Journal of Neurolinguistics 33 (2015) 1–2

Contents lists available at ScienceDirect

Journal of Neurolinguistics

journal homepage: www.elsevier.com/locate/jneuroling

Editorial

Towards an integrative understanding of the neuroanatomical and genetic bases of language: The Chinese context

Language as a hallmark of human evolution has been investigated by scientists from many disciplines including neuroscience, genetics, psychology, linguistics, and education. Understanding the neuroanatomical and genetic bases of language is not only important for theoretically elucidating the universality and specificity of language processing and language acquisition but also significant for early identification of language disorders and for planning of neurosurgery on patients with brain diseases. For example, when neurosurgeons perform an operation on a patient with brain tumor, they need to rely on scientific knowledge of which brain areas support language and motor skills in order to preserve these critical life skills for the patient after the surgery. Thus, the promises and challenges of translating basic neuroimaging research into clinical practice require us to carefully investigate the cortical organization of individual languages.

The Chinese language differs from Indo-European languages in many important aspects. For instance, spoken Chinese uses pitch contours (i.e. tones) to distinguish lexical meanings, but most Indo-European languages do not use a tonal system at the lexical level. At the writing system level, Chinese is based inherently on the association of meaningful morphemes with logographic units (i.e. characters), whereas alphabetic systems are based on the association of phonemes with graphemic symbols (i.e. letters). At the grammatical level, Chinese does not use inflectional morphology to indicate tense, number, or gender as in languages that have rich morphosyntax. Is the neural system that mediates language processing dependent on these language-specific properties, or is it universal across languages? How is second language learning influenced by the specific properties of one's native language? Can we capture the neuroanatomical changes as language learning takes place? Are there common candidate genes associated with language disorders in Chinese as in other languages? Scientists have attempted to address these questions in the last decade through a variety of neuroanatomical, genetic, and computational approaches. This Special Issue represents such an attempt on our part to integrate the latest research and address the important questions with studies from the Chinese language context.

Our goal for this Special Issue is to present the state-of-the-art development in neuroimaging and genetic research, using the Chinese language as an important test ground and a critical window for understanding the relationship between language and the brain. The Special Issue grew out of a research symposium of the same title held in October 2013 in Hong Kong, China. The selected papers can be grouped into three categories: fMRI/sMRI/fNIR studies, EEG/ERP studies, and genetic studies. The different neuroscience techniques and methods have allowed researchers to address different questions in the past, given the nature and spatio-temporal precision of the technologies associated with each method. As demonstrated here, scholars have also used these methods to understand the spatial and temporal properties of language processing and language learning in the Chinese context.

http://dx.doi.org/10.1016/j.jneuroling.2014.11.001

First, the fMRI/sMRI/fNIR studies were aimed at identifying cortical and subcortical correlates of grammatical processing of the Chinese language (Feng et al.), the lateralization patterns of dyslexic children (Xu et al.), the processing of syntactic complexity (Ansaldo et al.), and the interplay and competition between the native language and second language (Zinszer et al.). There is also strong evidence from studies here (and elsewhere) that the human brain demonstrates tremendous neuroplasticity as a result of second language experience, both functionally (Yang et al.) and structurally (Abutalebi et al.; Qi et al.), and the functional and structural neural correlates might also be predictive of second language learning success (Qi et al.; Yang et al.). It is important to note in this regard that the neural differences as measured by fMRI and DTI reflect clearly the language-specific properties of Chinese and their impact on representation, processing, and learning. Second, the EEG/ERP studies took advantage of the high temporal resolution of the technique to examine the time course of early sensory processing of Mandarin tones (Krishnan et al.), tone sandhi in speech production (Zhang et al.), component pathways to orthographic learning (Chang et al.), and world knowledge integration and sentence processing (Xu et al.). These studies have identified important eletrophysiological markers of language-specific processing of, for example, Mandarin lexical tones and Chinese characters. Finally, the genetic studies investigated how the candidate gene DCDC2, previously identified as relating to orthographic coding, affects brain activity at N170 in young Chinese readers (Su et al.), and whether candidate genes CMIP and ATP2C2, previously implicated in Specific Language Impairment, are associated with developmental dyslexia in the Chinese population (Sun et al.). These genetic studies indicate that it is important, on the one hand, to examine gene by environment interactions, and on the other, to understand the potentially common genetic underpinnings of different phenotypes and disorders.

Recent excitement associated with the study of the Chinese language has stemmed from two areas of progress: the understanding of the unique properties of the Chinese language, and the rapid development of neuroscience-based methods and technologies including functional and structural neuroimaging and genetic analysis. The articles in this Special Issue provide an excellent sample of studies that showcase the progress in both areas. In particular, they provide an integrative picture on how the orthographic, lexical, and grammatical properties can impact the representation, processing, and learning of native and non-native languages, and how such impacts are reflected in and subserved by individual brain regions, brain networks, and genetic structures. Different methods may also provide converging evidence, as shown in these studies, for example, in pointing to how lexical tones might engage the right hemisphere more strongly in both the native language (fMRI, fNIR, EEG) and the second language (DTI). Finally, the different methods are also complementary of each other in revealing the spatial and temporal properties of processing and learning, as reflected in this Special Issue. We hope that the articles here will inspire a new wave of studies in the neuroscience of language focused on comparative approaches, so that we can further elucidate the relationships among language, brain, and gene.

Acknowledgments

Preparation of this Special Issue was supported by a grant from the National Strategic Basic Research Program (“973” Program) of the Ministry of Science and Technology of China (2012CB720701), a grant from the National Natural Science Foundation of China (61372006), and grants from the US National Science Foundation (BCS-1157220; BCS-1338946).

Li Hai Tan
Neuroimaging Unit, Department of Biomedical Engineering, School of Medicine, Shenzhen University, Shenzhen 518060, China
E-mail address: tanlh@szu.edu.cn

Ping Li
Department of Psychology, Center for Brain, Behavior, and Cognition, Pennsylvania State University, University Park, PA 16802, USA
E-mail address: pul8@psu.edu