

Fundamentals of Neuroimaging

BENG 485 / 585

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Department of Psychiatry

Time: Wednesday, 3:30-5:30 pm (all classes will be in-person, with a minimal hybrid option)

Location: WLH 116

TAs: Sara Kurdi <sara.kurdi@yale.edu>
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Course Description

To understand the neuroenergetic and neurochemical basis of several dominant neuroimaging methods, including fMRI. Topics will range from technical aspects of different methods to interpretation of the neuroimaging results and data analysis. Controversies and/or challenges for application of fMRI and related methods in medicine will be identified. In addition to scientific topics covered, the course engages the student to actively work on scientific dissemination (written and oral forms) as well as the art of team collaboration.

Course Format

Class meets once a week in-person. Although hybrid option is available, it is used to record the class by Zoom for students to refer to materials after class. Reading and writing assignments each week. One formal collaborative presentation in a team with a follow-up paper. Two mid-sized papers, with feedback.

Enrollment Cap, Selection Process, and Notification (if applicable)

While priority is given to juniors/seniors, first years/sophomores are also included to represent diversity in STEM backgrounds in each class. Although STEMs major is not necessarily a prerequisite, familiarity with STEM materials will benefit.

Please provide the following information (Name, Email, Year of Study, Major, STEM courses, Audit/Credit, Additional Information (50 words max), Level of Enthusiasm by %). An example of the Additional Information

could be "I am fascinated by possibility of using brain imaging to read minds." Please send this information by email to Fahmeed Hyder <fahmeed.hyder@yale.edu> using your own Yale email.

Our first class meets 1/15 at 3:30pm. The information you provide will help us prioritize the class size in relation to TAs allocated.

Prerequisites

STEM major is preferred.

Required Course Materials

All course materials will be posted in Canvas.

All materials for class will be provided on Canvas

Main text: 1. "Brain Energetics & Neuronal Activity" (Wiley 2004). Shulman and Rothman

(will be kept on reserve at the MRRC library; contact Lesley Nadeau)

Secondary text: 1. On-line and photocopied materials will also be distributed when needed.

2. "Dynamic Brain Imaging" (Humana Press 2009). Hyder (will be kept on reserve at the MRRC library; contact Lesley Nadeau and specific chapters will be made available in Canvas)

3. "Brain Imaging: What it Can (and Cannot) Tell Us About Consciousness" (Oxford 2013) Shulman (will be kept on reserve at the MRRC library; contact Lesley Nadeau)

Assessments and Grading

Read. Each week about 20-40 pages of main text is required reading. The purpose of reading ahead is to engage in class discussions.

Team presentation. There will be a total of 10 teams, where each team will consist of 3-4 students and assigned based on backgrounds etc. Each team will present a topic (determined by lottery) from the syllabus Lectures 4-13.

Team paper. Each team will write a 5-page multi-author paper collaboratively after completion of their team presentation (see above). The team paper should be based on the team presentation, but in narrative form. Paper will be double spaced, 1" margin all around, and Font 12. Figures and tables do not count towards page limit. A maximum of 5 figures and/or tables can be used. Upload the team paper on Canvas.

Weekly synopsis. Each student will write a one-page synopsis (double spaced, no figures, 350 words maximum, 250 words minimum) each week. Be precise and succinct about fundamental concepts covered. Upload the synopsis on Canvas. Feedback provided.

Midterm and Final papers. Each student will write two single author papers on chosen or assigned topics using principles presented in class. The two papers are due around midterm and final (see below). Papers will be double spaced, 1" margin all around, and Font 12. Figures and tables do not count towards page limit. A maximum of 10 figures and/or tables can be used. Upload the midterm and final papers on Canvas.

- Midterm paper 7 pages. Feedback on midterm paper for an elongated final paper on a similar topic.

- Final paper 12 pages. Feedback provided in specific cases.

Students taking the course for credit will be graded on weekly class participation which includes attendance (7.5%), discussion (7.5%), 1-page synopsis reports of weekly lectures (15%), a collaborative team presentation (15%), a collaborative 5-page team paper (10%), and the two single author papers (midterm (20%) + final (25%) = 45%).

Due dates for synopsis/papers with -5% of score per day for delays.

Synopsis (~ 1-page, single author): following Sunday at 12 pm

Team paper (~ 5-pages, multiple authors): following Monday at 6 pm

Midterm paper (~ 7-pages, single author): Monday 3/24 at 6 pm

Final paper (~ 12-pages, single author): Thursday 5/01 at 6 pm

The word limit is very important to keep in mind. Each of the 12 narratives covers different subjects (see Syllabus). The objective of the narrative is to cover that subject matter as reflected in class. Think of a peer who misses that class, but they can get a general overview of what was discussed in class by reading your narrative. Goal is to achieve that within the word limit. If you have additional space, then you can provide additional materials pertaining to the subject matter of the class which you deem as important.

Diversity, Equity, Inclusion & Belonging

Collective understanding of any scientific discipline requires pluralistic perspectives, and in no other field is this more appropriate and necessary than in the field of neuroimaging. Brain imaging sciences is an extremely diverse field, as will be demonstrated every day in this course, in terms of range of expertise and topics – and also people. We welcome these diverse ideas and views as we strive for their equal representation, but with careful navigation around flaws and pitfalls. By working within team settings/presentations and also open class discussions, we aim towards being inclusive of views and ideas with mutual respect. Furthermore, the in-person course experience provides a great sense of belonging for students who are generally interested in brain and mind, as the sciences required to understand either or both requires perspectives across multiple disciplines, as the curriculum demonstrates.

Accessibility

We provide equitable academic experiences for students and other people auditing the course – including with disabilities – to the course materials, using a variety of technological means. Even prior to Covid, this course has always maintained a mind towards access to all materials covered in class and discussions, including the video recordings of each class. Any students/persons with questions about challenges to access of materials should feel free to reach out to instructors and TAs.

Academic Integrity

We provide equitable academic experiences for students and other people auditing the course – including with disabilities – to the course materials, using a variety of technological means. Even prior to Covid, this course has always maintained a mind towards access to all materials covered in class and discussions, including the video recordings of each class. Any students/persons with questions about challenges to access of materials should feel free to reach out to instructors and TAs. Use of ChatGPT is prohibited.

Recording Policy

Class will be recorded by Zoom with permission from students. All materials will be for BENG 485 course requirements for the current semester only.

Syllabus

Syllabus for BENG 485 / ENAS 585 “Fundamentals of Neuroimaging”

1/15	Lecture 1	FH	Class overview and some introduction to NMR principles
1/22	Lecture 2	EG & DLR	fMRI Data Analysis (out of text) and Energy Metabolism (Chapters 1 and 2)
1/29	Lecture 3	FH	Principles of MRI and MRS (Chapter 3 & parts of Chapter 9)
2/05	Lecture 4	Team ?	Bioelectricity & Neuroanatomy (parts of Chapter 7 & 10)
2/12	Lecture 5	Team ?	Neurotransmission & Neuroenergetics (glutamate, GABA) (Chapter 4-6)
2/19	Lecture 6	Team ?	Bottom-up cortical energy budget (Chapter 7)
2/26	Lecture 7	Team ?	17O MRS and calibrated fMRI for energy (Chapter 8 & 9)
3/05	Lecture 8	Team ?	Relationship of energy and activity (Chapter 10)
3/13	Spring Break		
3/20	Spring Break		
3/26	Lecture 9	Team ? / EG	Psychology: Long term memory (Chapter 14) + conventional fMRI analysis
4/02	Lecture 10	Team ? / EG	Psychology: Mind and Brain (Chapters 15-17) + advanced fMRI analysis
4/09	Lecture 11	Team ?	Clinical: Epilepsy (Chapter 11 and 12)
4/16	Lecture 12	Team ?	Clinical: Other + Psychiatric disorders (Chapter 13)
4/23	Lecture 13	Team ?	Clinical: Cancer (out of textbook)