

The Neurobiology of Food Intake and Overeating (PSY 333)

Overview: It is clear that as a species we are experiencing tremendous difficulty in our relationship with food. Food intake can be regulated by precise feeding mechanisms that have evolved allowing for the survival of the human race. However, the environmental conditions our ancestors dealt with differ drastically than those presented in today's society, where obesity and its physical comorbidities (e.g., diabetes, heart disease) continue to place a burden on society in general, and the individual in particular.

Instructional Objectives: This undergraduate course will examine the underlying basis of energy (food) intake, its expenditure; learned and unlearned physiological and neurological mechanisms that drive food intake and overeating, and vulnerabilities to obesity. Information will be presented from a range of disciplines including psychology, neuroscience and medicine. The overall goal of the course is to consolidate our understanding of what drives us to eat and why what we eat, and where we eat it is so important. Please be aware that this course deals with a lot of the **biology** underlying how the brain and body influence eating behaviors. If you don't like biology very much, this may not be the course for you.

Time and Location:

1:00-2:20 PM on Tuesday and Thursday throughout Fall 2019 in 312 Ernst Bessey Hall

Office hours on Wednesday 9:30-10:30 AM in 205 Giltner Hall

Instructor and Office Hours

Dr. Alex Johnson

Office: 205 Giltner Hall

Office hours: Wednesday 9:30-10:30AM (or by appointment)

E-mail: awj@msu.edu

Graduate TA: Taryn Meinhardt

Office: 309 Giltner Hall

Office hours: Monday 1-2PM (or by appointment)

E-mail: meinhar6@msu.edu

Grading: Grades will be determined from **four** sources:

(i) **Module quizzes** (40%): Three Midterm Exams: (50 questions/exam). These exams will cover material dealt with during lecture periods (lectures, movies, discussion, etc) or contained in the readings. They will be multiple-choice tests. Bring your student ID with you to the midterms. **Be on time:** No exam will be given if you are late and a completed exam has already been turned in.

(ii) **Class discussion (35%)**: There will be ten class discussions on topics related to the study of ingestive behavior and obesity.

(iii) **Final exam (20%)**: (**75 questions**). There will be a final exam that covers material dealt throughout the semester. It will be the same format as the midterms.

(iv) **Class attendance (5%)**: Attendance will be monitored throughout the semester; many classes will have overlapping themes, which are designed to help with conceptualizing the topics discussed. Students who attend less than 90% (without genuine mitigating circumstances) of the classes will receive a 5% reduction in their overall grade.

Grades will be assigned on the following scale:

90-100% = 4.0 75-79% = 2.5 60-64% = 1.0

85-89% = 3.5 70-74% = 2.0 < 60% = 0

80-84% = 3.0 65-69% = 1.5

Questions and Exam Preparation

ALL E-mail inquiries should be directed to Taryn Meinhardt. If you are having difficulty with the material, have questions or other concerns, you may come to office hours or make an appointment. You are encouraged to ask questions and utilize the service of the assistants who are available to help you learn.

Review sessions: A review session will be held during TA office hours that precede each exam (i.e., 1:00-2:00pm on 9/23; 10/30; 12/4; 12/11). We will answer your questions, but will not be giving a prepared lecture. If there are no questions, the review session will end early. These review sessions are not required. The TA will send an e-mail to the class should any room and/or date changes be necessary.

Make-up Exams

Make-up exams will **only be given in extreme cases such as**: 1) a documented serious medical or family emergency, or 2) a documented scheduled conflict, such as a religious holiday or required participation in a university-sanctioned event. No makeup exams will be given unless you have a valid, documented excuse (e.g., a note from the dean, a note from your doctor recommending that you not attend class). If you cannot get a note or if your excuse involves something that is personal and that you want to keep private, you must get a note from the Dean. If you cannot take the exam because of a university-scheduled event (e.g., a commitment for a sports team), a religious holiday, or some other acceptable event that you could have been foreseen, you must notify the instructor at least one week before the exam. If you cannot take the exam because of a sudden illness or because of a family emergency, you must notify the TA **by the end of the day of the exam**. Absence from an exam for any other reason will result in a grade of 0 for that exam.

There are no make-up exams without a written valid excuse AND permission from the instructor. **Permission must be obtained immediately before or after the missed exam (within 1 day).**

Academic Honesty

Article 2.3.3 of the Academic Freedom Report states that "The student shares with the faculty the responsibility for maintaining the integrity of scholarship, grades, and professional standards." In addition, the Department of Psychology adheres to the policies on academic honesty as specified in General Student Regulations 1.0, *Protection of Scholarship and Grades*; the all-University Policy on *Integrity of Scholarship and Grades*; and Ordinance 17.00, Examinations. (See *Spartan Life: Student Handbook and Resource Guide* (<http://www.vps.msu.edu/SpLife/index.htm>) and/or the MSU Web site: <http://www.msu.edu>). At MSU, General Student Regulation 1.00 states in part that "no student shall claim or submit the academic work of another as one's own." (For the complete regulation, see *Protection of Scholarship and Grades*.) You are expected to complete all course assignments, including homework, lab work, quizzes, tests and exams, without assistance from any source. You may not assist anyone or be assisted by anyone on an exam, and you may not use the text or any notes during an exam. Your written work must be your own and you are not authorized to use the www.allmsu.com web site to complete any course work in this course. Any student caught cheating, plagiarizing or otherwise violating the MSU academic integrity policy may receive the maximum punishment, including a grade of 0.0 in the course.

Classroom Behavior

Classes begin on time. Students are expected to put away all distractions before class begins, and turn off cell phones etc. It is not appropriate to answer phone calls or text message during lecture. If you arrive late or leave early, plan to sit near the back and by an aisle to minimize the disruption to others. **Please stop talking to your neighbor during the lecture.** Please respect your instructors and fellow students by turning off electronic communication devices during class. Laptop use is permitted. However, distracting activities such as instant messaging, writing e-mail, social networking, or playing games is **strictly prohibited during class time**. These behaviors are disruptive and are not conducive to the learning process.

Accommodations for Disabilities

Students with disabilities should contact the Resource Center for Persons with Disabilities (RCPD) to establish clear and reasonable accommodations. For an appointment with a counselor, call 353-9642 (voice) or 355-1293 (TTY). If you require testing accommodations as specified from RCPD, contact your TA with the appropriate paperwork at least one week prior to the exam date.

Additional information

Reading and other material: Relevant manuscripts, commentaries, opinion articles and

reviews will be made available electronically (suggested material can be found below). These readings have been purposely chosen due to their relevance to the material discussed in class. During class you will also be shown carefully selected videos on topics relevant to the study of food intake and overeating.

Suggested reading material

Module 1 Reading: Taste, flavor and experience

Scott, K. K. (2005). Taste recognition: food for thought. *Neuron*, 48(3), 455–464.

Brunstrom, J. M., & Mitchell, G. L. (2007). Flavor-nutrient learning in restrained and unrestrained eaters. *Physiology & Behavior*, 90(1), 133–141.

Berridge, K. C., & Kringelbach, M. L. (2015). Pleasure Systems in the Brain. *Neuron*, 86(3), 646–664.

Teff, K. L., Mattes, R. D., Engelman, K., & Mattern, J. (1993). Cephalic-phase insulin in obese and normal-weight men: relation to postprandial insulin. *Metabolism-Clinical and Experimental*, 42(12), 1600–1608.

Module 2 Reading: Traditional Feeding centers

Balagura & Davenport (1970). Feeding patterns of normal and ventromedial hypothalamic lesioned male and female rats. *Journal of Comparative and Physiological Psychology*. 71(3), 357-364.

Mogenson, G. J., & Stevenson, J. A. F. (1966). Drinking and self-stimulation with electrical stimulation of the lateral hypothalamus. *Physiology & Behavior*, 1(3), 251–IN9.

Module 3 Reading: Orexigenic gut peptide—ghrelin

Ariyasu, H. (2001). Stomach Is a Major Source of Circulating Ghrelin, and Feeding State Determines Plasma Ghrelin-Like Immunoreactivity Levels in Humans. *Diabetes*, 86(10), 4753–4758.

Cummings, D. E., Purnell, J. Q., Frayo, R. S., Schmidova, K., Wisse, B. E., & Weigle, D. S. (2001). A preprandial rise in plasma ghrelin levels suggests a role in meal initiation in humans. *Diabetes*, 50(8), 1714-1719.

Module 4 Reading: Anorexigenic gut peptides—insulin and leptin

Le Roux, C. W., Batterham, R. L., Aylwin, S. J. B., Patterson, M., Borg, C. M., Wynne, K. J. & Bloom, S. R. (2006). Attenuated peptide YY release in obese subjects is associated with reduced satiety. *Endocrinology*, 147(1), 3-8.

Lieverse, R. J., Jansen, J. B., Masclee, A. A., & Lamers, C. B. (1995). Satiety effects of

a physiological dose of cholecystokinin in humans. *Gut*, 36(2), 176-179.

Kahn, S. E., Hull, R. L., & Utzschneider, K. M. (2006). Mechanisms linking obesity to insulin resistance and type 2 diabetes. *Nature*, 444(7121), 840–846.

Ruhl et al., (2007). Body mass index and serum leptin concentration independently estimate percentage body fat in older adults. *The American journal of clinical nutrition*, 85(4), 1121-1126.

Module 5: Contemporary feeding mechanisms

Arora, S., Anubhuti. (2006). Role of neuropeptides in appetite regulation and obesity – A review. *Neuropeptides*, 40(6), 375–401.

Module 6: Brain reward and stress centers

Harbuz, M. S., & Lightman, S. L. (1992). Stress and the hypothalamo-pituitary-adrenal axis: acute, chronic and immunological activation. *Journal of Endocrinology*, 134(3), 327-339.

Wyvell, C. L., & Berridge, K. C. (2000). Intra-accumbens amphetamine increases the conditioned incentive salience of sucrose reward: enhancement of reward “wanting” without enhanced “liking” or response reinforcement. *Journal of Neuroscience*, 20(21), 8122-8130.

Module 7: Neuropeptide reward and stress feeding

Malik, S., McGlone, F., Bedrossian, D., & Dagher, A. (2008). Ghrelin Modulates Brain Activity in Areas that Control Appetitive Behavior. *Cell Metabolism*, 7(5), 400–409.

Abizaid, A., Liu, Z.-W., Andrews, Z. B., Shanabrough, M., Borok, E., Elsworth, J. D., et al. (2006). Ghrelin modulates the activity and synaptic input organization of midbrain dopamine neurons while promoting appetite. *Journal of Clinical Investigation*, 116(12), 3229–3239.

Johnson, A. W. (2013). Eating beyond metabolic need: how environmental cues influence feeding behavior. *Trends in Neurosciences*, 36(2), 101-109.

Module 8 Reading: Learning, cognition and obesity

Watson, P., Wiers, R. W., Hommel, B., & De Wit, S. (2014). Working for food you don't desire. Cues interfere with goal-directed food-seeking. *Appetite*, 79, 139-148.

Siegel, S. (1975). Conditioning insulin effects. *Journal of Comparative and Physiological Psychology*, 89(3), 189.

Module 9 Reading: Genetics of obesity

Bouchard, C., Tremblay, A., Després, J.-P., Nadeau, A., Lupien, P. J., Thériault, G., et al. (1990). The Response to Long-Term Overfeeding in Identical Twins. *The New England Journal of Medicine*, 322(21), 1477–1482.

O'Rahilly, S., & Farooqi, I. S. (2006). Genetics of obesity. *Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences*, 361(1471), 1095–1105.

Module 10 Reading: Epigenetics

Heijmans, B. T., Tobi, E. W., Stein, A. D., Putter, H., Blauw, G. J., Susser, E. S., et al. (2008). Persistent epigenetic differences associated with prenatal exposure to famine in humans. *Proceedings of the National Academy of Sciences*, 105(44), 17046–17049.

Module 11 Reading: Obesogenic environment

M. Ng, T. Fleming, M. Robinson, B. Thomson, N. Graetz, C. Margono, et al., Global, regional, and national prevalence of overweight and obesity in children and adults during 1980–2013: a systematic analysis for the Global Burden of Disease Study 2013, *Lancet* 384 (2014) 766–781.

Drewnowski, A. (2004). Obesity and the food environment. *American Journal of Preventative Medicine*, 27(3), 154–162.

Module 12 Reading: Models of obesity

Sterling, P. (2012). Allostasis: a model of predictive regulation. *Physiology & Behavior*, 106(1), 5–15.

Week beginning	Course topic(s)	Activities
8/26/19	- Course introduction - The Killer at Large	-Video
9/2/19	- Taste cells and receptors - Taste, preferences and aversions	- Module 1 reading materia - In class discussion #1
9/9/19	- Taste hedonics and 'liking'	- Module 1 reading material - In class discussion #'s 2 and 3
9/16/18	- Taste, brain and gut interactions - Traditional feeding centers	- Module 1 reading material - Module 2 reading material - In class discussion #4
9/23/19	- Ghrelin: The sole feeding signal in body	- Exam 1: 9/24/19 - Module 3 reading material
9/30/19	- Leptin and insulin: Food intake inhibitors	- Module 4 reading material - No class 10/3/19
10/7/19	- Leptin and insulin: Food intake inhibitors - Neuropeptide hypothalamic feeding	- Module 4 reading material - Module 5 reading material - In class discussion #5
10/14/19	- Brain mechanisms of stress and reward - Neuropeptide reward and stress-evoked feeding	- Module 6 reading material - Module 7 reading material
10/21/19	- Learning and its influence on feeding behaviors	- No class 10/22/19 - Module 8 reading material
10/28/19	- Cognitive disruptions in obesity	- Exam 2: 10/31/19 - Module 8 reading material
11/4/19	- Evolution and heritability - Why are thin people not fat	- Module 9 reading material - Video - In class discussion #6
11/11/19	-Genetic polymorphisms and human obesity genes - Epigenetics and obesity	- Module 10 reading material Video - In class discussion #7
11/18/19	- The obesogenic environment: What we eat and where we eat it - The obesogenic environment: How we eat and why it's a problem	- Module 11 reading material - In class discussion #8
11/25/19	- How to treat the obesity epidemic	- Module 11 reading material - In class discussion #9 - No class 11/28/19
12/2/19	- Set points and allostatic models	- Module 12 reading material - In class discussion #10 - Exam 3: 12/5/19
12/9/19	- Final Exam	- Final Exam: 12/12/19 @ 12:45PM