

## Psychology 2355r: Laboratory in Cognitive Neuroscience Seminar

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**Location and time:** To be arranged at a time of mutual convenience.

### Overview:

This seminar has two aims: The first is to teach students a set of experimental methods that are widely used in cognitive psychology and cognitive neuroscience. These methods all involve the design and execution of computer-administered tasks, which typically involve the measurement of response times and error rates. The same methods are used in behavioral studies and in brain-scanning studies, and can be used in the service of answering many types of questions. The second aim is to teach students how research questions and methods are linked. Specifically, the seminar will emphasize the use of the QALMRI method of thinking about the relation between theory and data. This method is equally useful when one reads reports of experiments as when one conceives of a new experiment.

### In brief:

The **Q** stands for the question. All research begins with a question, and the point of the research is to answer the question. In cognitive psychology and cognitive neuroscience, the issue usually concerns the nature of a specific mechanism, which different theories characterize in different ways.

The **A** stands for alternatives. It is important to delineate at least two positions on an issue (i.e., two ways a process could operate, two ways information could be stored, etc.), and to consider whether they are plausible. If every conceivable theory implies the same position, there is no point in doing an experiment. The goal of an experiment is to distinguish among the alternative positions on the issue.

The **L** stands for the logic of the study. The goal is to discriminate among the alternatives. The logic has the following structure: *If Position A (and not Position B), then when X is varied, Y should change in thus-and-such a way.* The logic is the key idea behind the method used to discriminate among the alternatives.

The **M** stands for the method: Exactly how will the experiment be conducted? How many groups? How many conditions, trials per condition, frequency of different responses? How will counterbalancing be conducted? Control groups? Etc. Etc. These nuts-and-bolts concerns are what makes or breaks an experiment; if these are not properly attended to, the results are ambiguous at best.

The **R** stands for the results. What happened? The results are measures of central tendency (means, medians, or modes) and some measure of the sampling variability. The results are descriptive. Secondary to this, one does inferential statistics (e.g., analyses of variance, t tests, multiple regression analyses, etc.) on these results to determine which patterns of variation should be taken seriously (i.e., are unlikely to have arisen due to chance).

The **I** stands for the inferences that can be drawn about the issue and alternatives, given the results. If the experiment was well designed (i.e., the logic was sound and method was rigorous), the results should allow one to eliminate at least one of the alternative positions on the issue. In designing one's own research, it is important to consider the implications of all possible results in advance, and sobering to realize that only a few of the possible patterns will be useful. Most experiments are "asymmetrical"

in that not all patterns of results are equally informative, and the researcher must decide when the gamble of obtaining such results is worth the effort and expense.

The QALMRI method will be used as a framework for designing and reporting an original piece of research. To learn more about QALMRI, please read:

[http://www.psy.jhu.edu/~spring200\\_206/qalmri.html](http://www.psy.jhu.edu/~spring200_206/qalmri.html)

[http://209.85.165.104/search?q=cache:r66EWUGonk4J:www.psych.utoronto.ca/~psy393\\_nite/QuALMRI\\_handout.doc+QuALMRI&hl=en&ct=clnk&cd=1&gl=us&client=safari](http://209.85.165.104/search?q=cache:r66EWUGonk4J:www.psych.utoronto.ca/~psy393_nite/QuALMRI_handout.doc+QuALMRI&hl=en&ct=clnk&cd=1&gl=us&client=safari)

### **Course structure:**

Each student will work with a "mentor," either a graduate student or post-doctoral fellow. In all cases, these "teams" will also meet with the instructor as needed. The mentor will provide much of the hands-on training. Each student will be assigned to work on a project, typically one just being conceived and implemented. Thus, the student will have a hand in every phase of research design. A project typically has the following aspects:

- 1 understanding the ethics of human subject research (Please see <http://www.fas.harvard.edu/%7Eresearch/HumSub.html>. Completion of the HETHR course mandatory.)
- 2 discussion about project conception; understanding how it fits into QALMRI framework
- 3 literature search (relevant to the project)
- 4 reading background literature
- 5 designing the study (deciding on within/between variables, balancing, and so forth)
- 6 creating stimuli
- 7 setting up experiment on computer (psyscope, e-prime)
- 8 recruiting/scheduling/testing subjects
- 9 data analysis
- 10 interpreting results
- 11 writing

The available projects will be described at the first meeting, and students will discuss the projects with the mentors. The mentors will then select the students based on their apparent interest and background.

It is rare that a single semester of this course will involve students in a project to the degree to which they would be eligible for authorship on published reports of the results, but those who are interested in our publication guidelines should read:

[http://www.wjh.harvard.edu/~kwn/Documents/authorship\\_criteria\\_Nov02.pdf](http://www.wjh.harvard.edu/~kwn/Documents/authorship_criteria_Nov02.pdf)

### **Requirements:**

The course will require:

1. At least 8 hours per week working on a research project in the lab (making stimuli, testing subjects, analyzing data, recruiting subjects) in addition to time spent attending the class, reading background materials, and writing papers.

2. Attending weekly course meetings. This is mandatory. In addition, Professor Kosslyn will deliver occasional lectures (at a time of mutual convenience) on specific topics, particularly regarding data analysis.

3. Reading. Primary source materials will be assigned, based on the particular project. In addition, the student will be expected to search for related material (to be included in the Introduction of the paper, as noted below).

4. Paper. The paper will be written in three phases, following APA format (the APA Style Manual is available at the Harvard Bookstore, as well as the WJH libraries):

i. The Introduction, which includes the Q, A, L of QALMRI. This portion should be about 7 or 8 pages long. *Please use headings: Question, Alternatives, and Logic, to make clear which parts of the Introduction deal with each aspect. The Introduction should include a literature review, which demonstrates that you understand: 1) why the question being asked is important and how it fits into a broad theoretical context; and, 2) why the alternatives are plausible.* The reviewed literature should allow the reader to understand why you are doing the study; it is not a review for its own sake, a review just to show that you are familiar with relevant background. ***DUE: The 4th week of the semester.***

ii. The Methods section (the M of QALMRI), which includes sections on Participants, Materials, Design, and Procedure. This portion is about 5 or 6 pages long. ***DUE: The 8th week of the semester.***

iii. The Results and Discussion (the R and I of QALMRI). This portion is about 8 pages long. The student will be encouraged to interpret the results in multiple ways and make suggestions about how to design follow-up studies or otherwise improve the design. ***DUE: Last day of Reading Period (no extensions are possible).***

### **Grading:**

Grades are based on:

1. Laboratory participation: 67%
2. Paper: 33%