

ANBI 140: Evolution of the Human Brain

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Course website: TritonEd.ucsd.edu. All lecture outlines and review guides will be posted on this site.

Course overview: This course is designed to provide an overview of the major concepts and themes related to evolution of the human brain. The course examines neuroanatomical specializations of the human brain, direct evidence of brain evolution based on endocasts of fossil hominins, and functional correlates of the brain organization as inferred from disorders and lesion studies. Emphasis is placed on brain structures and behaviors thought to be under selective pressure during the evolution of the human lineage.

Required Readings:

All readings are available electronically on the course web-site.

Course Requirements:

Midterm examination (25%)
Writing Assignment (40%)
Final examination (35%)

To pass the course, you must satisfy all course requirements; i.e., you must take all exams and turn in all assignments. You are expected to complete assigned readings for the day of lecture.

Examinations:

There will be one midterm exam in this course and a final exam. The examinations will be designed to assess your grasp of the readings and lectures. Each will consist of a variety of objective questions, so if you attend lectures consistently and complete the readings, you can expect to do quite well on these assessments. The final exam will be cumulative, with the emphasis on the material covered since the midterm. You will be given the list of terms/concepts for the cumulative part of the final exam.

Make-up exams will only be granted in extreme and exceptional emergencies, in which case, valid documentation will need to be provided. Makeups will be given in a different format and include different content.

Writing Assignments: You will write a 6-9 page paper that will enable you to further engage with the material discussed in the class. The topic should be related to one of the topics discussed in lectures/readings but, beyond that, you can decide to write on anything that ties the class material to your educational and research interests. Some examples of topics include – but are not limited to – variations of a specific neuroanatomical structure across species and their evolutionary significances, the connection between brain and cognitive evolution in fossil hominins, sex differences in the brain, ethics of using non-human primates in neuroanatomical research, etc. Or, you can focus on a specific disorder and examine it from neuroanatomical and

functional perspective. The paper grade consists of the paper proposal (**15% of your grade; due January 28**) and the final paper (**25% of your grade; due March 11**). The paper proposal should clearly identify the topic you are exploring and its significance for understanding human behavioral, cognitive, or anatomical specializations, and at least three scholarly sources (journal articles/edited books) which you will use in writing the paper. Both paper proposal and the final paper should be printed out and turned in as hard copies during the class.

All information that is not your own original work must be cited. As of 2017, American Journal of Physical Anthropology (AJPA) requires references to be prepared according to APA style guidelines (<https://onlinelibrary.wiley.com/page/journal/10968644/homepage/forauthors.html>), but you can use Chicago, MLA, CBE, or any other recognizable citation style.

Students with Disabilities:

Students requesting accommodations and services due to either a short or long term disability for this course need to provide a current [Authorization for Accommodation \(AFA\) letter](#) issued by the Office for Students with Disabilities (OSD), prior to eligibility for requests. Receipt of AFAs in advance is necessary for appropriate planning for the provision of reasonable accommodations. For additional information, contact the Office for Students with Disabilities: 858.534.4382 (V) 858.534.9709 (TTY) - Reserved for people who are deaf or hard of hearing, email: osd@ucsd.edu. OSD Website: < <http://disabilities.ucsd.edu> >.

TENTATIVE SCHEDULE OF TOPICS:

Week 1

January 7:

Introduction/ Course overview

January 9:

Brain and Intelligence in Comparative Perspective

Roth, G., & Dicke, U. (2005). Evolution of the brain and intelligence. *Trends in cognitive sciences*, 9(5), 250-257.

January 11:

Organization of the Nervous Systems

Purves, D. et al. (2004) Chapter 1: Studying the nervous systems of humans and other animals. The organization of the nervous system D. Purves et al. *Neuroscience*. (3rd ed.) Sinauer Associates. Pp. 1-24.

Week 2

January 14:

Organization of the Primate Brain

Allen, J. S. (2009). Chapter 2: The human brain in brief. *The Lives of the Brain*. Harvard University Press. Pp. 6-35.

January 16:

Organization of the primate brain (cont'd)

January 18:

Evolutionary Principles: Evolution of Brain Size

Holloway, Ralph L. (2009). Brain Fossils: Endocasts. Squire, Larry R. (ed.) *Encyclopedia of Neuroscience* (Vol. 2, pp. 353-361). Oxford: Academic Press

Du, A., Zipkin, A. M., Hatala, K. G., Renner, E., Baker, J. L., Bianchi, S., ... & Wood, B. A. (2018). Pattern and process in hominin brain size evolution are scale-dependent. *Proc. R. Soc. B*, 285. <http://doi.org/10.1098/rspb.2017.2738>

Week 3

January 21:

Martin Luther King, Jr. Holiday – no class

January 23:

Evolutionary Principles: Brain Reorganization

Striedter, Georg F. (2005). Chapter 5: Evolutionary changes in brain region size. *Principles of Brain Evolution* (pp. 137-176). Sinauer Associates.

January 25

Human Brain and Primate Brain Evolution

Barton, R. A. (2006) Primate brain evolution: integrating comparative, neurophysiological, and ethological data. *Evolutionary Anthropology* 15:224-236.

Rilling, James K. (2006). Human and nonhuman primate brains: are they allometrically scaled versions of the same design? *Evolutionary Anthropology* 15(2), 65-77.

Week 4

January 28:

The Evolving Cortex: Gross Features *** PAPER PROPOSAL DUE ***

Allen, J. S. (2009). Chapter 4: The Functional Evolution of the Brain. *The Lives of the Brain*. Harvard University Press. Pp. 82-85 and 99-109.

Bechara, A., Damasio, H., & Damasio, A. R. (2000). Emotion, decision making and the orbitofrontal cortex. *Cerebral cortex*, 10(3), 295-307.

January 30:

The Evolving Cortex (cont'd)

Aldridge K (2011) Patterns of differences in brain morphology in humans as compared to extant apes. *J Hum Evol* 2011:94–105

February 1:

Evolution of Language Networks

Schenker, N. M., Hopkins, W. D., Spocter, M. A., Garrison, A. R., Stimpson, C. D., Erwin, J. M., ... & Sherwood, C. C. (2009). Broca's area homologue in chimpanzees (Pan

troglydotes): probabilistic mapping, asymmetry, and comparison to humans. *Cerebral Cortex*, 20(3), 730-742.

Aboitiz, F., & Garcia, R. (1997). The evolutionary origin of the language areas in the human brain. A neuroanatomical perspective. *Brain Research Reviews*, 25(3), 381-396.

Week 5

February 4:

Evolution of Language Networks (cont'd)

Stout, D., & Chaminade, T. (2009). Making tools and making sense: complex, intentional behaviour in human evolution. *Cambridge Archaeological Journal*, 19(1), 85-96.

Decety, J. (2011). The neuroevolution of empathy. *Annals of the New York Academy of Sciences*, 1231(1), 35-45.

February 6:

The Limbic System and Social Brain Networks

Lew, C. H. & Semendeferi, K. (2017) Evolutionary specializations of the human limbic system. Kaas, J. (ed.) *Evolution of Nervous Systems* (2nd edition, p 277–291). Elsevier

February 8: *** MIDTERM EXAMINATION*******

Covers the material from 1/9 until 2/4

Week 6

February 11

Social Brain Networks (cont'd)

Pessoa, L. (2008). On the relationship between emotion and cognition. *Nature reviews neuroscience*, 9(2), 148.

Kennedy, D. P., & Adolphs, R. (2012). The social brain in psychiatric and neurological disorders. *Trends in cognitive sciences*, 16(11), 559-572.

February 13

Evolution of the Social Brain

Shultz, S., & Dunbar, R. I. (2012). Social cognition and cortical function: an evolutionary perspective. Schulkin, J. (ed.) *Action, perception and the brain: adaptation and cephalic expression*. New York:Palgrave Macmillan.

February 15

Microstructural specializations

Hrvoj-Mihic, B., Bienvenu, T., Stefanacci, L., Muotri, A. R., & Semendeferi, K. (2013). Evolution, development, and plasticity of the human brain: from molecules to bones. *Frontiers in human neuroscience*, 7, 707.

Week 7

February 18

Presidents' Day Holiday: NO CLASS

February 20

Transmitter systems

Raghanti, M. A., Edler, M. K., Stephenson, A. R., Munger, E. L., Jacobs, B., Hof, P. R., Sherwood, C. C., Holloway, R. L., Lovejoy, C. O. (2018) A neurochemical hypothesis for the origin of hominids. *Proc Natl Acad Sci* 115(6): E1108-E11162.

February 22

Evolution and Brain Development

Lecture notes

Week 8

February 25

Presidents' Day Holiday: NO CLASS

February 27

Evolution and Brain Development (cont'd)

Leigh, S. R. (2004). Brain growth, life history, and cognition in primate and human evolution. *American Journal of Primatology* 62(3), 139-164.

March 1

Evolution and Brain Development (cont'd)

Sakai, T., Matsui, M., Mikami, A., Malkova, L., Hamada, Y., Tomonaga, M., ... & Nakatsukasa, M. (2013). Developmental patterns of chimpanzee cerebral tissues provide important clues for understanding the remarkable enlargement of the human brain. *Proc. R. Soc. B*, 280(1753).

Leigh, S. R. (2012). Brain size growth and life history in human evolution. *Evolutionary Biology*, 39(4), 587-599.

Week 9

March 4

Functional Interpretations: Disorders/Lesion Studies

Hanson, K. L., Hrvoj-Mihic, B., & Semendeferi, K. (2014). A dual comparative approach: integrating lines of evidence from human evolutionary neuroanatomy and neurodevelopmental disorders. *Brain, behavior and evolution*, 84(2), 135-155.

March 6

Disorders/Lesion Studies (cont'd)

Petanjek, Z., & Kostović, I. (2012). Epigenetic regulation of fetal brain development and neurocognitive outcome. *Proceedings of the National Academy of Sciences*, 109(28), 11062-11063.

Gazzaniga, M. S. (2005). Forty-five years of split-brain research and still going strong. *Nature Reviews Neuroscience*, 6(8), 653.

Ramachandran, V. S., & Rogers-Ramachandran, D. (2000). Phantom limbs and neural plasticity. *Archives of neurology*, 57(3), 317-320.

March 8

Disorders/Lesion Studies (cont'd)

Pelphrey, K. A., Shultz, S., Hudac, C. M., & Vander Wyk, B. C. (2011). Research review: constraining heterogeneity: the social brain and its development in autism spectrum disorder. *Journal of Child Psychology and Psychiatry*, 52(6), 631-644.

Kapp, S. K., Gillespie-Lynch, K., Sherman, L. E., & Hutman, T. (2013). Deficit, difference, or both? Autism and neurodiversity. *Developmental psychology*, 49(1), 59-71.

Week 10

March 11

Modelling Human Brain Evolution *** FINAL PAPER DUE ***

Hrvoj-Mihic, B., Marchetto, M. C., Gage, F. H., Semendeferi, K., & Muotri, A. R. (2014). Novel tools, classic techniques: Evolutionary studies using primate pluripotent stem cells. *Biological psychiatry*, 75(12), 929-935.

March 13

Modelling Human Brain Evolution (cont'd)

Marchetto, M. C. et al. (in press). Species-specific maturation profiles of human, chimpanzee and bonobo neural cells. *e-Life*

March 15

Course Wrap-Up

***** FINAL EXAMINATION: MONDAY MARCH 18, 3:00-5:59 PM *****