

Course Information

Course Number: PBSI 647
Course Title: Seminar in Cognition and Cognitive Neuroscience Methods
Section: 600
Time: TR 11:10 – 12:25
Location: MILN 201
Credit Hours: 3

Instructor Details

Instructor: Dr. Darrell A. Worthy
Office: PSYC 287
Phone: (979) 845-3799
E-Mail: worthyda@tamu.edu (preferred method of contact)
Office Hours: By appointment

Course Description

Seminar in Cognition and Cognitive Neuroscience Methods: Survey of research in neuroimaging; electroencephalography; Bayesian cognitive modeling; reinforcement learning; eye and motion tracking; machine learning; computational modeling; course content will vary by semester. May be repeated up to four times for credit.

Course Prerequisites

None.

Special Course Designation

None

Course Learning Outcomes

By the end of the course a successful student will be able to:

- Evaluate the strengths and limitations of different cognitive neuroscience methods
- Design theoretically-motivated experiments
- Apply appropriate quantitative and analytical techniques to cognitive neuroscience data
- Critically assess published cognitive neuroscience research
- Integrate converging evidence across multiple methodological approaches

Textbook and/or Resource Materials

Farrell, S., & Lewandowsky, S. (2018). *Computational modeling of cognition and behavior*. Cambridge University Press.

Grading Policy and Requirements

Attendance (50 points): Up to four unexcused absences are allowed throughout the semester. After the fifth unexcused absence, 10 points will be deducted from the attendance grade for each additional absence. Nine or more unexcused absences will result in a zero for the attendance grade. If you have a university excused absence then please notify me via email as soon as possible, so that it will be excused.

Participation (50 points): Discussion is critical for the course. Students are expected to read all the assigned textbook chapters and journal articles assigned for the course, and to provide their input to class discussions. Points will be deducted if there is a lack of evidence that students completed the required readings, or if a student rarely contributes to class discussions.

Homework Assignments (70 points): There will be a total of 7 homework assignments, one per week. These assignments are worth ten points each; however, the lowest two homework grades will be dropped. Thus, the top twelve homework assignments will each be worth ten points, for 120 points total. These assignments will consist of short answer questions related to the material in the textbook, as well as questions related to the modeling code. Each homework assignment is due in class the following week. Unless otherwise instructed, homework assignments should be printed out and turned in during class.

Exploratory Project Presentation (75 points): The exploratory project presentation will be a 10-15 minute powerpoint presentation of an exploratory computational modeling analyses that you completed. This will be similar to a less formal talk that you might give at your research area's weekly meeting. Different types of analyses should be conducted for this project and the final paper. Ideally this exploratory project and the final paper will analyze different data sets, although it might be possible to present different types of analyses on the same data – for example, the exploratory project could examine choices, and the final project could examine response times, for the same data.

Interactive Content Mastery Quiz (50 points): This quiz will cover the major topics covered in the course, and it will be conducted as a group, although each student will complete their own answer sheet. For each question, one student will be asked to provide their answer, and then other students can agree or state reasons why another answer is the best. The structure of the quiz is designed to enhance discussion of the topics learned in the course, and aide long-term retention of the information.

Final Project Paper (100 points): The final project is a paper, approximately 5-7 pages in length, that explains the rationale, methodology, results, and implications of a computational analysis that each student will perform on some of their own data, or on data from a published study. The topic and approach can be anything related to model-based analysis of data from a behavioral science experiment. Students could also choose to model neuroscience-related data (e.g. single-cell recordings). The analysis should be novel, although it could be an incremental analysis that follows closely upon work from a published study. Students should submit their paper, along with data and code for the analysis.

Grading

- Attendance: 50 points
- Participation: 50 points
- Homework Assignments: 70 points
- Exploratory Project: 75 points
- Interactive Content Master Quiz: 50 points
- Final Project: 100 points

Final grades will be determined based on the following point system:

- A – 90% - 100%**
- B – 80% - 89%**
- C – 70% - 79%**
- D – 60% - 69%**
- F – Below 60%**

Late Work Policy

Homework assignments are due in class on the following week. If you have a conference, or university excused absence that causes you to miss class, then you may turn in your homework one week late.

If you do not have a conference or university excused absence, then you will be penalized two points per week. No assignments will be accepted if they are over four weeks late, and a grade of zero will be given.

For the final project, you will be penalized 10 points per day that the assignment is late.

Course Schedule

- 8/25 Introduction to the course
- 8/27 Lecture: Chapter 1 – Introduction **Homework 1: Downloading R and RStudio**

- 9/1 Lecture: Chapter 2 - From Words to Models: Building a Toolkit
- 9/3 Demonstration: Random-walk model **Homework 2: Random-walk model**

- 9/8 Lecture: Chapter 3 – Basic Parameter Estimation Techniques
- 9/10 Demonstration: Parameter estimation **Homework 3: Estimating Regression and Power Law Model Parameters**

- 9/15 Lecture: Chapter 4 – Maximum Likelihood Parameter Estimation
- 9/17 Demonstration: Maximum Likelihood, **Homework 4: Fitting the Generalized Context Model**

- 9/22 Lecture: Chapter 9 – Multilevel or Hierarchical Modeling
- 9/24 Demonstration: lme4 and brms, **Homework 5: Multilevel modeling of trial-level data with lme4 and brms**

- 9/29 Lecture: Chapter 10 – Model Comparison
- 10/1 Demonstration: Computing AIC and BIC, **Homework 6: AIC and BIC weights, Bayes Factors**

- 10/6 Lecture: Chapter 11 – Bayesian Model Comparison Using Bayes Factors; Discussion: Ahn, W. Y., Busemeyer, J. R., Wagenmakers, E. J., & Stout, J. C. (2008). Comparison of decision learning models using the generalization criterion method. *Cognitive science*, 32(8), 1376-1402.
- 10/8 Demonstration: A priori and post-hoc simulations **Homework 7: Model simulations**

- 10/13 Lecture: Chapter 12 – Using Models in Psychology
- 10/15 **Begin work on Exploratory Project**, Discussion: Shiffrin, R. M. (2010). Perspectives on modeling in cognitive science. *Topics in cognitive science*, 2(4), 736-750.
- 10/20 Lecture: Chapter 13 – Neural Network Models
- 10/22 Demonstration: Connectionist category-learning models; Discussion: Cornwall, A. C., Davis, T., Byrne, K. A., & Worthy, D. A. (2022). Effects of categorical and numerical feedback on category learning. *Cognition*, 225, 105163. **Continue work on Exploratory Project**
- 10/27 Lecture: Chapter 14 – Models of Choice Response Time
- 10/29 Demonstration: Response time models of gamble decisions; Discussion: Worthy, D. A., Lahey, J. N., Priestley, S. L., & Palma, M. A. (2024). An examination of the effects of eye-tracking on behavior in psychology experiments. *Behavior Research Methods*, 56(7), 6812-6825. **Continue work on Exploratory Project; begin work on final project**
- 11/3 Lecture: Chapter 15 – Models in Neuroscience
- 11/5 Demonstration: Reinforcement learning models;
Discussion: Daw, N. D., O'doherty, J. P., Dayan, P., Seymour, B., & Dolan, R. J. (2006). Cortical substrates for exploratory decisions in humans. *Nature*, 441(7095), 876-879.
Don, H. J., Davis, T., Ray, K. L., McMahon, M. C., Cornwall, A. C., Schnyer, D. M., & Worthy, D. A. (2022). Neural regions associated with gain-loss frequency and average reward in older and younger adults. *Neurobiology of Aging*, 109, 247-258. **Continue work on Exploratory Project; begin work on final project**
- 11/10 Exploratory Project Presentations and feedback
- 11/12 Exploratory Project Presentations and feedback
- 11/17 Demonstration: Combining computational and multilevel modeling; Discussion: Byrne, K. A., Peters, C., Willis, H. C., Phan, D., Cornwall, A., & Worthy, D. A. (2020). Acute stress enhances tolerance of uncertainty during decision-making. *Cognition*, 205, 104448.
- 11/19 Psychonomics: Work on Final Project
- 11/24 Psychonomics: Work on Final Project
- 11/27 Thanksgiving
- 12/1 Redefined day – attend Friday classes
- 12/3 **Interactive Content Mastery Quiz**

Finals No class. Final project due by 5 PM of the final exam date

Attendance Policy

The university views class attendance and participation as an individual student responsibility. Students are expected to attend class and to complete all assignments.

Please refer to [Student Rule 7](#) in its entirety for information about excused absences, including definitions, and related documentation and timelines.

Makeup Work Policy

Students will be excused from attending class on the day of a graded activity or when attendance contributes to a student's grade, for the reasons stated in Student Rule 7, or other reason deemed appropriate by the instructor.

Please refer to [Student Rule 7](#) in its entirety for information about makeup work, including definitions, and related documentation and timelines.

Absences related to Title IX of the Education Amendments of 1972 may necessitate a period of more than 30 days for make-up work, and the timeframe for make-up work should be agreed upon by the student and instructor" ([Student Rule 7, Section 7.4.1](#)).

"The instructor is under no obligation to provide an opportunity for the student to make up work missed because of an unexcused absence" ([Student Rule 7, Section 7.4.2](#)).

Students who request an excused absence are expected to uphold the Aggie Honor Code and Student Conduct Code. (See [Student Rule 24](#).)

Academic Integrity Statement and Policy

"An Aggie does not lie, cheat or steal, or tolerate those who do."

"Texas A&M University students are responsible for authenticating all work submitted to an instructor. If asked, students must be able to produce proof that the item submitted is indeed the work of that student. Students must keep appropriate records at all times. The inability to authenticate one's work, should the instructor request it, may be sufficient grounds to initiate an academic misconduct case" ([Section 20.1.2.3, Student Rule 20](#)).

You can learn more about the Aggie Honor System Office Rules and Procedures, academic integrity, and your rights and responsibilities at aggiehonor.tamu.edu.

Notice of Nondiscrimination

Texas A&M University is committed to providing safe and non-discriminatory learning, living, and work environments for all members of the University community. The University provides equal opportunity to all employees, students, applicants for employment or admission, and the public regardless of race, color, sex (including pregnancy and related conditions), religion, national origin, age, disability, genetic information, or veteran status. Texas A&M University will promptly, thoroughly, and fairly investigate and resolve all complaints of discrimination, harassment (including sexual harassment), complicity and related retaliation based on a protected class in accordance with System Regulation 08.01.01, University Rule 08.01.01.M1, Standard Administrative Procedure (SAP) 08.01.01.M1.01, and applicable federal and

state laws. In accordance with Title IX and its implementing regulations, Texas A&M does not discriminate on the basis of sex in any educational program or activity, including admissions and employment. The following person has been designated to handle inquiries and complaints regarding the non-discrimination policies: Jennifer M. Smith, TAMU Associate VP & Title IX Coordinator at YMCA Ste 108, College Station, TX 77843, 979-458-8407, or email civilrights@tamu.edu. For other reporting options, visit <https://ocrcas.ed.gov/contact-ocr> to locate the address and phone number of the office that serves your area, or call 1-800-421-3481.

Civil Rights, Free Speech, and Title IX Policies

Texas A&M University is committed to fostering a learning environment that is safe and productive for all. University policies and federal and state laws prohibit discrimination and harassment based on an individual's race, color, sex, (including pregnancy and related conditions), religion, national origin, age, disability, genetic information, veteran status, or any other legally protected characteristic. This includes forms of sex-based violence, such as sexual assault, sexual harassment, sexual exploitation, dating/domestic violence, and stalking.

Students can report discrimination/harassment, access supportive resources, or learn more about their options for resolving complaints on the [University's Civil Rights & Title IX webpage](#).

Students should be aware that all university employees (except medical or mental health providers) are mandatory reporters, which means that if they observe, experience or become aware of an incident that they reasonably believe to be discrimination/harassment alleged to have been committed by or against a person who was a student or employee at the time of the incident, the employee must report the incident to the university.

Americans with Disabilities Act (ADA) Policy

Texas A&M University is committed to providing equitable access to learning opportunities for all students. If you experience barriers to your education due to a disability or think you may have a disability, please contact the Disability Resources office on your campus (resources listed below). Disabilities may include, but are not limited to attentional, learning, mental health, sensory, physical, or chronic health conditions. All students are encouraged to discuss their disability related needs with Disability Resources and their instructors as soon as possible.

To request academic accommodations, contact the designated ADA office based on your location:

- Texas A&M University, College of Nursing, College of Dentistry, Irma Lerma Rangel College of Pharmacy College Station, College of Medicine, School of Public Health, Institute of Biosciences and Technology, EnMed Program, Bush School in Washington DC, Mays Business School – CityCentre, TAMU Engineering Academies, Texas A&M University Higher Education Center at McAllen and Texas A&M University at Galveston should contact [Disability Resources](#) at (979) 845-1637 or disability@tamu.edu.
- Texas A&M University School of Law should contact the Office of Student Affairs at (817) 212-4111 or law-disability@law.tamu.edu to request accommodations.
- Irma Lerma Rangel College of Pharmacy in Kingsville should contact the Disability Resource Center at Texas A&M University - Kingsville at (361) 593-3024 or drc.center@tamuk.edu to request accommodations.

- Texas A&M University College of Veterinary Medicine & Biomedical Sciences in Canyon should contact the Office of Student Accessibility at West Texas A&M University – Canyon at (806) 651-2335 or osa@wtamu.edu.
- Texas A&M University at Qatar (TAMUQ) should contact the campus psychologist, Dr. Steve Wilson +974-4423-0047 or stephen.wilson@qatar.tamu.edu.

If you are experiencing difficulties with your approved accommodations, contact the office responsible for approving your accommodations or the Texas A&M ADA Coordinator Julie Kuder at ADA.Coordinator@tamu.edu or (979) 458-8407.

Pregnancy Accommodations

Texas A&M provides reasonable accommodations to students due to pregnancy and/or related conditions, such as childbirth, recovery and lactation. Students should contact the University's [Pregnancy Coordinator](#) as soon as they become aware of the need for accommodation. Depending on the circumstances, accommodations could include extended time to complete assignments or exams, changes in course sequence, or modifications to the physical classroom environment. Texas A&M will also allow a voluntary leave of absence, ensure the availability of lactation space, and maintain grievance procedures to provide for the prompt and equitable resolution of complaints of sex discrimination. For information regarding pregnancy accommodations, email TIX.Pregnancy@tamu.edu.

Statement on Mental Health and Wellness

Texas A&M University recognizes that mental health and wellness are critical factors influencing a student's academic success and overall wellbeing. Students are encouraged to engage in healthy self-care practices by utilizing the resources and services available through [University Health Services](#) on its [mental health webpage](#). The [TELUS Health Student Support app](#) provides access to professional counseling in multiple languages anytime, anywhere by phone or chat, and the 988 Suicide & Crisis Lifeline offers 24-hour emergency support at 988 or 988lifeline.org.

Texas A&M College Station

Students needing a listening ear can contact University Health Services (979.458.4584) 24-hour emergency help is also available through the 988 Suicide & Crisis Lifeline (988) or at 988lifeline.org.

Statement on the Family Educational Rights and Privacy Act (FERPA)

FERPA is a federal law designed to protect the privacy of educational records by limiting access to these records, to establish the right of students to inspect and review their educational records and to provide guidelines for the correction of inaccurate and misleading data through informal and formal hearings. Currently enrolled students wishing to withhold any or all directory information items can do so within howdy.tamu.edu using the Directory Information Withholding Form. The complete [FERPA Notice to Students](#) and the student records policy is available on the Office of the Registrar webpage. Items that can never be identified as public information are a student's social security number, citizenship, gender, grades, GPR or class schedule. All efforts will be made in this class to protect your privacy and to ensure confidential treatment of information associated with or generated by your participation in the class.

Directory items include name, UIN, local address, permanent address, email address, local telephone number, permanent telephone number, dates of attendance, program of study (college, major, campus), classification, previous institutions attended, degrees honors and awards received, participation in

officially recognized activities and sports, medical residence location and medical residence specialization.