Prof Dr Dr Friedemann Pulvermüller
Freie Universität Berlin
WS 2013/2014
Language Mechanisms and the Brain
Lecture Series on Language Theory 16909
Tue. 6-8 pm, Room JK 29/118

Language Mechanisms and the Brain / Sprachmechanismen und Gehirn

(Lecture Series on Language Theory)

Introduction

The symbols, rules and representations underlying language describe aspects of human actions. The mechanisms supporting these actions and necessary for them are, without any doubt, realized in the brain. Language descriptions can be considered to be appropriate if they adequately describe human actions, but linguistic descriptions can also aim at being accurate formulations of the underlying mechanisms making these actions possible. With this latter focus, the question about the nature of language is therefore, realistically, a question about brain circuits. This lecture series will address questions about language at different levels, highlight important linguistic concepts and distinctions, and discuss their mechanistic basis in the human brain. In addition, the lectures will address brain activation patterns that index specific linguistic processes and patterns of linguistic deficits that arise from brain lesion or other focal functional impairment. Lectures cover the linguistic hierarchy, from words and speech sounds, to morphemes, phrases, sentences, grammar and communicative interaction. A main focus will be on semantics and questions about pragmatics will be touched upon. The relationship between language mechanisms and those of memory and attention will be discussed. Translational research will also be highlighted, addressing the field of language therapy after stroke, where linguistic theories led to new successful methods for clinical neurorehabilitation. The lectures will give an overview of current research in the new field of the neurobiology of language.

The lectures will be given in English, with discussion sections in both English and German.

Technicalities

The lecture series is part of the MA study programme “Languages of Europe – Structure and Usage”. The lectures are open to students of all departments and to post-graduates in the Excellence Cluster *Languages of Emotion*. Students of the MSc programme “Cognitive, Social, and Affective Neurosciences (SCAN)” can cover the language part of their module “Language and Music” by actively participating in this lecture series.

To actively participate and therefore obtain a certificate of attendance for the lecture series, it is necessary to

Prof Dr Dr Friedemann Pulvermüller
Freie Universität Berlin
WS 2013/2014
Language Mechanisms and the Brain
Lecture Series on Language Theory 16909
Tue. 6-8 pm, Room JK 29/118

- attend most of the lectures (maximum misses: three),
- prepare and reprocess the lecture content by reading the recommended key papers, and
- perform well at the final exam.

Preparation and reprocessing: To pre- and reprocess the lecture content, it is necessary to read the key paper recommended for each lecture. Please see the list below for the sequence of topics and related key papers. Key papers and books relevant in the lecture context are given in the reference list below; additional references will be provided in the lectures. Some of the reference texts and additional materials will be made available on the lecture's home page (see below). You should also be able to retrieve the key papers through "google scholar".

The *final exam* will take place in the last week of the semester, in the last lecture slot. It will take 60 min and will cover the content of all lectures in this series, plus that of any student presentations.

Student presentations: Students with a special interest in the neurobiology of language are welcome to prepare a plenary presentation, which can be given within the lecture series context. If you are interested, please speak to the lecturer. In this case, a cutting-edge research paper (to be agreed upon with the lecturer) should be presented to the lecture audience. The presentation should be 10 min in length and supported by up to 10 powerpoint slides. Well-readable (font size >10point) on-paper handouts should be distributed to all participants before the presentation. If you are interested in this latter option, please contact FP directly (in the Sprechstunde, Wednesdays, 12-1pm, room JK 31/232). Suggestions of papers whose presentation would benefit the lectures are listed at the end of this document.

To *register* for the lecture series, please go online and use the "Campus Management" system of the Freie Universität Berlin.

Website: Material and latest news about the course are collected and on the homepage of the Brain Language Laboratory (www.brainlang.fu-berlin.de) under "Teaching" (alternatively: http://www.geisteswissenschaften.fu-berlin.de/v/brainlang/teaching/index.html). The username is **fub** and the password will be announced in the lectures. All information is also accessible through a link on the university's e-learning system called "Blackboard".

For any technical questions related to this lecture series, please contact FP's secretary, Ms. Sabina Mollenhauer Sabina.mollenhauer@fu-berlin.de, room JK 31/234. For questions related to the lecture contents or your scheduled presentation, please speak to FP in his "Sprechstunde" Wed 12noon-1pm, room JK 31/232, or after the lecture.

Prof Dr Dr Friedemann Pulvermüller
Freie Universität Berlin
WS 2013/2014
Language Mechanisms and the Brain
Lecture Series on Language Theory 16909
Tue. 6-8 pm, Room JK 29/118

Dates and Topics

All lectures will take place Tuesdays at 18:15h in room JK 29/118 of the Freie Universität's main building, Habelschwerdterallee 45.

15.10. Introduction to the lecture series

Brain mechanisms and their significance for linguistics. Basic neuroscience background

22.10. Words, word recognition, and comprehension

Recommended reading: Pulvermüller, F. (2010). Brain-language research: Where is the progress? *Biolinguistics, 4*(2-3), 255-288.

29.10. Speech sounds

Recommended reading: Näätänen, R. (2001). The perception of speech sounds by the human brain as reflected by the mismatch negativity (MMN) and its magnetic equivalent (MMNm). *Psychophysiology, 38*(1), 1-21.

05.11. Language laterality and language learning

Recommended reading: Pulvermüller, F., Kiff, J., & Shtyrov, Y. (2012). Can language-action links explain language laterality?: An ERP study of perceptual and articulatory learning of novel pseudowords. *Cortex, 48*(7), 471-481. doi: 10.1016/j.cortex.2011.02.006

12.11. Language, memory and decisions

Recommended reading: Duncan, J. (2010). The multiple-demand (MD) system of the primate brain: mental programs for intelligent behaviour. *Trends in Cognitive Sciences, 14*(4), 172-179.

Prof Dr Dr Friedemann Pulvermüller
Freie Universität Berlin
WS 2013/2014
Language Mechanisms and the Brain
Lecture Series on Language Theory 16909
Tue. 6-8 pm, Room JK 29/118

19.11. Language and attention

Recommended readings: Garagnani, M., Wennekers, T., & Pulvermüller, F. (2008). A neuroanatomically-grounded Hebbian learning model of attention-language interactions in the human brain. *European Journal of Neuroscience, 27*(2), 492-513.

26.11. GUEST LECTURE

Prof Dr Markus Kiefer, University of Ulm: The brain basis of meaning and concepts

Recommended reading: Trumpp, N. M., Kliese, D., Hoenig, K., Haarmeier, T., & Kiefer, M. (2013). Losing the sound of concepts: damage to auditory association cortex impairs the processing of sound-related concepts. *Cortex, 49*(2), 474-486. doi: 10.1016/j.cortex.2012.02.002

03.12. Word types in mind and brain

Recommended reading: Pulvermüller, F. (1999). Words in the brain's language. *Behavioral and Brain Sciences, 22*, 253-336. (Only pp. 253-279 are relevant)

10.12. Sentences

Recommended reading: Friederici, A. D. (2002). Towards a neural basis of auditory sentence processing. *Trends in Cognitive Sciences, 6*(2), 78-84.

17.12. Rules of grammar

Recommended reading: Pulvermüller, F. (2010). Brain embodiment of syntax and grammar: Discrete combinatorial mechanisms spelt out in neuronal circuits. *Brain and Language, 112*(3), 167-179.

Possible additional lectures:

Speech acts in mind and brain

Recommended reading: Egorova, N., Shtyrov, Y., & Pulvermüller, F. (2013). Early and parallel processing of pragmatic and semantic information in speech acts: neurophysiological evidence. Front Hum Neurosci, 7(86), 1-13. doi: 10.3389/fnhum.2013.00086

Prof Dr Dr Friedemann Pulvermüller
Freie Universität Berlin
WS 2013/2014
Language Mechanisms and the Brain
Lecture Series on Language Theory 16909
Tue. 6-8 pm, Room JK 29/118

The temporal orchestration of phonological, lexical, syntactic, and semantic processing.

Recommended reading: Pulvermüller, F., & Shtyrov, Y. (2006).Language outside the focus of attention: the mismatch negativity as a tool for studying higher cognitive processes. *Progress in Neurobiology*, 79(1), 49-71.

Christmas break

07.01. 12:00 h, HS2: GUEST LECTURE:

Prof Dr Dr Horst Müller, University of Bielefeld: Repräsentation von Sprache: Wie untersucht man Sprache im Gehirn?

Recommended reading: Müller, H. M. (2013). *Psycholinguistik - Neurolinguistik: Die Verarbeitung von Sprache im Gehirn.* Stuttgart: UTB, Fink.

14.01. From semantic theory to semantic word types and neuroscience research

Recommended reading: Binder, J. R., & Desai, R. H. (2011). The neurobiology of semantic memory. *Trends in Cognitive Sciences, 15*(11), 527-536. doi: 10.1016/j.tics.2011.10.001

21.01. Proving semantic category specificity: Language and the motor system

Recommended reading: Pulvermüller, F. (2013). How neurons make meaning: Brain mechanisms for embodied and abstract-symbolic semantics. *Trends in Cognitive Sciences, 17*(9), 458-470. doi: 10.1016/j.tics.2013.06.004

28.01. Abstract and combinatorial semantics

Recommended reading: Moseley, R., Carota, F., Hauk, O., Mohr, B., & Pulvermüller, F. (2012). A role for the motor system in binding abstract emotional meaning. *Cerebral Cortex, 22*(7), 1634-1647. doi: 10.1093/cercor/bhr238

Prof Dr Dr Friedemann Pulvermüller
Freie Universität Berlin
WS 2013/2014
Language Mechanisms and the Brain
Lecture Series on Language Theory 16909
Tue. 6-8 pm, Room JK 29/118

04.02. From brain-language research to neurorehabilitation: Speech-language therapy in patients with chronic aphasia

Recommended reading: Berthier, M. L., & Pulvermüller, F. (2011). Neuroscience insights improve neurorehabilitation of post-stroke aphasia. *Nature Reviews Neurology, 7*(2), 86-97.

11.02. Final exam/Abschlussklausur

Key References:

Please find below some suggestions for general preparatory texts. Essential readings are indexed by asterisks. Note again that recommended readings for individual lectures are given above:

Chomsky, N. (1980). *Rules and representations*. New York: Columbia University Press.

*Fromkin, V., Rodman, R., & Hyams, N. (2011). *An introduction to language* (9th ed.). Wasworth: Cengage Learning. (earlier editions OK, down to 4th, 1988)

Fuster, J. M. (2003). *Cortex and mind: Unifying cognition*. Oxford: Oxford University Press.

Gaskell, G., ed. (2007), *Handbook of psycholinguistics (2nd ed.). Oxford: Oxford University Press.*

Harley, T. A. (2008). *The psychology of language* (3rd ed.). Hove, UK: Psychology Press, Taylor & Francis Group.

Kandel, E. R., Schwartz, J. H., & Jessell, T. M., eds. (2000). *Principles of neural sciences* (4 ed.). New York: McGraw-Hill, Health Professions Division.

Kiefer, M., & Pulvermüller, F. (2012). Conceptual representations in mind and brain: Theoretical developments, current evidence and future directions. *Cortex, 48*(7), 805-825.

Kolb, B., & Wishaw, I. Q. (2008). *Fundamentals of human neuropsychology (6 ed.)*. New York, NY: Worth Publishers (especially chapters 1-3 for basic neuroanatomy and cognition).

*Müller, H. M. (2013). *Psycholinguistik - Neurolinguistik: Die Verarbeitung von Sprache im Gehirn.* Stuttgart: UTB, Fink.

Näätänen, R. (2001). The perception of speech sounds by the human brain as reflected by the mismatch negativity (MMN) and its magnetic equivalent (MMNm). *Psychophysiology, 38*(1), 1-21.

*Pulvermüller, F. (2002). *The neuroscience of language*. Cambridge: Cambridge University Press.

Prof Dr Dr Friedemann Pulvermüller
Freie Universität Berlin
WS 2013/2014
Language Mechanisms and the Brain
Lecture Series on Language Theory 16909
Tue. 6-8 pm, Room JK 29/118

Pulvermüller, F. (2010). Brain embodiment of syntax and grammar: Discrete combinatorial mechanisms spelt out in neuronal circuits. *Brain and Language, 112*(3), 167-179.

Pulvermüller, F. (2013). How neurons make meaning: Brain mechanisms for embodied and abstract-symbolic semantics. *Trends in Cognitive Sciences, 17*(9), 458-470. doi: 10.1016/j.tics.2013.06.004

Special Readings Imaging Methods (EEG, MEG and fMRI)

EEG and MEG: http://www.mrc-cbu.cam.ac.uk/research/eeg/eeg_intro.html

fMRI: Cabeza, R., Kingstone, A. (2006). *Handbook of functional neuroimaging of cognition (2nd ed.).* Cambridge, MA: MIT Press (in case you want to know more about fMRI methods)

Papers for possible presentation in the lecture series:

Marslen-Wilson, W. D. (1987). Functional Parallelism in Spoken Word-Recognition. Cognition, 25(1-2), 71-102.

Näätänen, R., Lehtokoski, A., Lennes, M., Cheour, M., Huotilainen, M., Iivonen, A., et al. (1997). Language-specific phoneme representations revealed by electric and magnetic brain responses. Nature, 385, 432-434.

Duncan, J. (2006). Brain mechanisms of attention. Q J Exp Psychol (Colchester), 59(1), 2-27.

Baddeley, A. (2003). Working memory: looking back and looking forward. Nat Rev Neurosci, 4(10), 829-839.

McClelland, J. L., Botvinick, M. M., Noelle, D. C., Plaut, D. C., Rogers, T. T., Seidenberg, M. S., & Smith, L. B. (2010). Letting structure emerge: connectionist and dynamical systems approaches to cognition. Trends Cogn Sci, 14(8), 348-356. doi: 10.1016/j.tics.2010.06.002

Friederici, A. D. (2011). The brain basis of language processing: from structure to function. Physiol Rev, 91(4), 1357-1392.

Patterson, K., Nestor, P. J., & Rogers, T. T. (2007). Where do you know what you know? The representation of semantic knowledge in the human brain. Nat Rev Neurosci, 8(12), 976-987.

Warrington, E. K., & Shallice, T. (1984). Category specific semantic impairments. Brain, 107, 829-854.

Bedny, M., & Caramazza, A. (2011). Perception, action, and word meanings in the human brain: the case from action verbs. Ann N Y Acad Sci, 1224, 81-95. doi: 10.1111/j.1749-6632.2011.06013

Goldberg, A. E. (2003). Constructions: a new theoretical approach to language. Trends Cogn Sci, 7(5), 219-224.