

Psychology 376 / 3.0
Functional Neuroimaging the Human Brain and Mind
Fall 2019

Course Instructor: Jason Gallivan, PhD
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Teaching Assistants (TA):
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Office Hours: By Appointment

Class Days/Times: Mondays: 4 – 5:30 pm
Wednesdays: 2:30 – 4 pm

Location: Miller, room 105

Course Description:

Brain imaging, and functional magnetic resonance imaging (fMRI) in particular, has become a revolutionary tool in the study of human brain function and organization. This course will cover brain imaging technology, current tools and techniques for experimental design and analysis, as well as delve into details about brain areas, connectivity and topography. Throughout, the course will highlight the prominent role of fMRI in the burgeoning field of cognitive neuroscience and review, using specific examples, what human neuroimaging has revealed about the functional organization of the mechanisms underlying goal-directed behaviour (e.g., perception, planning, memory, language, decision-making, etc.). In addition, we will discuss the merits and limitations of fMRI as a tool for cognitive neuroscientists and the ways in which it can be combined with other techniques.

Intended Student Learning Outcomes:

Upon completion of this course, a successful student should be able to:

1. Understand how fMRI works and how it is commonly used to investigate cognitive processes in the brain
2. Understand, in principle, both basic and advanced fMRI analyses and how corresponding results should be interpreted
3. Understand some basic human functional neuroanatomy and topography
4. Critically read and scrutinize an fMRI paper and understand the strengths and weaknesses of the presented findings (i.e., appreciate what a research paper *does* and *does not* show)
5. Understand the merits and limitations of fMRI as it compares to other methodologies used in cognitive neuroscience
6. Apply active learning, critical thinking and problem-solving to the study of human cognitive neuroscience

Relevance of Course: Information taught in this course is highly relevant for students interested in the human brain and behaviour, cognitive and systems neuroscience, neurobiology, computer science, philosophy, medicine, clinical psychology, research and teaching.

Textbook &/or Courseware Package: There is no required textbook for this course. Required readings will be made available for download through OnQ. Students are responsible for all assigned readings as they contain more material than can be covered directly in lecture. Similarly, some material covered in lectures will not appear in the assigned readings. **Students are responsible for this material as it will appear on exams.**

Course Notes: Partial lecture slides will be provided for this course (you will need to attend lectures to fill in some of the gaps).

Contacting Me: Students requiring assistance are encouraged to speak with me either before or after lectures. I will arrive/leave lectures approximately 10 minutes before/after lecture and will be more than happy to answer any questions during this time. Should you wish to meet with me outside of this time, please email me (or the class TA) to make an appointment. Email, while commonly used, does limit the effectiveness of communications and may not be the best way for me to answer your question(s). In such instances, I may suggest a personal meeting at a mutually agreed upon time. I will do my very best to answer emails as soon as possible; however, emails can be expected to be replied to within 2 working days (i.e., a reply to a 1 am Saturday night email may not arrive before Tuesday). To facilitate my responses, please include the course ID (i.e., "PSYC 376") in the subject line of the email. Thanks.

Course Content: Tentative lecture schedule (*Subject to modification*)

Date	Lecture Topic
Monday, September 9, 2019	<ul style="list-style-type: none"> • Introduction to Course and Instructor • Go over course syllabus
Wednesday, September 11, 2019	Lecture 1: Introduction to fMRI
Monday, September 16, 2019	Lecture 2: MR Physics and Safety
Wednesday, September 18, 2019	Lecture 3: Origins of the BOLD Response
Monday, September 23, 2019	Lecture 4: fMRI Preprocessing and Design Principles
Wednesday, September 25, 2019	Nobel Prize Inspiration Initiative
Monday, September 30, 2019	Lecture 5: Block- and Event-Related Designs
Wednesday, October 2, 2019	Lecture 6: fMRI Statistics and Brain Normalization
Monday, October 7, 2019	Lecture 7: Analysis Approaches and Advanced Designs
Wednesday, October 9, 2019	Lecture 8: Repetition Suppression and Multivoxel Pattern Analysis
Monday, October 14, 2019	THANKSGIVING; (NO CLASSES)
Wednesday, October 16, 2019	Lecture 9: Brain Networks and Connectivity
Monday, October 21, 2019	NO CLASS (Jason at research conference)
Wednesday, October 23, 2019	Lecture 10: Brain Areas and Topography
Monday, October 28, 2019	Lecture 11: Combining fMRI with Other Techniques
Wednesday, October 30, 2019	**Midterm – In Class**
Monday, November 4, 2019	Lecture 12: Vision & Perception
Wednesday, November 6, 2019	Lecture 13: Motor Systems & Action Control
Monday, November 11, 2019	Lecture 14: Memory
Wednesday, November 13, 2019	Lecture 15: Audition & Language
Monday, November 18, 2019	Lecture 16: Executive Functions & Decision-making

Wednesday, November 20, 2019	Team Video Presentations: Vision & Perception / Motor Systems
Monday, November 25, 2019	Team Video Presentations: Memory / Auditory & Language
Wednesday, November 27, 2019	Team Video Presentations: Executive Functions & Decision-making
<i>Date to be determined</i>	**Final Exam**

Evaluation Scheme

<u>Description</u>	<u>Value</u>	<u>Date</u>
Midterm Exam (in-class)	25%	See above
Research Proposal	20%	TBA
Final Exam	25%	TBA
Team Video Presentations	20%	TBA
Weekly MC Questions (20 in total)	10%	at least 1 per lecture

Midterm and Final Exams (25% each; 50% of final mark combined):

The midterm and final exam will each consist of multiple choice questions only and will be assessing a combination of factual and conceptual issues related to the content of the course. There will be no overlap in content between the Midterm and Final Exams. Because of the structure of the course, you will need the content/knowledge acquired in the first half of the course to succeed in the second half and thus, there is no need to overlap content in the two exams. [As an aside, I always hated it when Professors would make you go back and re-study all the material from the midterm for the final exam].

Missed Test and Accommodation Policies: See below for specific details regarding the University's Regulations on these items. Specific to Psych 376, if the Midterm is missed for a **valid and approved reason PRIOR to the test**, a make-up date will be arranged at a mutually agreed upon time with the course TA. **All make-up test arrangements must be made by direct contact with the Instructor.**

Weekly Multiple Choice (MC) Questions (10% of final mark):

You will be required to create, for each lecture, a potential multiple choice question that could, in principle, be used on an exam (Midterm or Final). You must upload these questions, along with the corresponding **correct** response to these questions, using OnQ, prior to every Monday lecture. Each question will have a value of 0.5% on your final mark (note that although they carry a small percentage, they can often determine whether you end the course with an 89% versus a 90%, or a 79% versus 80% grade). Students must produce 20 of these questions over the term, and at least one question per lecture. Because we have 16 lectures in total, 4 of these 20 MC will need to overlap in content with another submitted MC question (with a maximum of 2 MC questions per lecture; this overlap can be done at the student's discretion).

Students will receive a 0.5% grade for producing a viable question (with correct answer) that could be used in an exam (i.e., it must require that one knows the course material to answer it correctly and it must be of average difficulty). Otherwise, students will receive a 0% grade for that particular question.

To up the ante, particularly thoughtful and well-formed MC questions may actually be used on either the Midterm or Final Exam. Thus, not only will the student who creates these questions receive a 0.5% grade, but they will know the answer to that particular question on the exam, and thus also receive additional benefit! **LATE MCs WILL NOT BE ACCEPTED.**

Team Video Presentations (20% of final mark):

For this project, self-assemble into groups of ~three (3) individuals (this number is subject to change depending on total course enrollment). For this project, you and your team will choose a research article in a particular content area (a list of potential articles will be provided with each of Lectures 12-16). **Research articles cannot be duplicated between groups. Therefore, topics will be selected on a first-come first-serve basis and must be approved by me.** This project will challenge you to think critically and apply the knowledge you have acquired from the entire course in an applied context. Such a task is highly relevant to many of the possible career paths associated with a university degree in Psychology, the Life Sciences, and related disciplines.

You and your team will be required to complete this project outside of class time. The team project is worth 20% of your final grade and all group members will receive the same mark, so choose your group wisely!

- 1. Video Content:** Your team will be required to read one of the research articles provided and produce a (hopefully) creative video presentation that addresses each of the following (this is not meant to be an exhaustive list of aspects you can include):
 - What was known before your selected research article and what particular gap in knowledge did the experiment(s) address? (note that providing this adequate background for the viewer may require you to read a few key papers from previous work cited in the article)
 - What was the specific research question asked and why (at the time) was it important, timely or novel?
 - What specific task and analysis methods were used?
 - What did the authors find?
 - Why are these results important in this particular research area? How do they fit within the larger literature on this topic?
 - What are some of the limitations in the methods used and/or conclusions drawn?

Note that visual aids, including diagrams, article figures, and/or animations etc. should be incorporated into your video so as to effectively convey your understanding of the article. You will also be graded on your ability to take complex ideas, research questions and approaches, and distill them so that they are easy-to-follow and readily comprehensible to non-experts in this area (this will require some thought on your part). You should also strive for your video presentation to be entertaining and engaging.

- 2. Format Guidelines:** Each video should be 8-10 minutes in length (no shorter or longer) and **all groups members must talk in the video at least once**. There are lots of free video editing programs to allow you to finalize your video presentation (most computers include a program capable of doing this) and most of you, I am assuming, have smart phones with video recording capability.
- 3. Submission Guidelines:** Each team's video presentation will need to be uploaded to Youtube on a date that is to be announced and the link to be provided. Failure to do so will result in a late penalty.
- 4. Grading:** Your total grade (20%) for this team project will be made up of the following: (1) 15% will be determined by the TA and me, based on how well the criteria in #1 are met, and, (2) 5% will be derived from an average of peer evaluations (i.e., grades received by your classmates). Note that content derived from the video presentations is fair game for the Final Exam and thus, attending the video presentations of your peers will prove to be in your benefit.

Research Proposal (20% of final mark):

You will be required to read one of the articles provided and design a follow-up experiment to the study that builds on those previous findings but which could, in principle, provide its own novel contribution to the literature. In only 1 page, you will be expected to:

- Briefly convey your selected article’s findings and provide motivation/justification for your own, follow-up experiment (in the context of the previous literature). You must demonstrate why your own experiment is important, novel and/or addresses a key research question in the field.
- Briefly outline your experimental task and how the data will be analyzed
- Outline your hypothesis (as well as hypothetical results) and indicate what, if confirmed, your findings would demonstrate
- Include no more than one figure (which can be multi-paneled) in your proposal

Note that all the text should fit onto a single page (¾ margins, minimum 11 pt font, single-spaced)! The single figure (with associated figure caption, of no more than 300 words) is to be included on a separate page. Other than these criteria, there are no formatting requirements. However, you will probably find it beneficial to use subheadings, underlining and boldface throughout to direct the reader’s attention to your key points and sections. Also, note that this single page research summary proposal **is worth 20% of your final mark (!!!) and so it should be thoughtfully constructed, easy-to-follow and heavily edited (underline heavily). Being able to write a concise and engaging one-page summary that nearly anyone can understand (perhaps even your grandmother) is one of the most important (yet poorly emphasized) skills one can acquire in the sciences (and, indeed, in most other career paths). It takes a great deal of thought and effort to do well. The purpose of this exercise, in addition to applying the course knowledge and forcing you to think creatively, is to help you further develop this critical skill. Due to the space limitations, you will need to think carefully about what details to include versus exclude, such that your reader has all the necessary content information to understand the scientific details of your proposal while, at the same time, appreciating why your proposal is novel and important. Your proposal will be evaluated by the TA, and so it should be written at a level for someone who has working knowledge of fMRI (e.g., there will be no need to describe a GLM, etc.)

Grading system – Numbers In, Letters Out: All components of this course will receive numerical percentage marks. The final grade you receive for the course will be derived by converting your numerical course average to a letter grade according to Queen’s Official Grade Conversion Scale as shown below:

Grade	Numerical Course Average (Range)	Descriptor
A+	90-100	Truly Exceptional
A	85-89	Outstanding
A-	80-84	Excellent
B+	77-79	Very Good
B	73-76	Good
B-	70-72	Reasonably Good
C+	67-69	Acceptable
C	63-66	Minimally Acceptable (Hons.)
C-	60-62	Minimally Acceptable (Gen.)
D+	57-59	Unsatisfactory Pass
D	53-56	Unsatisfactory Pass
D-	50-52	Unsatisfactory Pass
F	49 and below	Failure. No course credit

Late Policy: Unless otherwise stated, late submissions will be penalized by 5% per day it is late (e.g., a submission earning a grade of 85% will receive a 80% if submitted one day late).

Students are responsible for keeping back-up copies of all written work and assignments. Invalid or corrupt files submitted electronically will be subject to the course late penalty and computer, disk, and/or other hardware related problems will not be accepted as an excuse to hand in late hard-copy assignments.

REGULATIONS AND POLICIES

Academic Integrity

Queen's students, faculty, administrators and staff all have responsibilities for supporting and upholding the fundamental values of academic integrity. Academic integrity is constituted by the five core fundamental values of honesty, trust, fairness, respect and responsibility (see www.academicintegrity.org) and by the quality of courage. These values and qualities are central to the building, nurturing and sustaining of an academic community in which all members of the community will thrive. Adherence to the values expressed through academic integrity forms a foundation for the "freedom of inquiry and exchange of ideas" essential to the intellectual life of the University.

Students are responsible for familiarizing themselves with and adhering to the regulations concerning academic integrity. General information on academic integrity is available at Integrity@Queen's University, along with Faculty or School specific information. Departures from academic integrity include, but are not limited to, plagiarism, use of unauthorized materials, facilitation, forgery and falsification. Actions which contravene the regulation on academic integrity carry sanctions that can range from a warning, to loss of grades on an assignment, to failure of a course, to requirement to withdraw from the university.

Copyright of Course Material: "All course created material is copyrighted and is for the sole use of students registered in Psych 376 (Fall 2019) at Queen's University. This material shall not be distributed or disseminated to anyone other than students registered in this course. Failure to abide by these conditions is a breach of copyright, and may also constitute a breach of academic integrity under the University Senate's Academic Integrity Policy Statement." Third party copyrighted materials (such as journal articles) have either been licensed for use in this course or fall under an exception or limitation in Canadian Copyright law.

Copying this material for distribution (e.g. uploading material to a commercial third-party website) can lead to a violation of Copyright law. Find out more about copyright here:
<http://library.queensu.ca/copyright>.

Accessibility Statement

Queen's is committed to an inclusive campus community with accessible goods, services, and facilities that respect the dignity and independence of persons with disabilities. The material for this course is available in an accessible format or with appropriate communication supports upon request from the professor.

Turnitin Statement

This course makes use of Turnitin, a third-party application that helps maintain standards of excellence in academic integrity. Normally, students will be required to submit their course assignments to through onQ to Turnitin. In doing so, students' work will be included as source documents in the Turnitin reference database, where they will be used solely for the purpose of detecting plagiarism. Turnitin is a suite of tools that provide instructors with information about the authenticity of submitted work and facilitates the process of grading. Turnitin compares submitted files against its extensive

database of content, and produces a similarity report and a similarity score for each assignment. A similarity score is the percentage of a document that is similar to content held within the database. Turnitin does not determine if an instance of plagiarism has occurred. Instead, it gives instructors the information they need to determine the authenticity of work as a part of a larger process. Please read Turnitin's Privacy Pledge, Privacy Policy, and Terms of Service, which governs users' relationship with Turnitin. Also, please note that Turnitin uses cookies and other tracking technologies; however, in its service contract with Queen's Turnitin has agreed that neither Turnitin nor its third-party partners will use data collected through cookies or other tracking technologies for marketing or advertising purposes. For further information about how you can exercise control over cookies, see Turnitin's Privacy Policy.

Turnitin may provide other services that are not connected to the purpose for which Queen's University has engaged Turnitin. Your independent use of Turnitin's other services is subject solely to Turnitin's Terms of Service and Privacy Policy, and Queen's University has no liability for any independent interaction you choose to have with Turnitin

Accommodations Statement

Queen's University is committed to achieving full accessibility for persons with disabilities. Part of this commitment includes arranging academic accommodations for students with disabilities to ensure they have an equitable opportunity to participate in all of their academic activities. If you are a student with a disability and think you may need accommodations, you are strongly encouraged to contact Student Wellness Services (SWS) and register as early as possible. For more information, including important deadlines, please visit the Student Wellness website at:

<http://www.queensu.ca/studentwellness/accessibility-services/>

Academic Consideration for Students in Extenuating Circumstances

The Senate Policy on Academic Consideration for Students in Extenuating Circumstances (<http://www.queensu.ca/secretariat/sites/webpublish.queensu.ca.uslclwww/files/files/policies/senateandtrusteers/Academic%20Considerations%20for%20Extenuating%20Circumstances%20Policy%20Final.pdf>) was approved in April, 2017. Queen's University is committed to providing academic consideration to students experiencing extenuating circumstances that are beyond their control and which have a direct and substantial impact on their ability to meet essential academic requirements. The Faculty of Arts and Science has developed a protocol to provide a consistent and equitable approach in dealing with requests for academic consideration for students facing extenuating circumstances, which can be found at: <http://www.queensu.ca/artsci/accommodations>.

Midterms and Course Assignments

Requests for accommodation for midterms and course assignments must be received by the instructor in a timely manner and must be accompanied by official documentation (e.g. notice from a medical professional). Requests for computer assisted midterm exams must be arranged through the Student Wellness Centre at least 10 working days in advance of the exam. Requests for an alternative midterm exam time or an extension for course assignments for the purposes of accommodating travel arrangements for personal reasons will be automatically denied. Students who are unable to write a midterm exam on the published date for approved reasons will not be permitted to write in advance of the class.

Location and Timing of Final Examinations

Requests for accommodation for final exams must be arranged through the Student Wellness Centre in advance of the published deadlines on the [Office of the University Registrar's](#) webpage each term.

As noted in [Academic Regulation 8.2.1](#), "the final examination in any class offered in a term or session (including Summer Term) must be written on the campus on which it was taken, at the end of the appropriate term or session at the time scheduled by the Examinations Office." The exam period is

listed in the key dates prior to the start of the academic year in the Faculty of Arts and Science Academic Calendar and on the Office of the University Registrar's webpage. A detailed exam schedule for the Fall Term is posted before the Thanksgiving holiday; for the Winter Term it is posted the Friday before Reading Week, and for the Summer Term the window of dates is noted on the Arts and Science Online syllabus prior to the start of the course. Students should delay finalizing any travel plans until after the examination schedule has been posted. Exams will not be moved or deferred to accommodate employment, travel /holiday plans or flight reservations. Students requesting a final exam deferral due to extenuating circumstances must complete a [Permission for an Incomplete Grade form](#) for approval by the course instructor and submit the completed form to the Undergraduate Office. Exams deferred for extenuating circumstances should be written within the first two weeks of the subsequent term, if possible.