

COGS 179/279
Electrophysiology of Cognition:
Language Processing

<http://www.cogsci.ucsd.edu/~coulson/cogs179/>
(links to PDF of these slides available online)

Contact Info

- Dr. Coulson
- Office Hours
 - CSB 161
 - Monday/Wednesday 3-4pm
 - Or, by appointment
- Email
 - coulson “at” cogsci.ucsd.edu

Course Description

- Survey use of electrical and magnetic brain activity to study cognition
- Learn how electrophysiological techniques used to address issues in cognitive science
- Practice critical reading research reports and reviews
- Develop a research idea and write a proposal

What we're shooting for...



- Understand technical and theoretical aspects of electrophys recordings
- Identify how electrophys methods have contributed to cognitive science
- Evaluate research reports in the area
- Develop an interesting research question
- Write a proposal for an electrophys research project that might help answer your question

Reading Review Articles



- Cover lots and lots of research
- What are the research issues?
- How has EEG been used to date?
- What are typical designs in this area?
- What aspects of the EEG signal have been of interest?
- What insights about cognitive neuroscience have been obtained?

Reading Research Reports



- What is the goal of the study?
- What is their hypothesis?
- How does the experiment address the hypothesis?
- What are possible outcomes and what might each mean?
- What was the actual outcome?
- What did the authors conclude?
- Do you agree with the authors? Are there alternative explanations?
- What are further questions that need to be addressed?

Getting Readings



- Links to all PDFs available very soon on on-line syllabus
- Articles available soon at reserve desk at Geisel Library
- Interested in a Course Reader w/all readings for COGS 179?



Work for 179/279

- 6 Problem Sets (60% of grade)
 - Questions based on the reading and the lectures
 - Due Tuesdays in class (see syllabus for dates)
 - Each worth 10% of your grade
- 3 Proposal Related Papers (20% of grade)
 - 2-page paper about background for your proposed study (Thursday 2/23) (5%)
 - 2-page paper about design of your study (Thursday 3/2) (5%)
 - Final 5-10 page proposal due last day of classes (10%)
- Final Exam (20% of grade)
 - Similar to problem sets



Research Proposal

- Pick a topic in cognitive science amenable to study w/electrophysiological techniques
 - Can be a topic covered in this course
 - Can be a totally different topic in cognitive science
- Read about research in that area
- *Summarize research in that area and point to an unanswered question*
- Design a study to answer that question
- *Describe the design of your study*
- *Explain how it will answer an important question in this area*

Working Together

- Please work together on problem sets
 - Type/write up your own answer
- Ask Coulson about problem sets
 - Office hours: M/W 3-4pm in CSB 181 (or by appointment)
 - During class if question relevant to topic of discussion
- Discuss research proposal with instructor & with others
 - Write paper yourself
 - Include names of people who helped you in an acknowledgements section
 - Cite sources. Use quote marks when you quote
- Exam: you're on your own



179 vs. 279

- Tuesday/Thursday: everyone
- Friday: grads only (others welcome)
- Extra stuff for grads
 - Some extra problems on homework
 - Extra reading
 - Present an article in Friday section
 - Briefly describe your proposal on the last day of classes (in Friday section)
 - Slightly different exam

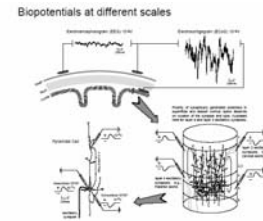
Outline

- Background Information
- Analysis & Inferences
- Speech Perception
- Audiovisual Integration
- Language Production
- Semantic Processing: N400
- Interactions between semantics and other aspects of language
- Linguistic vs. Nonlinguistic Meaning
- Pragmatic Processing
- Neural Plasticity

Sneak Preview



Neural Basis/Technical Details

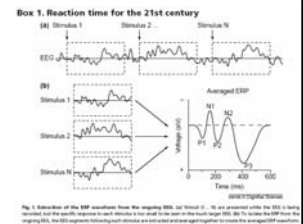


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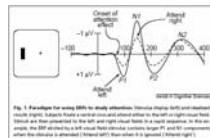
Analysis of Data

- How is ERP data processed?
- How is ERP data measured?
- What sorts of analysis is best suited for the different sorts of hypotheses tested by cognitive neuroscientists?



Inferences from ERP data

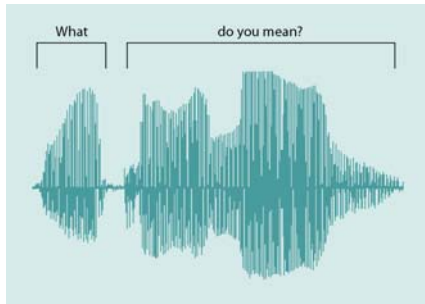
- Concrete Examples
- Attention Research
 - Memory Research



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Basics of Speech Perception



Auditory Change Detection

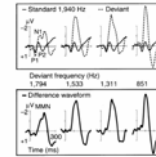
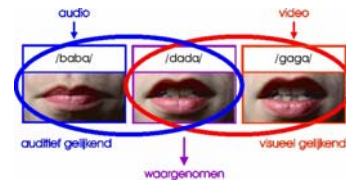


Figure 2 Top: the electric response from the frontal Fz electrode (grand average waveform of Finnish subjects) to the standard sinusoidal tone of 1.040 Hz (solid line) and to the Fz of an odd as the standard stimulus in the present phoneme experiment and to deviant sinusoidal tones of 1.794, 1.032, 1.311 and 851 Hz (broken line; equal to the Fz of the deviant stimuli (a)-(d), (e), and (f), respectively). The standard stimulus response shows relatively small P1 and P2 deflections. The negative displacement of the deviant stimulus response relative to the standard stimulus response is caused by the mismatch negativity (MMN), which can be seen by subtracting the standard stimulus trace from that for the deviant stimulus stimulus. MMN clearly increases in amplitude with the increasing magnitude of frequency change.

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Classic Studies in Audiovisual Integration



Recent Work in Audiovisual Integration

- Use of MMN to study McGurk effect

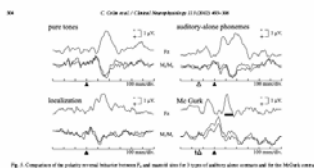


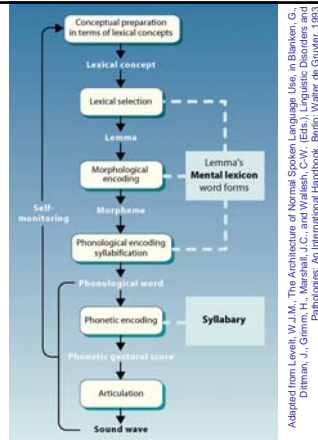
Fig. 3 Comparison of the probability-reversed MMN (PMMN) and MMN for three types of audiovisual mismatch used for the McGurk context.

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Speech Production

Outline of the theory of speech production developed by William Levelt (1999)



Adapted from Levelt, W.J.M., The Architecture of Normal Spoken Language Use, in Blanken, G., Marsh, J.L., & Levelt, W.J.M. (Eds.), Linguistic Disorders and Psycholinguistics: An International Handbook, Berlin, Walter de Gruyter, 1993.

Language Production: LRP

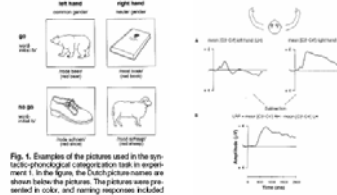
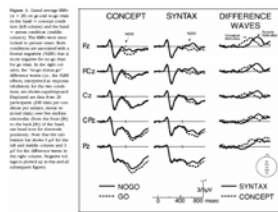


Fig. 4. Examples of the pictures used in the syntactic-phonological congruency task in experiment 1. In the figure the Dutch picture names are shown below the pictures. The pictures were presented in color, and naming responses included the color adjective, the correct adjectival inflection, and the picture name. The four picture-object pairs have separate trials for the four experimental conditions. In the example, a common gender word cues a left-hand response, and a male gender word cues a right-hand response. The response is evaluated if the picture name starts with a /r/ (go trials), and it is withheld if the picture name starts with an /v/ (no-go trials).

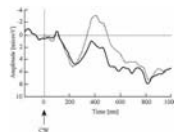
Language Production: Go-NoGo Paradigms



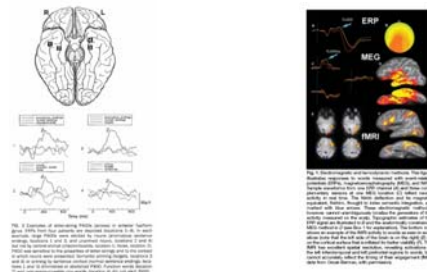
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Semantic Processing and the N400



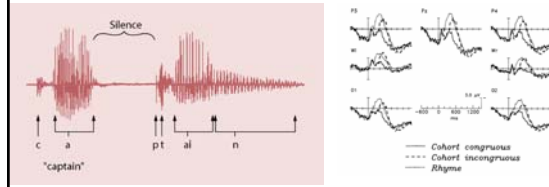
Neural Generators of the N400



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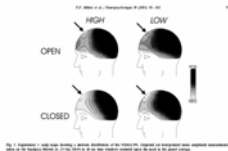
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Semantic Processing and Word ID



The movie was meant to be a horror flick, but the acting was so bad it was actually funny (cohort congruous)/ funnel (cohort incongruous)/penny (rhyme)

Open and Closed Class Words

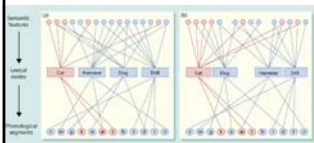


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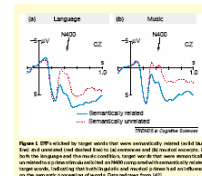
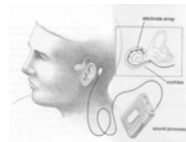
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Linguistic vs. Nonlinguistic Meaning

- Question:
 - Is the same conceptual representation of a robin activated regardless of whether one hears the word robin or sees one flying?



Sounds and Music



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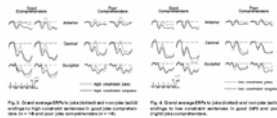
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Pragmatic Processing

- Discourse Context
- Metaphor



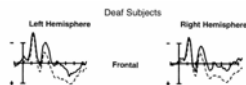
Jokes and Puns



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Sign Language: Neural Plasticity and Language Experience



General Plasticity Issues

- Does extensive musical experience (as the conductor of an orchestra) affect your ability to direct attention in space?
- Does being blind affect how you attend to auditory information in space?

