan for at least 6 months at the time of conducting this experiment. A questionnaire confirmed that no

one in either group started learning Japanese language before the age of 12. Thus, all participants were defined as late L2 learners.

Both groups of participants performed language producing and language comprehending tasks inside the fMRI scanner. For the language producing task, i.e., picture naming (PN) task, participants had to overtly name the visually presented objects in Japanese. For the language comprehending task, i.e., semantic decision (SD) task, participants listened to audio recording of object names in Japanese words and decided if the words represented man-made or natural objects.



Examples of experimental stimuli

Event-related design was used. Each MRI run consisted of 160 trials, including 120 task trials presented in a random order, intermixed with 40 baseline trials, lasting about 20 minutes in lengths (600 volumes of 2s each). Each subject participated in two runs of picture naming task and two runs of semantic task. MRI data were acquired on a Siemens TRIO 3.0-T MRI system (Siemens, Erlangen, Germany). For functional volumes, a blood oxygen level-dependent (BOLD) sensitive T-2*-weighted echo planar imaging (EPI) gradient echo sequence with the following parameters was acquired: TR = 2000 ms; TE = 30 ms; flip angle = 90°; matrix = 64 × 64; FOV = 192 × 192 mm²; and slice thickness = 3 mm. After acquiring the functional images, anatomical images were acquired using a transverse magnetization prepared rapid acquisition with gradient echo (MPRAGE) T1-weighted sequence (TR = 2000 ms; TE = 4.38 ms; flip angle=8°; matrix=224 × 256; FOV=246 × 230mm²; slice thickness= 1 mm).

fMRI data was analyzed using SPM8.

4. 研究成果

Despite having no significant differences in behavioral performance, the Chinese group showed significantly higher activity in peri-central area while the Vietnamese showed greater activation in the left anterior superior temporal gyrus. For the task effects, the Chinese group showed significantly higher activity in both superior occipital lobes, while Vietnamese speakers produced stronger activities of the left superior temporal

lobe in PN task (Figure 1). Similarly, in the SD task, higher activation in the left parietal lobe was seen in Chinese group, whereas the Vietnamese group showed greater activation in the left anterior superior temporal lobe (Figure 2).

Figure 1

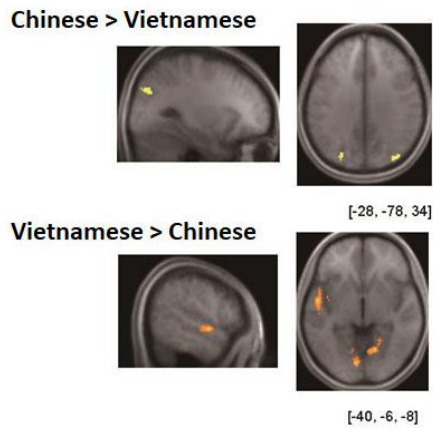
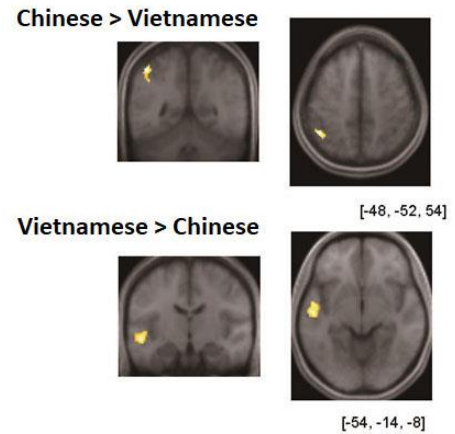


Figure 2



Effect of native language literacy on speaking

Effect of native language literacy on comprehension

The present study aimed to investigate whether and to what extent different literacy skills in L1 cause a measurable impact on later learning of L2. Because previous studies have identified several major determinants for the difference in brain activation of L2, such as age of L2 acquisition, L2 proficiency level, and amount of L2 exposure, we controlled for the factors in the present study. Additionally, there was no significant difference in the behavioral performances in both PN and SD tasks between the Chinese and Vietnamese groups. Therefore, the observed difference in brain activation patterns between Chinese and Vietnamese groups should be attributed to the difference in linguistic skills associated with the writing systems of their L1.

Previous bilingual studies showed that the left pre-/ postcentral gyrus are involved in L2 acquisition and processing for late L2 learners. In the present study, the behavioral performance for the Chinese group was slightly poorer than that of Vietnamese group, although this between-group difference did not reach significance. Hence, it is possible that stronger activation of the left pre-/post central gyrus for the Chinese group reflects an increase in cognitive demands necessary during L2 processing.

Since Vietnamese language is representative for a syllabic-based language system, Vietnamese participants are likely to more rely on phonological information converted from print than the Chinese group, and therefore may more greatly recourse to the phonological system even during processing of L2. This seems to be supported by the finding that the Vietnamese group showed greater activation in the left anterior superior temporal gyrus previously associated with phonological processing.

In conclusion, with considering that this study had matched the participants in age of acquisition and L2 proficiency level, our results demonstrated that the cultural difference of native language influences not only the reading process but also the comprehension and speaking out (language production) of the second language.

The native spoken languages, which are acquired during the evolutionary process, are universal abilities of our human being. However, unlike the L1, which is considered as an innate ability, the expression of L2 are influenced by the literacy of L1, as shown in the present study. This may reflect the nature of the second language is a kind of skill of our human being.

5. 主な発表論文等

〔雑誌論文〕（計 0 件）

〔学会発表〕（計 2 件）

〔図書〕（計 0 件）

〔産業財産権〕

○出願状況（計 0 件）

名称：
発明者：
権利者：
種類：
番号：
出願年：
国内外の別：

○取得状況（計 0 件）

名称：
発明者：
権利者：
種類：
番号：
取得年：
国内外の別：

〔その他〕

ホームページ等

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