

# Psych 3FA3: Neurobiology of Learning and Memory

(2007-2008, Term 1)

**Instructor:**

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**Tutorial Leaders:**

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**Weekly Schedule:**

Wednesday, 7-10pm

Lecture/Presentation: HH302

Group discussion: HH305

**Virtual Classroom:**

<http://www.learnlink.mcmaster.ca>

## Course Description

This course will explore empirical and theoretical accounts surrounding the neural basis of learning and memory. Neural mechanisms will be discussed from several perspectives ranging from cognitive neuroscience to synaptic physiology. Students will attain some understanding of the rationale and methodology of a variety of strategies that are used in the investigation of the neural mechanisms underlying learning and memory. The course will start with a historical perspective and an overview of the multiple memory systems. This model emphasizes the fact that memory is composed of multiple, separable systems that are associated with specific neurobiological substrates. A number of brain mechanisms subserving learning and memory at the systems level, cellular level, and molecular level will subsequently be discussed.

The lectures, required and supplementary readings, in conjunction with student discussion/presentations, are meant to provide students with both an overview of some of the currently "hot" areas in the field as well as some basic tools useful for research in this field. Moreover, students are expected, through active learning (discussions, presentations, and written critiques), to gain experience in critically evaluating research literature and in communicating ideas through written and oral presentations.

During 4 of the 12 weeks, for the entire 3 hours of class, introductory material will be covered in a traditional lecture format. In 8 of the 12 weeks, for 1 hour only, introductory lectures will be given by the instructor. There will be another hour of student group discussions, and another hour of class presentations/discussions.

## Class Schedule

Week	Hour 1	Hour 2	Hour 3
1	Sept 12	Course overview- Introduction to the research ideas, History	
2	Sept 19	History (con't), Lecture on the multiple memory systems	Group disc of M1
3	Sept 26	Group discussion of M2 & Presentation of M1 (Multiple memory systems I)	Lecture
4	Oct 3	Group discussion of M3 & Presentation of M2 (Multiple memory systems I)	Lecture
5	Oct 10	Group discussion of M4 & Presentation of M3 (Perceptual learning: visual system)	Lecture
6	Oct 17	Group discussion of M5 & Presentation of M4 (Hippocampus: Spatial learning in humans I)	Lecture
7	Oct 24	Midterm Exam	Lecture
8	Oct 31	Group discussion of M6 & Presentation of M5 (Hippocampus: Spatial learning in humans II)	Lecture
9	Nov 7	Group discussion of M7 & Presentation of M6 (Hippocampus: place cells)	Lecture
10	Nov 14	Group discussion of M8 & Presentation of M7 (LTP I: behavioural approaches)	Lecture
11	Nov 21	Presentation of M8 (LTP II: cellular approaches)	Lecture
12	Nov 28	Lecture & Review and additional final exam tutorial if needed	

## Overall Requirements

The course includes three learning formats:

- Reading
- Lecture
- Discussions/Presentations/Critiques

## **Reading Materials**

Reading 1: Psychology 3FA3 courseware (available in Campus Bookstore)

The required readings provided in the courseware are organized into 8 topic modules (see page 3-5 of the course outline for a “revised” list). For the 8 modules, students will be required to read:

- a) One review paper,
- b) One or two empirical papers, and
- c) A written commentary based on the empirical papers (for most modules).

Reading 2: Eichenbaum, H. (2002). *Cognitive Neuroscience of Memory: An Introduction*, New York: Oxford University Press. (Available in Campus Bookstore, about \$60)

The textbook by Eichenbaum will provide background information for the lectures. Some other supplementary reading materials will also be recommended.

[Background readings](#)

[Supplementary readings](#)

## Lectures

Two or three hours of lectures will be delivered in weeks 1, 2, 7 and 12. From week 3-6 to week 8-11, lectures will take place only in the last hour. All lectures will be held in HH302.

## Discussion/Presentations/Critiques (weeks 3-6 and 8-11, total 8 weeks)

For these 8 weeks, the first two hours of the classes will be reserved for group discussions (to be held in HH305) and class presentations by selected groups (to be held in HH302). Students will work in groups of 5-7.

- **Discussions:** During class time (for one hour), each group will discuss the empirical paper listed for the target module which is scheduled to be formally presented in a week. At the end of the one-hour discussion, the group will be required to hand in a written summary of the issues discussed.
- **Presentations:** Each group will be assigned 2 of the 8 modules for which they will be responsible for giving a formal presentation of the empirical papers to the class (half of the class). The other six groups will attend the presentation and participate in the discussions. For each module, the presentation in class is done by two groups (one as a primary presenter, the other as a “commentator”).
- **Critiques:** Each student will be required to write critiques for any 2 of the 8 modules (but not the ones they are presenting in class). The content of the critiques should be discussed during group discussions mentioned above; however, the critiques must be written individually, **not** as a group.

During that 8 weeks, half of the class will spend the 1st hour holding their group discussions (HH305) and spend their 2<sup>nd</sup> hour listening or presenting in the group presentations session (HH302); the other half of the class will have the opposite schedule (i.e., 1st hour group presentation and 2<sup>nd</sup> hour group discussion).

The group discussion, in-class presentation and writing of the critiques should all be based on the empirical papers listed in each module (see articles underlined in the next two pages).

## Presentation/Group Discussion Schedule

Time	Group Discussion (HH305)	Presentation (HH302)									
		groups	Role	M1	M2	M3	M4	M5	M6	M7	M8
1 <sup>st</sup> Hour	All “B” groups	All “A” groups	As primary presenters	A1	A2	A3	A4	A5	A6	A7	A8
			As commentators	A8	A7	A6	A5	A4	A3	A2	A1
2 <sup>nd</sup> Hour	All “A” groups	All “B” groups	As primary presenters	B1	B2	B3	B4	B5	B6	B7	B8
			As commentators	B8	B7	B6	B5	B4	B3	B2	B1

## Required Reading for each module (revised from the version in the courseware)

Please note the change from the table of content of the courseware. The total number of modules has been changed from 9 (specified in courseware) to 8. Module 4 in the courseware has been deleted. The order number for the subsequent modules should be changed accordingly.

The items highlighted in yellow are the review/background papers for the module. For the modules without such papers listed, use the review paper in the previous module.

The empirical papers are the items underlined. Those are the ones that you are supposed to (1) discuss in group and generate written minutes, (2) write critiques, or (3) present in-class

The rest of the papers are commentary to the empirical papers.

### 1. Multiple memory systems I

- a. Eichenbaum, H. B. (1999). Learning and memory: Systems Analysis. In M.J.Zigmond, F. E. Bloom, S. C. Landis, J. L. Roberts, & LR. Squire (Eds.), *Fundamental neuroscience* (pp. 1455-1486). San Diego: Academic Press.
- b. Vargha-Khadem, F., Gadian, D. G., Watkins, K. E., Connelly, A., Van Paesschen, W., & Mishkin, M. (1997). Differential effects on early hippocampal pathology on episodic and semantic memory. *Science*, 277, 376-380.
  - i. Eichenbaum, H. (1997). How does the brain organize memories? *Science*, 277, 330-332.

### 2. Multiple memory systems II

- a. Kesner, R. P., Bolland, B. L., & Dakis, M. (1993). Memory for spatial locations, motor responses, and objects: triple dissociation among the hippocampus, caudate nucleus, and extrastriate visual cortex. *Experimental Brain Research*, 93, 462-470.

### 3. Perceptual learning: visual system

- a. Gilbert, C. D., Das, A., Ito, M., Kapadia, M., & Westheimer, G. (1996). Spatial integration and cortical dynamics. *Proc.Natl.Acad.Sci.U S.A*, 93, 615-622.
- b. Gilbert, C. D. & Wiesel, T. N. (1992). Receptive field dynamics in adult primary visual cortex. *Nature*, 356, 150-152.

Please note that Module 4 in the courseware has been deleted. The order number for the subsequent modules should be changed accordingly.

## 4. Hippocampus: Spatial learning in humans I

- a. Maguire, E. A., Burgess, N., & O'Keefe, J. (1999). Human spatial navigation: cognitive maps, sexual dimorphism, and neural substrates. *Curr Opin Neurobiol*, 9, 171-177.
- b. Maguire, E. A., Gadian, D. G., Johnsrude, I. S., Good, C. D., Ashburner, J., Frackowiak, R. S. et al. (2000). Navigation-related structural change in the hippocampi of taxi drivers [see comments]. *Proc Natl Acad Sci U S A*, 97, 4398-4403.
  - i. Terrazas, A. & McNaughton, B. L. (2000). Brain growth and the cognitive map. *Proceedings of the National Academy of Sciences of the United States of America*, 97, 4414-4416.

## 5. Hippocampus: Spatial learning in humans II

- a. Maguire, E. A., Burgess, N., Donnett, J. G., Frackowiak, R. S., Frith, C. D., & O'Keefe, J. (1998). Knowing where and getting there: a human navigation network [see comments]. *Science*, 280, 921-924.
  - i. Fried, I. & Maguire, E. A. (1998). The hippocampus and human navigation. *Science*, 282, 2151a.

## 6. Hippocampus: place cells

- a. Wilson, M. A. (2000). The neural correlates of place and direction. In M.S.Gazzaniga (Ed.), *The new cognitive neurosciences* (2nd ed., pp. 589-600). Cambridge, MA, US: The MIT Press.
- b. Wilson, M. A. & McNaughton, B. L. (1993). Dynamics of the hippocampal ensemble code for space. *Science*, 261, 1055-1058.
  - i. Eichenbaum, H. (1993). Thinking about brain cell assemblies. *Science*, 261, 993-994.

## 7. LTP I: behavioural works

- a. Martinez, J. L. & Derrick, B. E. (1996). Long-term potentiation and learning. *Annual Review of Psychology*, 47, 173-203.
- b. Bannerman, D. M., Good, M. A., Butcher, S. P., Ramsay, M., & Morris, R. G. M. (1995). Distinct components of spatial learning revealed by prior training and NMDA receptor blockade. *Nature*, 378, 182-186.
- c. Saucier, D., & Cain, D. P. (1995). Spatial learning without NMDA receptor-dependent long-term potentiation. *Nature*, 378, 186-189.
  - i. Eichenbaum, H. (1995). The LTP memory connection. *Nature*, 378:131-132.

## 8. LTP II: cellular approaches

- a. Rioult-Pedotti, M. S., Friedman, D., Hess, G., & Donoghue, J. P. (1998). Strengthening of horizontal cortical connections following skill learning. *Nature Neuroscience*, 1, 230-234.
- b. Rioult-Pedotti, M. S., Friedman, D., & Donoghue, J. P. (2000). Learning-induced LTP in neocortex. *Science*, 290, 533-536.
- c. Martin, S. J. & Morris, R. G. M. (2001). Cortical plasticity: It's all the range! *Current Biology*, 11, R57-R59.

## **Evaluation**

	Marked by	Performance	%	Total %
<b>WORK AS A GROUP</b>				
Group Discussion Notes	TAs		8	8
Presentation as primary presenter	Instructor/Peers		8	15
Presentation as commentator	Instructor/Peers		7	
<b>WORK AS AN INDIVIDUAL</b>				
Written Critiques (Total 2)	TAs		10	20
	TAs		10	
Participation	Peers	Within group	8	12
	Instructor/TAs	In class/group	4	
Written Exam	Midterm	TAs	15	45
	Final	TAs	30	

## **Detailed Requirements**

### **Discussions:**

- Each group will discuss the empirical paper listed for the target module which is scheduled to be formally presented in class one week after the discussion.
- At the end of the one-hour discussion, the group will be required to hand in a written summary of the issues discussed.
- The summary sheet will be graded and only students who attend the discussion will be given the grade.

### **Presentations**

- The primary presenting group should present the basic findings (15 minutes).
- The “commentator” group should make comments on the paper (15 minutes) and explore the broader issue(s) related to the empirical papers. For the issues to be addressed, this group may follow the guidelines for writing the 2nd part of a critique.
- Each group may elect a few members to give the presentation in class but all group members must participate in the preparation of the presentations and the answering of questions during/following the presentation.
- Oral presentations will be graded by class as well as by the instructor, based on the content delivered, the logical flow of ideas, and the presentation style.
- The presentations should incorporate proper audiovisual aids (e.g., Powerpoint slides) and handouts if necessary. The final version of the presentation slides should be sent to the instructor electronically by noon, the day of the presentation.

### **Critiques**

- For 2 of the 8 modules (NOT the module they are responsible for presenting), students are expected to write a critique based on all empirical papers listed for that module. Students will

be given the opportunity to write **three** critiques, in which case, the two critiques with the highest marks will be included in the final grade.

- The hard copy of the critique of a module is due at class when that module is being presented.
- Late critiques will not be accepted.
- See separate sheet below for detailed instructions for the suggested content of the critique.

## **Submission of Electronic files**

### **Critique Submission:**

In addition to the hard copy requirement, **ALL** critiques should also be submitted electronically using anonymous ftp to <ftp://psyftp.mcmaster.ca/sun/>. You may use Window Explore to upload your file. Copy the ftp link above to the address, then drag the icon of your document from the folder on your computer to the ftp folder. You should see your file name appeared on the ftp site after you upload the file.

Use the following format in your file name "**3FA3M#Critique\_LastName-FirstName.doc**".  
e.g. for module 1's critique written by John Smith, the file name should be "3FA3M1Critique\_Smith-John.doc".

it is strongly encouraged that you also upload the pdf files of the papers you cited in your critique (especially those you discussed extensively).

Use the following format in the file name of your reference articles  
"3FA3M1Ref1\_Smith-John.pdf".  
"3FA3M1Ref2\_Smith-John.pdf".

## **Presentation slides submission**

Use ppt filename format like the following:

3FA3M1-P-A1.ppt, for module 1, presentation group, group A1

3FA3M1-C-A1.ppt, for module 1, commentating group, group A1

Use the following format in the file name of the pdf files of your reference articles cited in your presentation

3FA3M1-P-A1\_Ref1.pdf".

3FA3M1-P-A1\_Ref2.pdf".

## **Participation Grades**

### **Participation graded for within group performance by peer group members**

- At the end of the term, each member will be required to hand in a written evaluation of the contributions of each of their group members.
- Both, grades (in terms of %) and a written justification should be provided for ALL aspects of participation (e.g. including intellectual contribution and contribution of time and effort, etc).
- Typically, all group members will be given the same grade for the discussion note and presentation, however the instructor reserves the right to factor-in peer evaluations, and may adjust the presentation marks for certain individuals accordingly (e.g., those who contribute very little to the joint effort).

Participation graded by instructor/TAs:

Participation grades will be assigned based on the student's performance in the following aspects:

- Attendance in class and at group meetings **and punctuality**
- Active learning
  - Contributions to class and group discussions
  - Contributions to LearnLink discussions
  - Contributions to literature search (students are encouraged to share suitable articles with the group and class, possibly through LearnLink)
  - Showing initiative in organizing group activities
- Providing extensive and informative feedback to other students on their oral presentation, by completing a very brief evaluation form at the end of each presentation
- Providing feedback and suggestions to the teaching of this course (e-mail to the instructor)

### **Exams**

The written exams (closed book) will cover lecture and required readings materials. Midterm tests can only be written at the times indicated. There will be no make-up tests or special sessions for any student. Students with valid reasons for missing a midterm test must consult the Dean of Studies office for their faculty (e.g. Science or Social Science). If (and only if) there is adequate written justification for missing the test, such students will have their grades proportionately re-weighted, increasing the relative contribution of the other portion of the grades. The exams will consist of short answer and essay questions.

Final grades will be assigned according to the following conventional scheme:

90-100	85-89	80-84	77-79	73-76	70-72	67-69	63-66	60-62	57-59	53-56	50-52	0-49
A+	A	A-	B+	B	B-	C+	C	C-	D+	D	D-	F

The instructor reserves the right to adjust final marks up or down, on an individual basis, in light of special circumstances and/or the individual's overall performance in the course.

### **Message from the Chair of Psychology**

The instructor cannot be responsible for returning long distance calls from students. Any student wishing to reach an instructor is invited to e-mail the instructor.

**Policy Reminder**

Attention is drawn to the *Statement on Academic Ethics* and the *Senate Resolutions on Academic Dishonesty* as found in the Senate Policy Statements distributed at registration and available in the Senate Office. Any student who infringes one of these resolutions will be treated according to the published policy.

## Guidelines for Writing Critiques

(also useful for presentation/group discussion)

The goal of writing a critique is to allow students to attain a deeper understanding of some of the major issues with the topic of the neurobiology of learning and memory and to provide experience in critically evaluating primary source materials in scientific literature.

Each critique must be written in APA style, typed in 12-point font, and the length should be no more than 2 double-spaced pages with 1-inch margins, excluding references. Papers that do not meet these criteria will not be accepted.

Generally, the critique should accomplish two things. First it should try to summarize the important message delivered in the article (half to one page). Second, it should include a discussion of the theoretical implications and their relation to the broader literature.

1. The summary section might include short discussions of:
  - a. the research issue addressed in the article
  - b. the experimental method and hypothesis
  - c. whether the empirical findings of the paper support the hypothesis and/or theoretical conclusions
2. The critical analysis could include (but not be limited to) some of the following:
  - a. Methodological issues
    - i. whether the data presented supports the authors' claims as stated in the article.
    - ii. some factors that were not controlled in a study or other ways in which it was incomplete.
  - b. Suggestions
    - i. further analysis of the data already collected that could tell us something more
    - ii. logical alternatives to the authors' explanations of their results
    - iii. relevance to theories and phenomena not discussed by the authors
    - iv. additional predictions or experiments that could come out of the conclusions
    - v. related issues that could be studied by similar approaches
    - vi. possible next steps for the research program
  - c. Relevance to other studies - relating the results to other findings in the literature
    - i. Way to search relevant literature
      1. Review articles, Introduction and Discussion of empirical articles
      2. Use web resource such as researchers' web pages, goggle etc.
      3. Using Science Citation Index to search papers that cited the target article
        - a. <http://portal.isiknowledge.com/portal.cgi?DestApp=WOS&Func=Frame>
    - ii. Relating the study to the greater theoretical context; how the findings of this paper extend our knowledge of this area of research (why is this study important and interesting?) or why this study has limitations.  
Cite at least 2 other related references (empirical papers) from the literature other than the primary source paper. Websites, textbooks, and other secondary source materials may be used, but are not sufficient on their own.

Additional guideline on writing critiques:

<http://www.psychology.mcmaster.ca/3vv3/position.htm>

Sample Critiques <http://www.psychology.mcmaster.ca/3vv3/sample%20position.htm>