Course overview

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Hello world!

Assistant professor

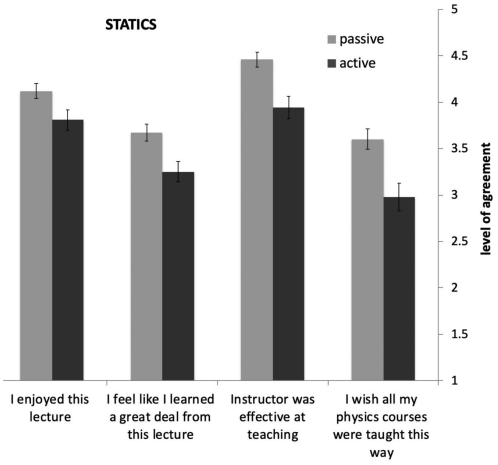
Research unit for Robophilosophy &
Interacting Minds Center

- BA & MA in philosophy
- PhD in cognitive neuroscience (medicine)

Research topics:

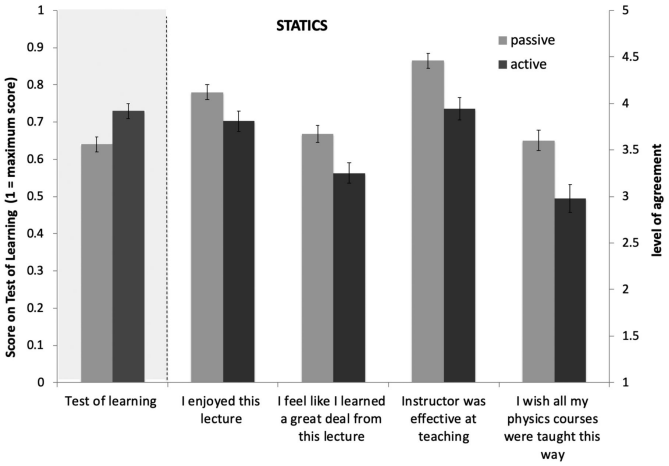
- Sense of agency
- Decoding language processing with MEG
- Neuroscience of social robots

Interactive lectures



(Deslauriers et al., 2019)

Interactive lectures



(Deslauriers et al., 2019)

Learning outcomes

Overview of the course

Students will acquire advanced knowledge about the structure and function of the brain, with a focus on how brain function contributes to cognitive function. Students will learn advanced experimental methods in cognitive neuroscience, and will conduct their own cognitive neuroimaging/cognitive neurophysiology research. Students will learn advanced statistical methods for analysing data acquired from the measurement of neural processes, with a focus on modeling techniques for relating neural data to cognitive functions.

Overview of the course

The course includes:

1. advanced theory of neural and cognitive processes;
2. advanced statistical methodologies for analysing neuroimaging data; and
3. an introduction to the theoretical relationships between neurobiological and cognitive brain processes.

The course will also introduce students to neural network approaches used in artificial intelligence.

Overview of the course

This course builds on students' background knowledge of cognition, and their skills and competencies in using statistical methods. The course integrates with the course on decision-making, and builds towards the advanced cognitive modeling course. The statistical methods used in the course will prepare students for the data science course. The course will prepare students for careers involving complex data analysis, and for careers in the health sector.

Knowledge, skills, & competences

Knowledge:

- describe the anatomy and physiology of the human brain, and explain the brain basis of cognitive function
- contrast different cognitive neuroscience methods in terms of their strengths and weaknesses, and use this knowledge to develop appropriate experimental research for investigating different cognitive functions of the brain.

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Skills:

- run experiments using neuroimaging and/or neurophysiological measurement equipment
- use advanced statistical methods to make inferences about cognitive brain functions from neuroimaging and/or neurophysiological data.

Competences:

- identify the appropriate measurement technology and experimental designs for investigating different cognitive functions
- accurately and clearly communicate the results of complex analyses.

Lectures

0. Overview
1. The brain & brain data
2. Electrophysiology

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11. Summery and Q & A

Exam

Portfolio exam

DEADLINE: 21st OF DECEMBER.

Portfolio exam

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The exam consists of a portfolio containing 3-7 assignments, which the student submits to the teacher during the course. Their form (individual and/or group-based, written, product and/or oral, set and/or on a topic of the student's choice), length and deadline for submission will be announced on Blackboard by the teacher at the start of the semester.

The complete portfolio must be handed in for assessment in the Digital Exam system by a specified date. The portfolio can be written individually or in groups of up to 3 students. **Group assignments must be written in such a way that the contribution of each student can form the basis of individual assessment**. The portfolio should clearly state which sections the individual students are responsible for.

Exam questions

Topic	Question
The brain	• Describe a cognitive function? • Discuss the use of fMRI and EEG/MEG for investigating action selection?
Electrophysiology	• What are the pros and cons of EEG vs MEG? • How are ERPs related to brian structures and functions of the mind?
Oscillations	• How can oscillations be used to investigate and cognition? • Link oscillations to a cognitive function. This can be in term of frequencies and/or cortical location(s) etc.
MVPA	• Why use MVPA for statistical assessment of EEG data? • Pros and cons of linear vs non-linear MVPA models for brain imaging data
Neural networks	• Are neural networks better than MVPA for analysis of neuroimaging data? • Can neural networks be used to model cognition?

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- EEG sample data, provided MNE-python and similar.
- Try the methods discussed in the lectures.

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Tools:

- Python
  - MNE-python (MEG & EEG package)
  - Scientific python stack (NumPy, SciPy, Scikit-learn, Pandas, Matplotlib)
  - PyTorch & Braindecode (Neural networks)

Handing in exercises

Requirements:

- Must be on time, late submissions are automatically discarded.

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- Must be on time, late submissions are automatically discarded.
- Must follow PEP8 rules, scripts that does not follow will be automatically discarded.

Examples

What is cognitive neuroscience?

Gazzaniga, Ivry, & Mangun (2002)

Cognitive neuroscience: the biology of the mind.

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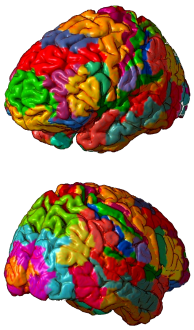
Gazzaniga, Ivry, & Mangun (2002)

Cognitive neuroscience: the biology of the mind.

Folk psychological concepts:

- Attention
- Memory



Distributed and overlapping representations of faces and objects

Distributed and Overlapping Representations of Faces and Objects in Ventral Temporal Cortex

James V. Haxby,[1]* M. Ida Gobbini,[1,2] Maura L. Furey,[1,2]
Alumit Ishai,[1] Jennifer L. Schouten,[1] Pietro Pietrini[3]

Distributed and overlapping representations of faces and objects

Example: https://nilearn.github.io/auto_examples/02_decoding/plot_haxby_stimuli.html

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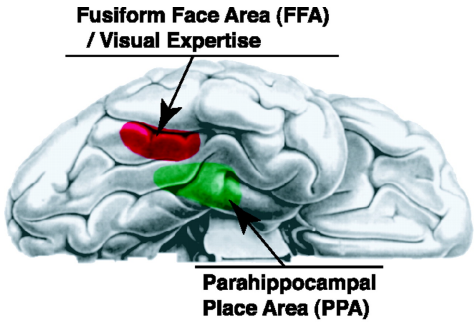
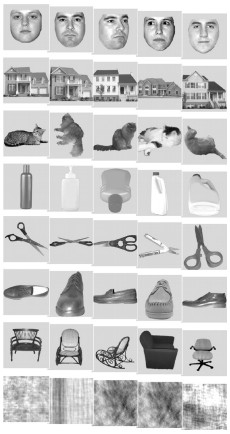


(Haxby et al., 2001)

Stimuli



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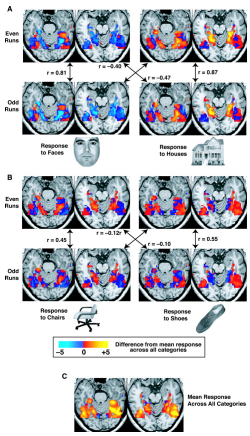
Results



(Haxby et al., 2001)

Gating by inhibition

frontiers in
HUMAN NEUROSCIENCE

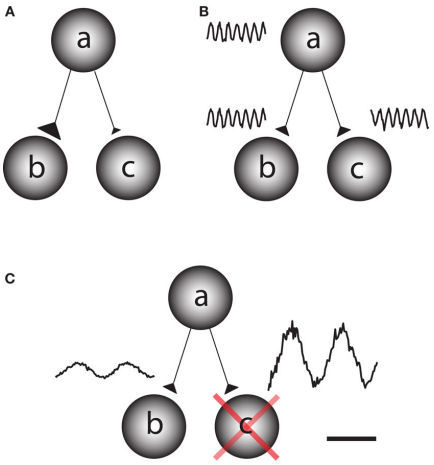
HYPOTHESIS AND THEORY ARTICLE
published: 04 November 2010
doi: 10.3389/fnhum.2010.00186

Shaping functional architecture by oscillatory alpha activity: gating by inhibition

Ole Jensen* and Ali Mazaheri

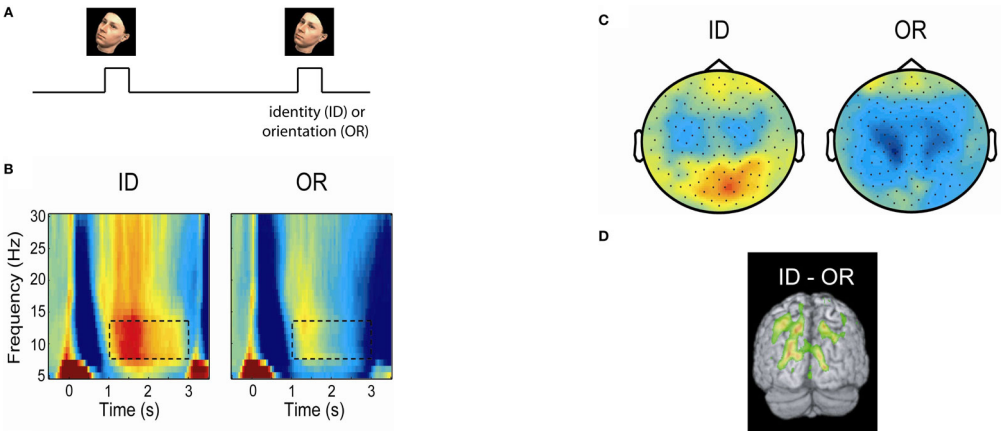
Donders Institute for Brain, Cognition and Behavior, Radboud University, Nijmegen, Netherlands

Gating information



(From Jensen & Mazaheri, 2010)

Gating information



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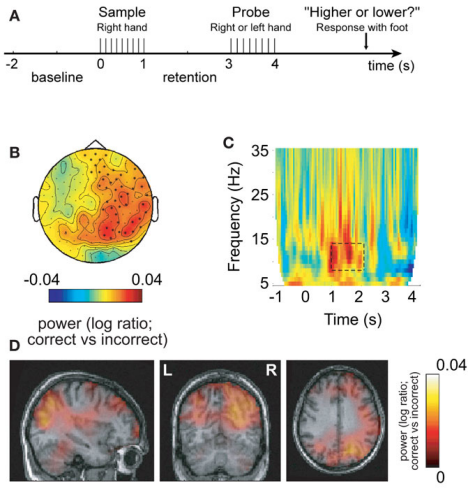
Gating information



(From Jensen & Mazaheri, 2010)

Version control

What is version control?

Version control 101:

We make changes to our code/documents etc.
We want to track these changes.

What is git?

- Decentralised version control system
- Easy to use
- Easy to use with external services, e.g. GitHub, GitLab

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Torvalds:

> *I'm an egotistical bastard, and I name all my projects after myself. First 'Linux', now 'git'.*

Linus Torvalds

Definition of GIT

British
: a foolish or worthless person

Git workflow

- Tell git a file is interesting
- Tell git about the file
- Update git to include the new file

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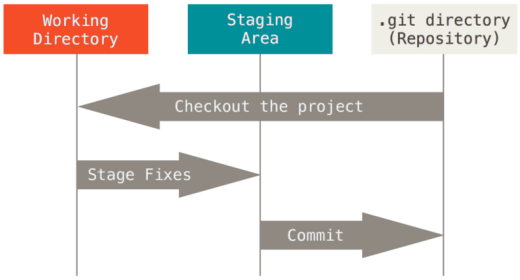
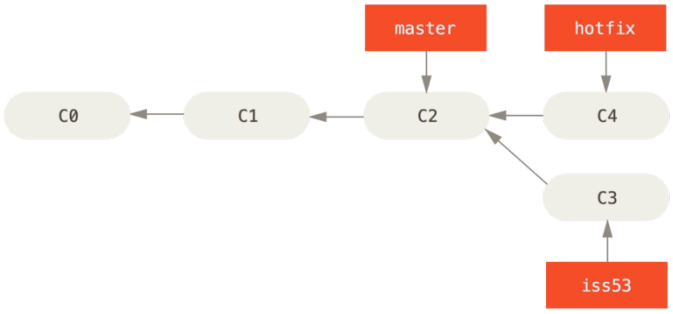


(Chacon & Straub, 2014)

Commit messages

https://xkcd.com/1296/

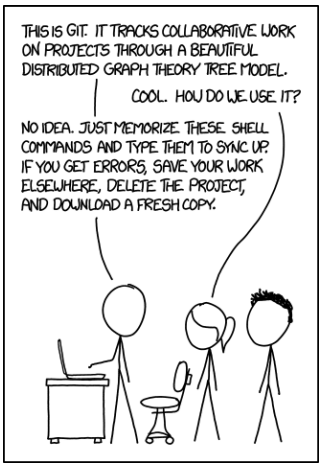
Branches



Git resources

- Main site (includes *the* book on git): https://git-scm.com
- Video: Git Tutorial for Beginners: Command-Line Fundamentals

In a nutshell



https://xkcd.com/1597/

Questions?

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