

Electrophysiology of language

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Class times: Monday/Wednesday/Friday (August 14th – 28th; N.B. only 7 classes!)

Course description:

The last ten years of the 20th century might well be classified as the “decade of the brain”. With the advent of new neuroscientific methodologies, the field of cognitive neuroscience thrived. The study of language posed no exception to this general tendency: in addition to providing a vehicle for more general goals in neuroscientific research, language soon became one of the major domains of neurocognitive investigation in its own right. The beginning of the 21st century has seen a further continuation of this development within linguistics: neurocognitive methods are currently not only in use in the majority of psycholinguistic laboratories, they have also sparked the interest of a number of researchers with a primarily theoretical orientation.

This course provides a state-of-the-art introduction to one of the main neurocognitive methods used in the investigation of language: electroencephalography (EEG) and, primarily, event-related brain potentials (ERPs). It encompasses a brief introduction into the history of the ERP method and its basic premises, followed by a critical review of the physiological and functional nature of language-related components (e.g. left-anterior negativities, N400, P600) and the scope of their interpretation. Seeing that the correspondence between ERP components and particular language domains is not one-to-one, methods for approaching this indeterminacy will be presented. Finally, language-related ERP components will be discussed in the context of current neurocognitive models of language processing.

Requirements

A 10-15 page essay due by the end of the summer school. The essay should critically evaluate one of the topics covered during the course, drawing upon relevant primary literature. [Because of the short notice of the instructor change, essays related to Doug Saddy’s original reading list will also be accepted.]

Schedule

1. Introduction

The session will begin with a brief motivation for why ERPs are a useful tool in language research and with some historical remarks on the human EEG. We will then briefly explain the physiological bases of the EEG, before describing the relationship between the EEG and ERPs. Finally, we will introduce basic concepts in data acquisition and analysis.

Readings: (Garnsey, 1993; Otten & Rugg, 2004; Rugg & Coles, 1995)

2. ERP components: the classical view

The notion of an “ERP component” has long played a central role in the interpretation of ERP data. Components are effects that can be described and classified according to a number of parameters (e.g. a particular latency and polarity) and that can be associated with (a) particular functional interpretation(s). This session will provide a comprehensive introduction to the most important language-related ERP components and their “classical” interpretation. Components to be discussed include the N400, P600, anterior negativities and a number of slightly less well-known components.

Readings: (Kutas *et al.*, in press)

3. The N400: anatomy of a component

In this session, we will use the “most classical” of the classical ERP components (the N400) as a test case in order to show that functional inferences drawn from word-level processing cannot be straightforwardly transferred to the sentence-level. Thus, recent findings show that a one-to-one mapping between the N400 and the lexical-semantic domain cannot be upheld. The simplest possible scenario, in which idiosyncratic and rule-based knowledge can be distinguished from one another via distinct ERP components, therefore does not hold. Consequences of this observation will be discussed.

Readings: (Kim & Osterhout, 2005; Kutas & Federmeier, 2000; Schlesewsky & Bornkessel, in press; van Herten *et al.*, 2006)

4. Methods for approaching the one-to-one mapping problem

As discussed in session 3, an isomorphic mapping between ERP components and functional domains appears virtually impossible to uphold. Thus, under certain circumstances, components that are indistinguishable in terms of their surface characteristics call for clearly differing functional interpretations. Furthermore, an observable effect may be due to several overlapping components. Mapping problems of this type therefore render the interpretation of ERP effects somewhat more complex than the traditional component perspective would appear to suggest. In this session, we

provide examples for the different kinds of mapping problems and discuss some possible solutions to them (e.g. alternative EEG-based analysis methods).

Readings: (Altenmüller & Gerloff, 1999; beim Graben *et al.*, 2004; Makeig *et al.*, 2004; Penny *et al.*, 2002; Roehm *et al.*, in press; Weiss & Rappelsberger, 1996)

5. From the brain to behaviour: mapping ERP results onto behavioural findings

The correspondence between ERP data and the behavioural “output” of the language processing system (e.g. eye movements, acceptability judgements) is more complex than one might imagine. In particular, it is sometimes the case that one method shows effects of a particular critical factor that are not apparent in the other method. We will present several findings of this type and will discuss the consequences for psycholinguistic modelling arising from them. Consequences for theory of grammar – which is exclusively based on behavioural output – will also be touched upon.

Readings: (Bornkessel *et al.*, 2004; Knoeferle *et al.*, 2005a; Knoeferle *et al.*, 2005b; Sereno & Rayner, 2003)

6. Neurocognitive models I: autonomy vs. interaction

In this session, we will discuss language-related ERP data within the context of existing neurocognitive models of language processing. In this context, we will discuss how ERP data can be used to differentiate between different classes of models, but also which restrictions should be kept in mind when interpreting ERP data.

Readings: (Friederici, 2002; Hagoort, 2005)

7. Neurocognitive models II: Cross-linguistic aspects

This final session will extend the discussion of neurocognitive modelling to the cross-linguistic domain. In this context, we will show how electrophysiological findings can be used to shed light on the unity and diversity of processing mechanisms across languages. The discussion will be based on recent data from Japanese, Chinese, Turkish, Hindi and Icelandic.

Readings: (Bornkessel & Schleewsky, in press; Schleewsky & Bornkessel, 2004)

References

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