Neuroscience of Addiction and Fear (PSYC-4820/3, Section 001)

Instructors

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Drop-in visits are always welcome. You can count on finding us in our offices at the times listed above.

Course Content

The first part of the course the class will consider theories of addictions with a focus on underlying stress and reward circuity. We will also examine the similarity of addiction-related processes to other psychological phenomena.

The second part of the course will examine the neural circuitry of fear conditioning in animals, and explore fear learning in a model system, Fraidy Rat, which has been implemented in a computer program.

Addiction Section (Sept 8 to Oct 26)

The course begins with an overview of neuroplasticity and an examination of two major theories of drug addiction – incentive sensitization and hedonic dysregulation and adaptation. The following weeks cover recent developments in addiction and relate what is known to other psychological phenomena.

This section of the course culminates with a quiz (**Addiction Theories, 20 points**) and a paper (**20 points; due Nov 9**) following a corresponding 15 min seminar presentation the same topic approved by the instructor (**10 points, due Weeks of Oct 19 or 26 – see schedule below**).

Readings

Neuroplasticity:

Kandel, E. R. (2001). The Molecular Biology of Memory Storage: A Dialogue Between Genes and Synapses. Science, 294(5544), 1030–1038. http://doi.org/10.1126/science.1067020

Beninger, R. J., & Gerdjikov, T. V. (2004). The role of signaling molecules in reward-related incentive learning. Neurotoxicity Research, 6(1), 91–103.

Jones S. & Bonci, A. (2005). Synaptic plasticity and drug addiction. Current Opinion in Pharmacology,5, 20–25

Allostasis:

McEwen, B. S. (2000). Allostasis and allostatic load: implications for neuropsychopharmacology. Neuropsychopharmacology, 22(2), 108–124.

Hedonic Dysregulation:

Koob, G. F., & Le Moal, M. (2001). Drug addiction, dysregulation of reward, and allostasis. Neuropsychopharmacology, 24(2), 97–129.

Incentive Sensitization:

Robinson, T. E., & Berridge, K. C. (2003). Addiction. Annu. Rev. Psychol. 2003. 54:25–53.

Reward/Executive Function:

Everitt, B. J., & Robbins, T. W. (2005). Neural systems of reinforcement for drug addiction: from actions to habits to compulsion. Nature Neuroscience, 8(11), 1481–1489.

Crews, F. T., & Boettiger, C. A. (2009). Impulsivity, frontal lobes and risk for addiction. Pharmacology Biochemistry and Behavior, 93(3), 237–247. http://doi.org/10.1016/j.pbb.2009.04.018

Theory Comparison:

Wise, R. A., & Koob, G. F. (2014). The development and maintenance of drug addiction. Neuropsychopharmacology, 39(2), 254–262.

Behavioural Addictions:

Sescousse, G., Barbalat, G., 1, Domenech, P., & Dreher, J-C. (2013). Imbalance in the sensitivity to different types of rewards in pathological gambling, Brain, 136; 2527–2538

Granero, R., Fernández-Aranda, F., Mestre-Bach, G., Steward, T., Baño, M., del Pino-Gutiérrez, A., Moragas, L., Mallorquí-Bagué, N., Aymamí, N., Gómez-Peña, M., Tárrega, S., Menchón, J. M., & Jiménez-Murcia, S. (2016). Compulsive Buying Behavior: Clinical Comparison with Other Behavioral Addictions. Front. Psychol., doi.org/10.3389/fpsyg.2016.00914

Frascella, J., Potenza, M. N., Brown, L. L., & Childress, A. R. (2010). Shared brain vulnerabilities open the way for nonsubstance addictions: Carving addiction at a new joint? Ann. N.Y. Acad. Sci., 1187, 294–315

Psychedelics:

Morgan, C., McAndrew, A., Stevens, T., Nutt, D., & Lawn, W. (2017). Tripping up addiction: The use of psychedelic drugs in the treatment of problematic drug and alcohol use. Current Opinion in Behavioral Sciences, 13, 71–76. https://doi.org/10/gmpft3

López-Giménez, J. F., & González-Maeso, J. (2017). Hallucinogens and Serotonin 5-HT2A Receptor-Mediated Signaling Pathways. In A. L. Halberstadt, F. X. Vollenweider, & D. E. Nichols (Eds.), Behavioral Neurobiology of Psychedelic Drugs (Vol. 36, pp. 45–73). Springer Berlin Heidelberg. https://doi.org/10.1007/7854_2017_478

Smigielski, L., Scheidegger, M., Kometer, M., & Vollenweider, F. X. (2019). Psilocybin-assisted mindfulness training modulates self-consciousness and brain default mode network connectivity with lasting effects. NeuroImage, 196, 207–215. https://doi.org/10/gf2d97

Davis, A. K., Barrett, F. S., May, D. G., Cosimano, M. P., Sepeda, N. D., Johnson, M. W., Finan, P. H., & Griffiths, R. R. (2021). Effects of Psilocybin-Assisted Therapy on Major Depressive Disorder: A Randomized Clinical Trial. JAMA Psychiatry, 78(5), 481. https://doi.org/10/ghhw2h

Weekly Schedule

Week of Sept 7	Neuroplasticity; Lecture	Neuroplasticity; Lecture
Week of Sept 14	Allostasis/Hedonic Dysregulation; Lecture	Incentive Sensitization; Lecture
Week of Sept 21	Executive Function; Lecture	Theory comparison; Lecture and Discussion
Week of Sept 28	Behavioural Addictions; Lecture	National Reconciliation Day, No Classes
Week of Oct 5	Psychedelics; Lecture	**Addiction Theories Quiz**
Week of Oct 19	**Presentations Persons 1-6**	**Presentations Persons 7-12**
Week of Oct 26	**Presentations Persons 13-18**	Fear Section Begins

Please note the schedule is tentative; all topics may not be covered (any omitted material will be indicated during class). Extraneous material will not be permitted for use during quizzes

Fear Section (Oct 28 – Dec 9)

Lectures will introduce you to the circuitry underlying fear acquisition and then explore mechanisms of fear extinction. Emphasis will be placed on what is known

about their neural underpinnings. A quiz will assess your knowledge of this lecture material and the LeDoux readings. (**Fear Quiz, 25 points, Nov 18**).

FraidyRat is a computer simulation of a plausible neural structure to account for a number of salient aspects of fear conditioning and extinction in rats. For example, the Fraidy program assumes the hippocampus is critical for establishment of a neural representation of the conditioning context by binding together individual features of the environment. Over time the conditioning context representation is assumed to become independent of the continued existence of the hippocampus as it becomes consolidated in other parts of Fraidy's brain. It may then serve as a cue to signal danger.

On Nov 23 you will be introduced to the Fraidy rat program. The main anatomical regions of his brain will be investigated by recording neural firing rates and by activating or inactivating brain regions via stimulation or drug infusion. You will be working through series of guided exercises and will answer a set of laboratory questions. (**25 points, due Dec 23)**

As a part of the preceding exercise, each student will use the Fraidy program to determine if it can account for a finding in the literature. The student will choose a scientific paper from a list provided by the instructor and then attempt to simulate those results with Fraidy.

Fear Required Books

LeDoux, J. (2016). *Anxious: Using the Brain to Understand and Treat Fear and Anxiety*, New York, NY: Penguin Random House. ISBN 9780143109044 (This popular book is widely available for $25 at bookstores)

Krasne, Franklin B. (2014) Fraidy Rat Companion. Creative Commons. (Supplied by Instructor)

Weekly Schedule

Week of Oct 26	Addiction Section Ends	LeDoux Chapter 1, 2
Week of Nov 2	LeDoux Chapter 3, 4	LeDoux Chapter 5, 7
Week of Nov 9	LeDoux Chapter 8, 9	Remembrance Day, No Classes
Week of Nov 16	LeDoux Chapter 10, 11	**Fear Quiz**
Week of Nov 23	Fraidy Companion, Chapters 1, 2	Fraidy Companion, Chapter 3
Week of Nov 30	Fraidy Companion, Chapter 4	Fraidy Companion, Chapter 5
Week of Dec 7	**Presentations Persons 1-9**	**Presentations Persons 9-18**

Final Grades

Letter grades based on the tally of all course components will be distributed as closely as possible to the following scale:

Grade Distribution

Letter Grade	Minimum %
A+	95
A	85
A-	80
B+	75
B	70
C+	65
C	60
D	50
F	0

All grades and grade cutoffs are tentative and may be changed in either direction by (i) the professor, (ii) the Departmental Review Committee, or (iii) the Senate, when circumstances warrant.

Components of the course are Addiction Theories Quiz (20 points), Paper (20 points), and seminar (10 points), Fear System Quiz (25 points), and Fraidy Lab Report (25 points). Grades are reviewed by the Psychology Department Review Committee be increased or decreased, although changes are extremely unlikely. The final date for withdrawing from this course without academic penalty is **November 16, 2021**.

General Information

Please acquaint yourself with university regulations, policies and procedures, including grade appeals and academic misconduct, http://uwinnipeg.ca/academics/calendar/docs /regulationsandpolicies.pdf.

All students, faculty, and staff have the right to participate, learn, and work in an environment that is free of harassment and discrimination. The UW Respectful Working and Learning Environment Policy may be found online at www.uwinnipeg.ca/respect.

Students with documented disabilities, temporary or chronic medical conditions, requiring academic accommodations for tests/exams or during lectures/laboratories are encouraged to contact Accessibility Services (AS) at 204.786.9771 or https://www.uwinnipeg.ca/accessibility-services/ to discuss appropriate options. All information about a student's disability or medical condition remains confidential.

Students may choose not to attend classes or write examinations on holy days of their religion, but they must notify their instructors at least two weeks in advance. Instructors will then provide an opportunity for students to make-up work and/or examinations without penalty. A list of religious holidays can be found in the 2021-2022 Academic Calendar, in the section, https://www.uwinnipeg.ca/academics/calendar/dates.html.

To follow events in Psychology, check out Psychology Department @ UWinnipeg **on Facebook, view our homepage at** http://psychology.uwinnipeg.ca**, or follow us on Instagram** (psychologyatuwinnipeg).