Psychology 770, Neurobiology and Applications of Sleep and Circadian Rhythms

Spring 2020
Class meetings Fridays, 9:15-11:45 AM, PAIS 494
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Content: Have you ever wondered whether it matters exactly when you test your subjects, or whether their patterns of sleep (and sleep deprivation!) might matter for how they perform in your tasks or respond to your treatments? Alternatively, have you wondered whether (and how) sleep and sleep timing might have implications for specific physiological processes related to wellness, cognition, and development? This is a seminar course which approaches the biological basis of sleep and sleep timing in a multidisciplinary fashion suitable for graduate students in psychology and related disciplines. Data from the primary literature will be considered in light of their potential for application to research, clinical, and educational domains. Material addressed will include 'typical' patterns and perturbations of sleep and circadian function, neural and hormonal mechanisms, animal models and evolutionary considerations, cross-cultural findings, connections with mental health and wellness, and sleep as it pertains to issues of awareness and brain mechanisms thereof. Specific emphases and readings will be determined in reference to the specific interests of students in the course. For all topics, the scope of readings and content will be designed to integrate biological, affective, and cognitive approaches.

Format will be primarily discussion and student presentation of research literature. Some lecture material for background will be provided by the instructor as needed. Students will also have opportunities to keep and reflect on a sleep log, assess their own chronotype, and explore practical approaches to measuring sleep with wearable or portable technology.

Prerequisites: The course does not have formal prerequisites. It does assume that students have:

- background in psychology and neuroscience at least at the level of an advanced undergraduate majoring in one of those areas
- a willingness to dive into some complex literature and see what can be gleaned from it (note, the course does not have assessments that stress memorization)
- a basic belief that biological mechanisms (including neural, evolutionary, genetic, etc.) can tell us something crucial about human behavior and the human condition
- enthusiasm for sharing ideas and learning from the perspectives of others

Assignments. Course grades will be based on the following four areas, each contributing equally. For all assignments, a key feature of evaluation will be the student's ability to integrate across approaches (e.g., neuro, cognitive, evolutionary, affective, etc.) and, where relevant, content areas.

1. **Participation** in class discussion of readings, ideas, themes, and connections between the topics of this course, course members' research, and other areas of scholarly inquiry.
2. Several short class **presentations** (~15 mins) of empirical articles and leading related discussion.
3. In alternate weeks, short written **response papers** (1-2 pages single spaced, hardcopy due in class) on the assigned readings, or **posting of discussion questions** (for the remaining dates). The response papers can include evaluations, reactions, queries, comments on areas of confusion, suggestions for experiments, connections you discover between approaches to key issues, connections to other topics in which you have expertise, etc.
4. Several **small projects:**
   - Sleep log (2+ wks)
   - 2 pg summary of a personal 'experiment' with sleep variation or consumer sleep tech
   - Individualized short bibliography and timeline of key studies in the sleep and circadian fields that are important specifically to the student's own research interests

Readings

An assignment/ reading sheet will be given out weekly (see sample at end of syllabus). Student input for winnowing topics/ readings for the semester will be sought in the first class session. Readings for most weeks (i.e., after next week) will be given in three categories: **assigned readings, optional/alternate sources,** and some **additional suggested bibliography** for presentations or simply for your later reference. You many want to purchase the (very inexpensive, portable, and useful) Lockley & Foster and Foster & Kreitzman *"A short introduction…"* books referred to in the set of our first readings. The majority of other readings will be articles from the scientific literature, both empirical and theoretical/ review papers.

Course policies

Attendance. This is a small graduate level seminar and I treat class members as mature adults. You are expected to attend every class unless you have a medical or legal emergency or legitimate professional conflict (e.g., academic conference, job interview). Any special circumstances should be discussed with me well in advance.

Electronics. I realize that some students take class notes on laptops, cell phones, etc. During class, you may use your device **only** for note-taking or referring to assigned readings. Do not expect to be able to plug devices into outlets, lest someone trip. I reserve the right to tighten these policies if needed.

General. The classroom constitutes a *de facto* social contract. Do not do things that would reasonably be expected to disrupt the learning experience of others. E.g., bringing a container of coffee is fine; a full smelly meal is not. (However, given the hour, we'll have snacks – snack-bringing schedule TBA.) Turn off your phone ringer. Arrive on time. I recognize that sometimes delays happen on the way to class, but they should not be a pattern.

Part of the social contract is that you will not cheat. ***Your enrollment in this course indicates that you agree to abide by the academic standards set forth in the Emory University Honor Code.*** To review, go to http://catalog.college.emory.edu/academic/policies-regulations/honor-code.html.
If in doubt about something that pertains to these policies, always ask me.

Preliminary Schedule of Topics

1. Jan. 17	Discussion of aims, background knowledge; winnowing of topics
2. Jan. 24	Basics of circadian rhythms of behavior
3. Jan. 31	Circadian rhythms, neurophysiology, endocrinology
4. Feb. 7	Circadian function, cognition, and mood
5. Feb. 14	Human sleep phenomena, variations, assessment
6. Feb. 21	Systems approaches to the biology of sleep
7. Feb. 28	Molecular and neurochemical approaches to the biology of sleep
8. Mar. 6	Evolutionary and comparative approaches to sleep
[Mar. 13]	[Spring Break – no classes]
9. Mar. 20	Sleep, cognition, and health
10. Mar. 27	Sleep, development, and aging
11. Apr. 3	Sleep disorders and overlap with neurological and psychiatric disease
12. Apr. 10	Sleep, circadian rhythms, psychopathology, and causality
13. Apr. 17	Neurobiology and possible functions of dreaming
14. Apr. 24	Catch-up time for topics of particular interest

Readings for next class (Jan. 24) – on Canvas

Ch. 2 in Lockley, S.G., & Foster, R.G. (2012*) Sleep: a very short introduction,* pp. 7-32.

Ch. 1-2 in Foster, R.G., & Kreitzman, L. (2017) *Circadian rhythms: a very short introduction,* pp. 1-23.

Aschof, J. (1965) Circadian rhythms in man. *Science, 148,* 1427-1432.

Czeisler, C.A., Duffy, J.F., Shanahan, T.L., Brown, E.N., Mitchell, J.F., Rimmer, D.W., … and Kronauer, R.E. (1999) Stability, precision, and near-24-hour period of the human circadian pacemaker. *Science, 284,* 2177-2181.

Brief response paper due – see samples on Canvas

Sample weekly assignment sheet (revised each year; see description of Readings on p. 2)
Psychology 770 Spring 2018
Mar. 23: Sleep, cognition, & health

I. Please read the first three, and at least skim the others:

Lockley and Foster Ch. 7, pp. 89-95; Ch. 8, pp. 103-115.

Stickgold, R., and Walker, M.P. (2007) Sleep-dependent memory consolidation and reconsolidation. *Sleep Medicine, 8,* 331-343.

Ben Simon, E., Oren, N., Sharon, H., Kirschner, A., Goldway, N., Okon-Singer, H,. Taumann, …& Hendler, T. (2015) Losing neutrality: the neural basis of impaired emotional control without sleep. *The Journal of Neuroscience, 35,* 13194-13205.

Hansen, B.T., Sonderskov, K.M., Hageman, I., Dinesen, P.T., and Ostergaard, S.D. (2017) Daylight savings time transitions and the incidence rates of unipolar depressive episodes. *Epidemiology, 28,* 346-353.

Van Cauter, E., Spiegel, K., Tasali, E., and Leproult, R. (2008) Metabolic consequences of sleep and sleep loss. *Sleep Medicine, 9,* S23-S28.

II. Optional/ alternate sources for more detail, summaries of additional key facets, etc:

Lavie, P. Ch. 11 from *The Enchanted World of Sleep*, pp. 111-128.

Walker, M. (2010) Sleep, memory and emotion. *Progress in Brain Research,* 185, 49-68.

Killgore, W.D.S. (2015) Sleep deprivation and behavioral risk-taking. In Watson, R. (Ed.) *Modulation of sleep by obesity, diabetes age and diet.* London: Academic Press, pp. 279-287.

Post discussion questions by Thursday noon
Try an informal psychomotor vigilance task:
https://www.bbc.co.uk/science/humanbody/sleep/sheep/reaction_version5.swf
Take a nap and see how you feel it affects you (we'll read and talk about napping on 3/30)

III. Presentation suggestions, reference and bibliography: selected studies and seminal papers

Bennion, K.A., Ford, K.H., Kensinger, E.A., and Payne, J.D. (2013) Sleep and cortisol interact to support memory consolidation. Cerebral Cortex, 25, 646-657.

daCosta Souza, A., & Ribiero, S. (2015) Sleep deprivation and gene expression. *Current Topics in Behavioral Neuroscience, 25,* 65-90.

Donga, E., van Dijk, M., van Dijk, G., Biermasz, N.E., et al. (2010) A single night of partial sleep deprivation induces insulin resistance in multiple metabolic pathways in healthy subjects. *J. Clin. Endocrinol. Metab., 95,* 2963-2968.

Ewell, L.A., and Leutgeb, S. (2014) Replay to remember: a boost from dopamine. *Nature Neuroscience, 17,* 1629-1631.

Elmenhorst, E.-M., Elemenhorst, D., Luks, N., Maass, H., Vejvoda, M., and Samel, A. (2008) Partial sleep deprivation: impact on the architecture and quality of sleep. *Sleep Medicine, 9,* 840-850.

Gais, S., Lucas, B., and Born, J. (2016) Sleep after learning aids memory recall. *Learning and Memory, 13,* 259-262.

Giesbrecht, T., Smeets, T., Leppinkc, J., Jelicic, M., and Merckelbach, H. (2013) Acute dissociation after 1 night of sleep loss. *Psychology of consciousness: theory, research and practice, 1S,* 150-159.

Gujar, N., Yoo, S.-S., and Walker, M.P. (2011) Sleep deprivation amplifies reactivity of brain reward networks, biasing the appraisal of positive emotional experiences. *The Journal of Neuroscience, 31,* 4466-4474.

Gulevich, G., Dement, W., and Johnson, L. (1966) Psychiatric and EEG observations on a case of prolonged (264 hours) wakefulness. *Archives of General Psychiatry, 15,* 29-35.

Jenkins, J.G., and Dallenbach, K.M. (1924) Oblivescence during sleep and waking. *American Journal of Psychology, 35,* 605-612.

Killgore, W.D.S., Killgore, D.B., Day, L.M., Li, C., Kamimori, G.H., and Balkin, T.J. (2007) The effects of 53 hours of sleep deprivation on moral judgment. Sleep, 30, 345-352.

Maquet, P., Laureys, S., Peigneux, P., Fuchs, S., Petiau, C., Phillips, C., …. & Cleermans, A. (2000) Experience-dependent changes in cerebral activation during REM sleep. *Nature Neuroscience, 3,* 831-836.

Meerlo, P., de Bruin, E.A., Strijkstra, A.M., and Dann, S. A social conflict increases EEG slow wave activity during subsequent sleep. *Physiology & Behavior, 73,* 331-335.

Oswald, I. (1980). Sleep as a restorative process: human clues. *Progress in Brain Research, 53,* 279–288.

Rasch, B., Buchel, C., Gais, S., and Born, J. (2007) Odor cues during sleep promote declarative memory consolidation. *Science, 315,* 1426-1429.

Rechtschaffen, A., and Bergmann, B.M. (2002) Sleep deprivation in the rat: an update of the 1989 paper. *Sleep, 25,* 18-24.

Ribiero, S., Goyal, V., Mello, C.V., and Pavlidis, C. (1999) Brain gene expression during REM sleep depends on prior waking experience. *Learning and Memory, 5,* 500-508.

Ross, J.J. (1965) Neurological findings after prolonged sleep deprivation. *Archives of Neurology, 12,* 399-403.

Stickgold, R., Malia, A., Maguire, D., Roddenberry, D., & O'Connor, M. (2000) Replaying the game: hypnagogic images in normal and amnesics. *Science, 290,* 350-353.

Tononi, G., and Cirelli, C. (2006) Sleep function and synaptic homeostasis. *Sleep Medicine Reviews, 10,* 49-62.

Van der Helm, E., Yao, J., Dutt, S., Rao, V., Saletin, J. M., and Walker, M. P. (2011). REM sleep depotentiates amygdala activity to previous emotional experiences. *Current Biology, 21,* 2029–2032.

Wetzel, W., Wagner, T., and Balschun, D. (2003) REM sleep enhancement induced by different procedures improves memory retention in rats. *European Journal of Neuroscience, 18,* 2611-2617.

Wilhelm, I., Diekelmann, S., Molzow, I., Ayoub, A., Mölle, M., & Born, J. (2011). Sleep selectively enhances memory expected to be of future relevance. *The Journal of Neuroscience, 31,* 1563–1569.