



# Course program and reading list

Semester 3 Year 2024

**School:** Baruch Ivcher School of Psychology

## Functional Magnetic Imaging Course FMRI

**Lecturer:**

Prof. Amir Amedi [amir.amedi@runi.ac.il](mailto:amir.amedi@runi.ac.il)

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<b>Course No.:</b>	<b>Course Type :</b>	<b>Weekly Hours :</b>	<b>Credit:</b>
9060	Elective	2	2

<b>Course Requirements :</b>	<b>Group Code :</b>	<b>Language:</b>
Final Paper	242906002	English

**Prerequisites**

**Prerequisite:**

8000 - Introduction To Psychology  
8935 - Biological Basis of Behavior A **OR** 9067 - Psychology and Neuroscience: An Interdisciplinary Approach A

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Course Description

## Applied fMRI Course September 2024

### Course Description:

Magnetic resonance imaging (MRI) is a non-invasive method that allows for measurement

of various features of the human brain, including its structure and function. Functional magnetic resonance imaging (fMRI), specifically, can be used to assess brain activity, during performance of a task or during rest, through analysis of modulations in the BOLD signal. Resting state fMRI (RS-fMRI) is a technique which investigates the ways in which various brain areas interact in the absence of an external task or stimulus, and what the relationships and patterns of activity mean. RS-fMRI enables researchers to explore the brain's functional organization in healthy individuals and in clinical populations. Examining the functional connectivity of the brain through RS-fMRI also allows scientists to evaluate the effects of specific interventions, as well as investigate the impact of disease or loss of function on intrinsic brain activity.

The aim of the current course is to provide students with a methodological and practical basis in task-fMRI and RS-fMRI, ranging from the theoretical basis, to physiology, and the mathematical and technical aspects of data analysis (e.g., using General Linear Modelling, correlation analysis, resting-state functional connectivity, Phase analysis, tractography).

Students will:

1. Learn about the nature of the hemodynamic (BOLD) signal, basic structures of the brain, and the power of neuroimaging as a diagnostic tool.
2. Discover how functional neuroimaging has revolutionized neuroscience research.
3. Hear about groundbreaking insights regarding the human brain from neuroimaging research in recent years.
4. Learn about using MRI in assessment of novel interventions for psychological disorders, sensory deficits, and neurodegenerative diseases.
5. Learn about the MRI scanner capabilities and visit the Ruth and Meir Rosental Brain Imaging Center at Reichman University.

The students will also gain practical knowledge in applied workshops using real data and learn about recent studies at Reichman University and abroad which utilized RS-fMRI to investigate the Nobel prize winning theory of critical periods, and novel interventions for promoting brain health. Students will be assisted in the stages of data analysis and present their projects at the end of the course.

By the end of the course students will have gained basic application tools through which they will be able to design and run MRI experiments, as well as perform basic analysis. Students will be able to generalize these abilities beyond the specific software and use them in future experiments. Finally, students will learn to read imaging literature in a critical way.

## Course Structure:

### **Day 1:**

**Lecture and Presentation (Prof. Amir Amedi):**

**Hands – On**

*Introduction to MRI & fMRI*

- Origins of the BOLD signal: connection between the blood system and neuronal activity.
- The underlying assumptions behind functional fMRI imaging (task versus resting-state) and the basic idea behind 'decoding' (inferring information based on brain activity)
- Experimental design, modeling, and statistical analysis.
- What can we learn from MRI studies?
  - What neuroimaging has taught us about the human brain.

*Talk: Innovation and Exploration - Reprogramming the Brain Through Sensory Substitution*

- A new theory of critical periods: Investigating the question of nature versus nurture using neuroimaging.
- Activity of the visual system in the absence of early visual experience

**Day 2:**

**Lecture (Prof. Amir Amedi)**

*Introduction to Functional Connectivity*

- Why do we measure connectivity.
- The underlying assumptions behind measuring functional connectivity.
- Statistical analysis & advanced approaches

Day 3:

**Presentations: (Prof. Amir Amedi)**

BrainVoyager:

- Introduction and set-up for task fMRI analysis

**Hands – On**

BrainVoyager:

- Finish set-up
- Preprocessing and preparation of the data
- How to: GLM analysis

CONN:

- Start set-up.

Hands – On

*Reprogramming the Brain for Longevity:*

- Diagnosis and assessment for clinical cases
- Assessing the effects of psychological interventions
- In depression.
- In Aging/longevity.
- In Alzheimer's disease progression and prevention.

*Advanced MRI Approaches*

- Combining MRI with Artificial Intelligence: How MRI can be used to record dreams and what we can decode from this data.

Day 4:

**Final Presentations**

Student Presentations

CONN:

- Finish set-up
- Begin resting-state analysis of real data

Hands – On

CONN:

- Finish analysis
- Prepare and finalize projects for presentation.

September 2nd – 5th 13:45–19:00 Room PE102

Tools that will be used during the course:

- **BrainVoyager** <https://www.brainvoyager.com/products/brainvoyageredu.html> (free education version)
- **CONN** (requires installation of MatLab and SPM12) : <https://web.conn-toolbox.org/>

## Grading:

- 30% : participation and data analysis.
- 70% : final project/presentation (to be presented in pairs on the final day, grade based upon student feedback and evaluation by course instructor).
  - Option a) design of a new imaging experiment.
  - Option b) analysis of real data from the lab.

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### **Reception hours by appointment at:**

amedilab@runi.ac.il

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### **Supplementary Material (will be expanded):**

1) fMRI Bootcamp with Prof Rebecca Saxe:

[https://www.youtube.com/watch?v=yA65FuSpOMs&list=PLyGKBDfnk-iDVpUGSR\\_GIDmQrZOS0Lk6k](https://www.youtube.com/watch?v=yA65FuSpOMs&list=PLyGKBDfnk-iDVpUGSR_GIDmQrZOS0Lk6k)

2) fMRI for Newbies: <http://www.fmri4newbies.com/lectures>



Course Goals

# Applied fMRI Course September

# 2024

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### Hands – On

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Hands – On

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