The Behavioral Neuroscience of Motivated and Emotional Behaviors (Psych 127 - BBB 227)
Syllabus: FALL 2014

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Classroom: Fisher Bennett 419, T/Th 3-4:20pm

TA Office Hours: Amber: Tuesdays 1:45-2:45 [before class] or by appointment in Solomon D25
Hana: Thursdays 4:45-5:45 [after class] or by appointment in Solomon B36

Course Description: This course focuses on evaluating the experiments that have sought to establish links between brain structure (the activity of brain cells [neurons] in specific parts of the brain) and behavioral function (the control of particular motivated and emotional behaviors). Students are exposed to concepts from regulatory physiology, neuroscience, pharmacology, endocrinology and psychology and read textbook as well as original source materials. The course focuses on the following behavioral functions: fear, anxiety, depression, aversion, reward, energy balance and feeding. The course also considers the neurochemical control of responses with an eye towards evaluating the development of drug treatments for anxiety disorders, depression, vomiting anorexia/cachexia, addiction, and obesity.

Canvas Site contains important information for the class (including the syllabus which will be revised throughout the course) and you are advised to consult it often. Powerpoint files of the slides/visual material used in each lecture will be found there, as well as the required readings for each class. Other types of demonstration material including animations can also be found there.

Readings are taken from original scientific material (journal articles and reviews) and a few textbook chapters (primarily from Carlson's Physiology of Behavior, tenth edition). To save you on expenses, online material will be used when possible and posted on the course Canvas Site [CS]. Textbook material and material not found in PDF form is in a BulkPack [BP] that is available at Campus Copy Center (39th and Walnut). Supplemental reading or revisions to readings will be posted on the Canvas Site and your attention will be directed to it via an announcement. When I refer to a multi-authored reading I will do so by calling it by the last name of the first author, as in "Andrews paper", and when there are two authors I may refer to the reading by using either the first authors last name or the last names of both authors.

Effective studying and Preparation for each class: It is **strongly suggested** that you read/review the assigned materials **prior to the lecture** that they were assigned and that you either print the lecture slides from the Canvas Site and take notes on them or that you bring your computer, open the Powerpoint of the lecture slides and take notes associated with each slide covered. It will be more beneficial to your studying if you take notes on the file [or printed page] associated with the slide that I was referring to when I was lecturing than it would to take notes in notebook not associated with the slides. If you for some reason don't have the time to read an assignment thoroughly before the related lecture, read the abstract and study the figures and conclusions in the Discussion section of the paper.

Students are urged to review their lecture notes alongside the Powerpoint slides presented **on the day of the lecture** or within a day. Look over your notes on the reading and pay attention to the figures. Make sure that you understand all figures reviewed in lecture. If you do this you it will greatly aid your consolidation of the material. Study questions will be provided for journal article readings. Answers will not be posted, but you are encouraged to complete these questions and consult the TA during office hours with any questions. If you do not review your notes until you begin review for an exam [weeks after a given lecture] you are handicapping yourself and reducing your ability to consolidate the information you have listened to, viewed and read about.

Addressing the questions you have: Try your best to find the answers to such questions in the reading themselves and using online resources. Should you still have questions, you can pose them to the TA during

their offices hours or raise the question in class. The TAs will be able to answer your questions but in the rare case where after having discussed the question with the TA you are still unclear, contact Prof. Grill via email.

Grading**:** there will be one quiz and 3 exams (two in class and a final). Exams will have short answers and short essay forms. Final grade will be based on these assessments in the following way – quiz (10%), first exam (22%), second exam (34%) and third exam (34%). Class participation will serve as a positive weighting factor by increasing grades by up to half of a letter grade (i.e. from B+ to A-).

Make-up exams: There will be no make-up exams. Special cases will be individually evaluated and will require medical documentation.

Semester Lecture Schedule and Readings List

Week 1:

8/28 Course Introduction and Orientation to Course Organization and Requirements (Lecture 1)

Reading for after class: Excerpt from W.B. Cannon's book The Wisdom of the Body pages 19-26 [BP]

Foundation Lectures

Week 2:

9/2 Brain Structure and Introduction to Brain Systems of Key Relevance to Course Themes (Lecture 2)

Reading: Textbook chapter 3 pages 69-76; 83-100 [BP]
Hypothalamus: An Overview pages 897-908 [BP]

For the textbook chapters found in the Bulkpack I seek an overview of the material, not a detailed knowledge of the huge number of terms that are covered. Beyond some basics I will highlight the parts of the nervous system that we will delve more deeply into such as the amygdala, extended amygdala and striatum, hippocampus, hypothalamus, and medulla. By contrast you need not be concerned with details of the cerebral cortex or spinal cord.

Review audio-visual material associated with this lecture on the Canvas Site or made available otherwise.

9/4 Neuron Function: Released neurotransmitters interact with specialized receptors that excite or inhibit neurons. When, through the action of the neurotransmitters acting on them, neurons are sufficiently excited electrically they "fire" (aka have action potentials) which results in the release of neurotransmitters that affect other neurons that they project to. We focus on principles of pharmacology and neurochemical transmission (Lecture 3)

Reading: Textbook chapter 2 pages 29-33; 47-61 [BP]
Textbook chapter 4 110-114, gain general knowledge of each neurotransmitter discussed from pages 114-127

Review audio-visual material associated with this lecture on the Canvas Site or made available otherwise.

Week 3:

9/9 Methods and Strategies Used to link Structure to Function (Lecture 4)

Reading: Textbook chapter 5 pages 135-168 [BP]

Review audio-visual material associated with this lecture on the Blackboard Site or made available otherwise.

9/11 ***QUIZ on lectures 1-4.*** Followed by → Introduction to reading a scientific paper, its components (abstract/summary, introduction, methods, results and discussion) and its associated figures

Readings: skim through Davis 1998 and Sahuque et al 2006 and become familiar with the sections of the papers.

Week 4:

The Neural Basis of Emotion

9/16 Emotion and the Brain- A Focus on Fear and the Neurobiological Function of the Amygdala (Lecture 5)

Reading: Davis, M. (1998). Are different parts of the extended amygdala involved in fear versus anxiety? *Biological Psychiatry, 44,* 1239–1247. [CS]
Kamkwalala, A., Ressler, K. et al (2012) Dark-enhanced startle responses and heart rate variability in a traumatized civilian sample: putative sex-specific correlates of posttraumatic stress disorder *Psychosomatic Medicine* [CS]
Textbook chapter 11 pages 367-372 [BP]

9/18 Emotional Function Assessed in the Amygdala: Data from Normal & Brain Damaged Humans (Lecture 6)

Reading: Labar, K, LeDoux, J. E Phelps, E. A. et al. (1998). Human Amygdala Activation during Conditioned Fear Acquisition and Extinction: a Mixed-Trial fMRI Study. *Neuron* [CS]

Adolphs R et al (2005) A mechanism for impaired fear recognition after amygdala damage. *Nature* [CS]

Week 5:

9/23 Stress, the Stress Response, the CRF System (Lecture 7)

Reading: Textbook chapter 17 pages 601-608 [BP]
Sahuque, L., et al. (2006). Anxiogenic and aversive effects of corticotrophin releasing factor (CRF) in the bed nucleus of the stria terminalis in the rat: Role of CRF receptor subtypes. *Psychopharmacology, 186,* 122-132. [CS]
Zorrilla E. et al. (2002) Effects of antalarmin, a CRF type 1 receptor antagonist, on anxiety-like behavior and motor activation in the rat. *Brain Research*. [CS]

9/25 Using Animal Models to study the Neurobiology of Depression; begin background for neuropathology of depression (Lecture 8)

Reading: Textbook chapter 4 pages 118-127 [BP]
Cryan, J. F., Markou, A., and Lucki, I. (2002). Assessing antidepressant activity in rodents: Recent developments and future needs. *Trends in Pharmacological Sciences, 23*, 238-245. [CS]
Sheline, Y. et al. Depression duration but not age predicts hippocampal volume loss in medically healthy women with recurrent major depression. *Journal of Neuroscience*

Week 6:

9/30 Hypothesis for the Neuropathology Underlying Human Depression Part I (Lecture 9)

Reading: Czeh, B., et al. (2001). Stress-induced changes in cerebral metabolites, hippocampal volume, and cell proliferation are prevented by antidepressant treatment with tianeptine. *Proceedings National Academy of Sciences, 98,* 12796-12801. [CS]
Malberg, J.E. et al. (2000) Chronic antidepressant treatment increases neurogenesis in adult rat hippocampus *J Neuroscience.*

10/2 Hypothesis for the Neuropathology Underlying Human Depression Part II (Lecture 10)

Reading: Shirayama, Y., Chen, A. C., Nakagawa, S., Russell, D. S., and Duman, R. S. (2002). Brain-derived neurotrophic factor produces antidepressant effects in behavioral models of depression. *The Journal of Neuroscience, 22*, 3251-3261. [CS]
Santarelli, L., et al. (2003). Requirements of hippocampal neurogenesis for the behavioral effects of antidepressants. *Science, 301*, 805-809. [CS]

Week 7:

Reward Systems

10/7 Taste and Reward: taste sensation, taste reward, ventral forebrain reward system (Lecture 11)

Readings:
Roitman, M. F., Wheeler, R. A., Wightman, R. M., and Carelli, R. M. (2008). Real-time chemical responses in the nucleus accumbens differentiate rewarding and aversive stimuli. *Nature Neuroscience, 11,* 1376-1377. [CS]
--Textbook chapter 7 pages 250-254 [BP]

10/9 * FALL BREAK*****

Week 8:

10/14 *EXAM I on lectures 5-10*

10/16 Food Reward and Drug Reward (Lecture 12)

Readings: Volkow, N. D. et al. (2002). "Nonhedonic" food motivation in humans involves dopamine in the dorsal striatum and methylphenidate amplifies this effect. *Synapse, 44,* 175-180. [CS]
Small, D.M., Jones-Gotman, M., Dagher, A. (2003). Feeding-induced dopamine release in dorsal striatum correlates with meal pleasantness ratings in healthy human volunteers. *NeuroImage,* 19, 1709-1715. [CS]
Volkow, N. D. et al. (2006). Cocaine cues and dopamine in dorsal striatum: Mechanisms of craving in cocaine addiction. *The Journal of Neuroscience, 26,* 6583-6588. [CS]

Week 9:

10/21 Food and Drug Reward Neurobiology (Lecture 13)

Readings: Harris, G. C., Wimmer, M., Randall-Thompson, J. F., and Aston-Jones, G. (2007). Lateral hypothalamic orexin neurons are critically involved in learning to associate an environment with morphine reward. Behavioral *Brain Research, 183,* 43-51. [CS]

Hollander, J.A., Pham, D., Fowler, C.D., Kenny, P.J. (2012). Hypocretin-1 receptors regulate the reinforcing and reward-enhancing effects of cocaine: pharmacological and behavioral genetics evidence. *Frontiers in Behavioral Neuroscience*, *6*, 1-9. [CS]

10/23 Food and Drug Reward Neurobiology (Lecture 14)

Readings: DiLeone R et al The drive to eat: comparisons and distinctions between mechanisms of food reward and drug addiction (optional) [CS]

Wetherill et al. (2014). Neural responses to subliminally presented cannabis and other emotionally evocative cues in cannabis-dependent individuals. *Psychopharmacology*, 231:1397-1407. [CS]

Bossert et al. (2009). Role of Dopamine D_1-family receptors in dorsolateral striatum in context-induced reinstatement of heroin seeking in rats. *Psychopharmacology*, 206:51-60. [CS]

Week 10:

Aversion Systems, Emesis

10/28 Linking Nausea and Vomiting to food aversion in humans and other animals (Lecture 15)

Readings: Pelchat, M. L. and Rozin, P. (1982). The special role of nausea in the acquisition of food dislikes in humans. *Appetite, 2,* 341-351. [BP]

Bernstein, I. L. (1982). Physiological and psychological mechanisms of cancer anorexia. *Cancer Research, 42,* 715-720. [BP]

Pelchat, M. L., Grill, H. J., Rozin, P., Jacobs, J. (1983) Quality of acquired responses to tastes by *Rattus norvegicus* Depends on type of associated discomfort. *Journal of Comparative Psychology,* 97(2), 140-153 [CS]

10/30 The role of the parabrachial nucleus (PBN) in forming associations between food taste and nausea/vomiting (Lecture 16)

Readings: Spector, A.C. (1995). Gustatory function in the parabrachial nuclei: implications from lesion studies in rats. *Reviews in the Neurosciences, 6,* 143-175. **Only read sections 1, 3.1, 3.2, 3.3.2, 3.3.4, 3.3.5, 3.3.8, 3.5 [**CS]

Reilly, S., Grigson, P.S., Norgren, R. (1993). Parabrachial nucleus lesions and conditioned taste aversion: Evidence supporting an associative deficit. *Behavioral Neuroscience, 107(6),* 1005-1017. **Only read introduction and Experiment 3 [**CS]

Week 11:

11/4 Brain circuits mediating the reduced food intake resulting from anorectic/chemotherapeutic agents (Lecture 18)

Reading: Carter et al. 2013. Genetic identification of a neural circuit that suppresses appetite. *Nature* 503(7474), 111-4.

11/06 ***EXAM II on lectures 11-16***

Week 12:

11/11 Neurobiology and Pharmacology of Emesis. (Lecture 17)

Readings: Andrews, P. L. R., Rapeport, W. G., and Sanger, G. J. (1988). Neuropharmacology of emesis induced by anti-cancer therapy. *Trends in Pharmacologic Science, 9,* 334-341. [CS]

Horn, C. C., Richardson, E. J., Andrews, P. L., and Friedman, M. I. (2004). Differential effects of gastrointestinal and hepatic vagal afferent fibers in the rat by the anti-cancer agent cisplatin. *Autonomic Neuroscience, 30,* 74-81. [CS]

Energy Balance: Energy Expenditure and Autonomic Neural Control of Energy Balance

11/13 Diet-induced thermogenesis (Lecture 19)

Readings: Stock, M. J. (1999). Gluttony and thermogenesis revisited. *International Journal of Obesity, 23,* 1105-1117. [CS]
Bachman, E. S., Dhillon, H., Zhang, C., Cinti, S., Bianco, A. C., Kobilka, B. K., and Lowell, B. B. (2002). βAR signaling required for diet-induced thermogenesis and obesity resistance. Science, 297, 843-845. [CS]
Weyer, C., Vozarova, B., Ravussin, E., and Tataranni, P. A. (2001). Changes in energy metabolism in response to 48h of overfeeding and fasting in Caucasians and Pima Indians. *International Journal of Obesity, 25,* 593-600. [CS]

Energy Balance: Food Intake and Obesity

Week 13:

11/18 Obesity is a disease affecting many adults and children; to effectively treat obesity, a very detailed understanding of the basic science of energy balance is needed, as is the use of animal models. Obesity has genetic features that are best explained as polygenic rather than monogenic. Exceptions are melanocortin receptor mutations, BDNF mutations, oxytocin related mutations. Evidence that daily caloric intake and even calorie intake in individual meals are regulated (Lecture 19)

Readings: Kaplan, J. M. et al (1997). d-fenfluramine anorexia: dissociation of ingestion rate, meal duration, and meal size effects. *Pharmacology of Biochemistry and Behavior, 57*, 223-229. [CS]
Blundell paper on human individual differences in satiety TBD

11/20 Inhibiting Food Intake. Focus on gastrointestinal "satiation" signals, GLP-1 and Leptin and their representations in the neural control energy balance. (Lecture 21)

Week 14:

11/25 Stimulating Food Intake. Focus on food palatability, ghrelin, AgRP, NPY, conditioned feeding, conditioned place preferences and their representations in the neural control of feeding (Lecture 20)

Readings: Malik et al. (2008). Ghrelin modulates brain activity in areas that control appetitive behavior. *Cell Metabolism* 7(5): 400-9. [CS]
Luquet S et al (2005) NPY/AgRP neurons are essential for feeding in adult mice but can be ablated in neonates. Science. [CS]

11/27 THANKSGIVING: NO CLASS

Week 15:

12/2 Leptin – a peptide hormone made in white fat discovered in in mid 90s has significant impact on energy balance and obesty

Readings: Hayes, M. R., et al. (2010). Endogenous leptin signaling in the caudal nucleus tractus solitarius and area postrema is required for energy balance regulation. *Cell Metabolism, 11*, 77-83. [CS]
Farooqi I.S. Leptin regulates striatal regions and human eating behavior. *Science*. 2007

12/4 Effects on weight loss on hormones and the problems with weight loss maintenance. Drug treatments for obesity.

Readings: Sumithan et al paper, Kissileff et al, Rosenbaum et al

Human Feeding Disorders and the use of animal models to study the underlying biology of these human diseases with an eye toward treatment development (Lecture 23

Week 16:

12/9 Human Feeding Disorders and the use of animal models to study the underlying biology of these human diseases . Also Conversation with students on what they thought about this course: feedback on what worked, what didn't, how might things be modified to be more effective in the future.

Reading Heaner and Walsh

Final Exam: ***EXAM III on lectures 18-23*** Dec 16