Language as a Window into the Brain and its Pathologies

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Introduction

Traditionally, psycholinguistics and neuropsychology have been informed by conspicuous pathologies such as aphasia, which revealed the localization of some of the processes involved in language comprehension and production, in particular of those related to lexical access and morphological and syntactic processing. One of the main objectives of this symposium is to explore whether psychiatric pathologies are informative of the processes involved in meaning construction and comprehension, in the same way that aphasia research has contributed to our knowledge of the neurobiology of other aspects of language (Elvevåg, Helsen, De Hert, Sweers, & Storms, 2011).

The kind and type of language disturbances displayed by patients can shed some light on the underlying pathologies, hopefully suggesting tractable lines for further research. Conversely, an improved understanding of the mechanism of psychiatric diseases can promote the understanding of some intricate aspects of non-pathological language production. In this Symposium we bring together different perspectives to the study of language in pathology and as a manifestation of the underlying neural networks' workings. The symposium is thus centered around language, both from an empirical perspective and a modeler's point of view. We describe this two aspects in the following sections.

Language analysis in pathology

The last decades have seen a tremendous increase in the development of techniques to study the physiological and pathological processes in the brain. Among them, the study of language production and comprehension has been recognized as a central research topic. The disturbances in language vary between different brain pathologies. For instance Garrard and coworkers (Garrard, Maloney, Hodges & Patterson, 2005) have shown that Alzheimer's disease can notoriously affect the way lexical items are selected and used by a writer, even before the symptoms of the disease are apparent. Several measures of language comprehension and production have been used to assess the presence and course of schizophrenia and mania. Classically, for patient state evaluation, there is a variety of fine-grained rating scales of the coherence of speech and communication, such as the Scale for the Assessment of Thought, Language and Communication (Andreasen & Grove, 1986). The use of these scales requires extensive training and the results remain open to variance across raters. Several recent approaches attempt to devise automatic or semiautomatic methods aimed at diagnosis or with the purpose of understanding the cognitive deficits involved (Cabana,Valle-Lisboa, Elvevåg, & Mizraji, 2011). The description of the underlying causes of these alterations is specially relevant when these methods are combined with imaging and modeling data. We turn next to models.

From data to models

The complex patterns of linguistic productions, with the associated generation of measurable neurobiological responses, can only be interpreted in light of models and theories. The other aspect of the symposium is the use of neural models and theories in order to interpret the data, to propose new experiments and to suggest new therapeutic avenues for research. The models of choice are based on connectionist approaches. There is an increasing tendency to develop connectionist models of psychiatric pathologies (e.g. Hoffman, Grasemann, Gueorguieva, Quinlan, Lane, & Miikkulainen, R., 2011). At the symposium two types of models will be discussed. One type is that of coarse-grained models that when deteriorated can lead to alterations of language processing and production that mimic some of the properties displayed by language produced by patients (Valle-Lisboa, Pomi, Cabana, Elvevåg & Mizraji, 2013). This type of model is aimed at the level of brain networks as

derived from fMRI. The other type of model is concerned with the syntactic level of description and its expression through brain potentials as measured through EEG (beim Graben & Potthast, 2012). Interestingly, both type of models can be related through their basic assumptions (i. e. multiplicative synaptic interactions).

The symposium will consist of a 10 minute introduction by the chairman followed by 20 minute talks by each speaker and followed by a round of discussion.

Speakers

Dr. Peter Garrard (pgarrard@sgul.ac.uk)

Dr Garrard is a Neurologist with vast experience in the study of semantic dementia and Alzheimer's disease, in particular the linguistic manifestations of those pathologies. He has developed several diagnostic procedures and is currently exploring the symptoms and neuroimaging manifestations of patients suffering atypical dementias. He is Reader in Neurology at St George's, University of London and Honorary Consultant Neurologist, St George's Stroke and Dementia Research Centre, UK.

Dr. Peter beim Graben (peter.beim.graben@hu-berlin.de).

Dr beim Braben is a Physicist who works in Cognitive Neurodynamics, Computational Psycholinguistics and Computational Neuroscience. His recent work is related both to the processing of sentences by neural networks and the electrical potential measurements of neural activity. He is DFG Heisenberg Fellow for Cognitive Neurodynamics, at the Institut für deutsche Sprache und Linguistik, Humboldt-Universität zu Berlin, Germany.

Dr. Brita Elvevåg (brita@elvevaag.net).

Dr Elvevåg is a research psychologist interested in cognitive neuropsychiatry, cognitive neuroscience, and the cognitive, neural and genetic basis of language in healthy individuals and those with clinical conditions that affect the brain, especially psychosis and dementia. She is Professor of Psychiatry in the Department of Clinical Medicine at the University of Tromsø, and also at the Norwegian Centre for Integrated Care and Telemedicine at the University Hospital of North Norway Tromsø, Norway.

Dr. Eduardo Mizraji (mizraj@fcien.edu.uy)

Dr. Mizraji is a Biophysicist who studies neural network theory and the implementation of high level cognitive activities through the use of neural models. The part of his recent works more related to the symposium are concerned with discourse generating neural models, and the emergence of symbolic activities in a neural network. He is Professor of Biophysics in the School of Sciences, Universidad de la República, Uruguay.

Chairman and Organizer

Dr. Juan Valle Lisboa (juancvl@fcien.edu.uy)

Dr Valle Lisboa is a Biophysicist and Neurobiologist interested in theoretical neuroscience and the neural basis of high level cognition. His latest works include the development of language production models and their deterioration in pathologies as well as neural models of lexical representation. Dr Valle Lisboa is at the School of Sciences and the School of Psychology at the Universidad de la República, Uruguay.

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