Editorial

Application of Medical Imaging Techniques to Studies of Human Language Processing and Acquisition

Satoru Yokoyama

Department of Functional Brain Imaging, Institute of Development, Aging, and Cancer, Tohoku University, Japan

Abstract: Language is one of the most important higher brain functions for humans. Using medical imaging techniques, such as MRI, PET, MEG, EEG, and NIRS, scientists have been investigating how the brain processes and acquires language. This special issue concerns the processing and acquisition of languages, and the investigations that apply medical imaging techniques to functional brain imaging studies. Hence the purpose of this special issue is to collect articles on studies of language processing and acquisition in humans utilizing medical imaging techniques. This special issue will contribute to uncovering the mechanisms of language processing and acquisition, and also to clarifying some of the questions concerning the clinical aspects of language deficits.

APPLICATION OF MEDICAL IMAGING TECHNIQUES TO LANGUAGE STUDIES

Language is one of the most important higher brain functions for humans, because in our daily lives we have to live with others and to communicate with them. All humans can acquire at least one language by themselves and can process it, if they have a language environment. Since language processing is conducted in the brain, there is no doubt that medical imaging techniques are highly useful to examine how the brain uses or processes a language.

Of course, lesion studies for language have been conducted using medical imaging to see to see how certain brain injuries affect language. However, now we can use medical imaging techniques to not only see brain structures, but also to measure brain activation. This enables us to use brain activation data to investigate how our minds process language. Hence, researchers can use medical imaging techniques, such as functional magnetic resonance imaging (fMRI), positron emission topography (PET), electroencephalography (EEG), magnetoencephalography (MEG), and *near-infrared* spectroscopy (NIRs), to measure brain activation patterns during language processing.

THE PURPOSE OF THIS SPECIAL ISSUE

Because of recent developments in medical imaging techniques, many researchers have applied such techniques to researching human cognitive processes, including language processing. This special issue concerns the processing and acquisition of both one's mother language and foreign languages, as well as the investigations that apply medical imaging techniques to functional brain imaging studies. Hence, the purpose of this special issue is to collect articles on studies which utilize medical imaging techniques to investigate language processing and acquisition in humans.

ARTICLES IN THIS SPECIAL ISSUE

This special issue includes two interesting review articles on language processing in the human brain, and one experimental research paper on human language processing using the technique of functional brain imaging.

In the first article, Bornkessel-Schlesewsky and Schlesewsky review the role of the left prefrontal cortex, including Broca's area which has been assumed to be one of the most important regions for human language processing.

*Address correspondence to this author at the Department of Functional Brain Imaging, Institute of Development, Aging, and Cancer, Tohoku University, Japan; Tel: +81-22-717-7988; Fax: +81-22-717-7988;
E-mail: yokoyama@idac.tohoku.ac.jp

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There is an ongoing debate about whether Broca's area works as a neural substrate specific to language processing, or whether it's involved in several cognitive processes including language processing (e.g., Burns and Fehy [1]; Friederici [2]). In this review article, they argue that the processing of linguistic sequence and semantic information, two essential components of language, is supported by a more general cognitive process, and that the prefrontal cortex is involved in these processes in the human brain. Additionally, they discuss the roles of each sub-region of the prefrontal cortex.

Hashimoto, *et al.,* takes a cross-linguistic perspective on previous neuroimaging studies of sentence comprehension in the second review article. Focusing on studies using similar sentence comprehension tasks but different languages as stimuli, they categorize these studies into studies on SVO or SOV canonical word order languages. In previous literature, the processing strategy for sentence comprehension was assumed to be different for SVO and SOV languages (e.g., Bornkessel-Schlesewsky and Schlesewsky [3]; Yokoyama *et al.,* [4]). Indeed, previous studies reported different brain activation patterns for sentence comprehension in both languages. It's on these results that Hashimoto *et al*.'s review article is based.

Included lastly in this issue is a report by Koizumi *et al.* on the results of their fMRI experiment on sentence comprehension in healthy adults. The results are partially related to Bornkessel-Schlesewsky and Schlesewsky's review article in terms of the role of the sub-regions of the prefrontal cortex. This study found that the left prefrontal cortex is involved in several types of scrambling processes in different ways. Scrambling processes are a type of the syntactic operation in sentence comprehension. Hence, both reports suggest that several sub-regions having different functions exist in the prefrontal cortex.

Since all of the articles which have been included in this special issue relate to relatively fundamental research rather than clinical research, they make a relatively small contribution to medical imaging research for language. However, clinical research using medical imaging techniques would be highly meaningful for clarifying the role of one of the most important brain regions for language processing, the left prefrontal cortex, and for clarifying the effect of cross-linguistic difference/variability on language processing in our brains.

Finally, I would like to thank all of the contributors to this special issue for their time and effort.

CONFLICT OF INTEREST

None declared.

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