Spring 2024

HEB 3200: Graduate Seminar in Human Evolutionary Biology

Wednesdays 10:15-12:00 in Peabody 52H

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COURSE OVERVIEW: Human evolutionary biology seeks to understand why humans are the way we are, and how we came to be. In this course, we will discuss adaptations and the process of adaptation using examples from various subfields of human evolutionary biology, including anatomy, physiology, ecology, genetics/genomics, life history, social organization, cognition, and culture. This course is intended to (a) provide an intermediate-level survey of our field, (b) ensure familiarity with key concepts, and (c) help prepare you to teach as a graduate student in HEB.

We will maximize our collective learning in this course through:

- Critical reading of the assigned literature
- Active and thoughtful discussion in seminar
- Presentation of weekly subfield perspectives, beginning Week 2 – see below
- Final paper draft, due April 15th by 5:00 pm – see below
- Peer-review of two draft final papers, due April 22nd by 5:00 pm – see below
- Final paper, due May 8th by 5:00 pm – see below

Subfield perspectives. Just as our field combines different scientific perspectives and toolkits to address common questions, in this course we will leverage the fortuitous diversity of disciplines represented. Beginning with our meeting in Week 2 (January 31), each of us will present an idea, hypothesis, approach, or paper from our particular subfield that dovetails with the weekly topic of discussion. You should aim to teach and/or lead discussion of your topic for approximately 5 minutes each week. You may use slides, the white board, or simply talk, as you prefer. By bringing our diverse perspectives to the table, we can learn from each other and achieve a better sense for how our subfields work together toward common understanding.

Final paper. You will each prepare a draft paper (due April 15th by 5:00 pm) addressing the central HEB question: "Through an evolutionary lens, why are humans the way we are?" You can approach the question from any angle(s) that you deem to be efficient, and you may support your arguments using ideas gleaned from course readings and class discussion, outside readings, and/or your own research. Your draft paper will be circulated to two classmates, selected at random, who will provide a written peer-review of your paper (due April 22nd by 5:00 pm). [Likewise, you will review papers for two classmates.] Based on the feedback received, you will revise your paper into final form (due May 8th by 5:00 pm). Your final paper should be ~5,000-9,000 words and must include a graphical abstract. You may include other figures and/or tables if desired. Your final paper will be evaluated based on its conceptual richness, clarity, originality, and consideration of peer-reviewer comments.

COURSE MATERIALS: All readings are available electronically on Canvas. However, you may want to borrow or acquire a physical copy of "On the Origin of Species. A Facsimile of the First Edition" by Harvard University Press. Many graduate students in the department have a copy of this book, or you can borrow a copy from the library or purchase one on Amazon (https://a.co/d/b2ad8id).

GRADING BASIS: Satisfactory/Unsatisfactory. This course exists to help you grow as a scholar, and what you get out of the course will be commensurate with what you put into it.

READING LIST (subject to change)

Week 1, January 24: Darwin and Wallace

1) Darwin C. 1859**.** On the Origin of Species. A Facsimile of the First Edition. Harvard University Press. Read: Chapters 1–4 and Chapter 14.
2) Wallace AR. 1858. On the tendency of varieties to depart indefinitely from the original type. *Journal of the Proceedings of the Linnean Society (Zoology)* 3: 53–62.

Note: No subfield perspectives required this week.

Week 2, January 31: Introduction to natural selection, adaptation, and evolution

1) Grant PR, Grant BR. 2011. Natural selection, adaptation, and evolution. Chapter 5 (pp. 46–64) in How and Why Species Multiply. Princeton University Press.
2) Hendry AP. 2009. Speciation. *Nature* 458: 162–164.
3) Reznick DN, Ricklefs RE. 2009. Darwin's bridge between microevolution and macroevolution. *Nature* 457: 837–842.
4) Gould SJ, Lewontin RC. 1979. The spandrels of San Marco and the Panglossian paradigm: a critique of the adaptationist programme. *Proceedings of the Royal Society B* 205: 581–598.
5) Carroll SB. 2008. Evo-devo and an expanding evolutionary synthesis: a genetic theory of morphological evolution. *Cell* 134: 25–36.

For further information – not assigned:

a) Grant BR, Grant PR. 2017. Watching speciation in action. *Science* 355: 910–911.
b) Kolodny O, Schulenberg H. 2020. Microbiome-mediated plasticity directs host evolution along several distinct time scales. *Philosophical Transactions of the Royal Society B* 375: 20190589.

Week 3, February 7: Hominids, hominins, and their relationships

1) Baum DA et al. 2005. The tree-thinking challenge. *Science* 310: 979–980.
2) Wrangham R, Pilbeam D. 2001. African apes as time machines. Chapter 1 (pp. 5–17) in All Apes Great and Small, eds. Galdikas BMF, Briggs NE, Sheeran LK, Shapiro GL, Goodall J. Springer Press.
3) Wood B, Harrison T. 2011. The evolutionary context of the first hominins. *Nature* 470: 347–352.
4) Gopalan S et al. 2021. Inferring archaic introgression from hominin genetic data. *Evolutionary Anthropology* 30: 199–220.
5) Moeller AH et al. 2016. Cospeciation of gut microbiota with hominids. *Science* 353: 380–382.

For further information – not assigned:

a) Moorjani P et al. 2016. Variation in the molecular clock of primates. *PNAS* 113: 10607–10612.
b) Pilbeam DR, Lieberman DL. 2017. Reconstructing the last common ancestor of chimpanzees and humans. Chapter 2 (pp. 22–141) in Chimpanzees and Human Evolution, eds. Muller MM, Wrangham RW, Pilbeam DR. Belknap Press.
c) Hare B, Wrangham RW. 2017. Equal, similar, but different: convergent bonobos and conserved chimpanzees. Chapter 3 (pp. 142–173) in Chimpanzees and Human Evolution, eds. Muller MM, Wrangham RW, Pilbeam DR. Belknap Press.
d) Boyd R, Silk JB. 2014. Primate diversity and ecology. Chapter 5 (pp. 109–144) in How Humans Evolved**.** W.W. Norton & Company.

Week 4, February 14: Paleoecology and human evolution

1) Cerling TE et al. 2011. Woody cover and hominin environments in the past 6 million years. *Nature* 476: 51–56.
2) Peppe DJ et al. 2023. Oldest evidence of abundant C4 grasses and habitat heterogeneity in eastern Africa. *Science* 380: 173–177.
3) Potts R et al. 2020. Increased ecological resource variability during a critical transition in hominin evolution. *Science Advances* 6: eabc8975.
4) Faith JT et al. 2021. Rethinking the ecological drivers of hominin evolution. *Trends in Ecology and Evolution* 36: 797–807.

For further information – not assigned:

a) Levin NE. 2015. Environment and climate of early human evolution. *Annual Reviews in Earth and Planetary Science* 43: 405–429.
b) Sistiaga A et al. 2020. Microbial biomarkers reveal a hydrothermally-active landscape at Olduvai Gorge at the dawn of the Acheulean, 1.7 Mya. *PNAS* 117: 24720–24728.
c) Dominguez-Rodrigo M. 2014. Is the "Savanna Hypothesis" a dead concept for explaining the emergence of the earliest hominins? *Current Anthropology* 55: 59–81.
d) Potts R et al. 2018. Environmental dynamics during the onset of Middle Stone Age in eastern Africa. *Science* 360: 86–90.
e) WoldeGabriel G et al. 2009. The geological, isotopic, botanical, invertebrate, and lower vertebrate surroundings of *Ardipithecus ramidus*. *Science* 326: 65–65e5.
f) Melin AD et al. 2014. Seasonality, extractive foraging and the evolution of primate sensorimotor intelligence. *Journal of Human Evolution* 71: 77–86.

Week 5, February 21: Anatomical changes in the human lineage

1) Langdon JH. 2005. Teeth. Chapter 5 (pp. 66–76) in The Human Strategy: An Evolutionary Perspective on Human Anatomy. Oxford University Press.
2) Aiello LC, Wheeler P. 1995. The expensive–tissue hypothesis: the brain and the digestive system in human and primate evolution. *Current Anthropology* 36: 199–221.
3) Navarrete A et al. 2011. Energetics and the evolution of human brain size. *Nature* 480: 91–93.
4) Bramble DM, Lieberman DL. 2004. Endurance running and the evolution of *Homo*. *Nature* 432: 345–352.
5) Capellini TD et al. 2017. Ancient selection for derived alleles as a GDF5 enhancer influencing human growth and osteoarthritis risk. *Nature Genetics* 49: 1202–1210.

For further information – not assigned:

a) Pilbeam DR, Lieberman DL. 2017. Reconstructing the last common ancestor of chimpanzees and humans. Chapter 2 (pp. 22–141) in Chimpanzees and Human Evolution, eds. Muller MM, Wrangham RW, Pilbeam DR. Belknap Press.
b) Pontzer H et al. 2016. Metabolic acceleration and the evolution of human brain size and life history. *Nature* 533: 390–392.
c) Fonseca-Azevedo K, Herculano-Houzel S. Metabolic constraint imposes tradeoff between body size and number of brain neurons in human evolution. *PNAS* 109: 18571–18576.
d) Gruss LT, Schmitt D. 2015. The evolution of the human pelvis: changing adaptations to bipedalism, obstetrics and thermoregulation. *Philosophical Transactions of the Royal Society B* 370: 20140063.
e) Roach NT et al. 2013. Elastic energy storage in the shoulder and the evolution of high–speed throwing in *Homo*. *Nature* 498: 483–486.
f) Gómez-Robles A et al. 2017. Brain enlargement and dental reduction were not linked in hominin evolution. *PNAS* 114: 468–473.

Week 6, February 28: Evolution of the human diet

1) Sponheimer M et al. 2013. Isotopic evidence of early hominin diets. *PNAS* 110: 10513–10518.
2) Laden G, Wrangham RW. 2005. The rise of the hominids as an adaptive shift in fallback foods: plant underground storage organs (USOs) and australopith origins. *Journal of Human Evolution* 49: 482–498.
3) Carmody RN. 2017. Evolution of the human dietary niche: quest for high quality. Chapter 9 (pp. 311–338) in Chimpanzees and Human Evolution, eds. Muller MM, Wrangham RW, Pilbeam DR. Belknap Press.
4) Zink KD, Lieberman DE. 2016. Impact of meat and Lower Palaeolithic food processing techniques on chewing in humans. *Nature* 531: 500–503.
5) Cordain L et al. 2000. Plant-animal subsistence ratios and macronutrient energy estimations in worldwide hunter-gatherer diets. *American Journal of Clinical Nutrition* 71: 682–692.

For further information – not assigned:

a) Wrangham RW et al. 1999. The raw and the stolen: cooking and the ecology of human origins. *Current Anthropology* 40: 567–594.
b) Carmody RN et al. 2011. Energetic consequences of thermal and nonthermal food processing. *PNAS* 108: 19199–19203.
c) Carmody RN et al. 2016. Genetic evidence of human adaptation to a cooked diet. *Genome Biology and Evolution* 8: 1091–1103.
d) Carmody RN et al. 2019. Cooking shapes the structure and function of the gut microbiome. *Nature Microbiology* 4: 2052–2063.
e) Eaton SB, Konner M. 1985. Paleolithic nutrition — a consideration of its nature and current implications. *New England Journal of Medicine* 312: 283–289.
f) Lieberman DE et al. 2023. Comparing measured dietary variation within and between tropical hunter-gatherer groups to the Paleo diet. *American Journal of Clinical Nutrition* 118: 549–560.

Week 7, March 6: Life history

1) Kirkwood TBL, Austad SN. 2000. Why do we age? *Nature* 408: 233–238.
2) Hawkes K et al. 1998. Grandmothering, menopause, and the evolution of human life histories. *PNAS* 95: 1336–1339.
3) Kaplan H et al. 2000. A theory of human life history evolution: diet, intelligence, and longevity. *Evolutionary Anthropology* 9: 156–185.
4) Kuzawa CW et al. 2014. Metabolic costs and evolutionary implications of human brain development. *PNAS* 111: 13010–13015.
5) Lea A et al. 2017. Developmental plasticity: bridging research in evolution and human health. *Evolution, Medicine, and Public Health* 2017: 162–175.

For further information – not assigned:

a) Gurven M, Kaplan H. 2007. Longevity among hunter-gatherers: a cross-cultural examination. *Population and Development Review* 33: 321–365.
b) Hawkes K et al. 1997. Hadza women's time allocation, offspring provisioning, and the evolution of long postmenopausal life spans. *Current Anthropology* 38: 551–577.
c) Kramer KL, Ellison PT. 2010. Pooled energy budgets: resituating human energy allocation trade-offs. *Evolutionary Anthropology* 19: 136–147.
d) Wrangham R, Carmody R. 2010. Human adaptation to the control of fire. *Evolutionary Anthropology* 19: 187–199.
e) Fisher DO et al. 2013. Sperm competition drives the evolution of suicidal reproduction in mammals. *PNAS* 110: 17910–17914.

Week 8, March 13: Spring Break (no meeting)

Week 9, March 20: Social structure and cooperation

1) Hill KR et al. 2011. Co–residence patterns in hunter–gatherer societies show unique human social structure. *Science* 331: 1286–1289.
2) Apicella CL, Silk JB. 2019. The evolution of human cooperation. *Current Biology* 29: R447–R450.
3) Samuni L and Surbeck M. 2023. Cooperation across borders in bonobos. *Science* 382: 805–809.
4) Kramer KL. 2010. Cooperative breeding and its significance to the demographic success of humans. *Annual Review of Anthropology* 39: 417–436.
5) Wrangham RW. 2018. Two types of aggression in human evolution. *PNAS* 115: 245–253.

For further information – not assigned:

a) Boyd R, Richerson PJ. 2009. Culture and the evolution of human cooperation. *Philosophical Transactions of the Royal Society B* 364: 3281–3288.
b) Pisor AC, Surbeck M. 2019. The evolution of intergroup tolerance in nonhuman primates and humans. *Evolutionary Anthropology* 28: 210–223.
c) Sarkar A et al. 2020. Microbial transmission in animal social networks and the social microbiome. *Nature Ecology & Evolution* 4: 1020–1035.
d) Sarkar A et al. 2024. Microbial transmission in the social microbiome and host health and disease. *Cell* 187: 17–43.
e) Wrangham RW, Benenson J. 2017. Cooperative and competitive relationships within sexes. Chapter 14 (pp. 509–547) in Chimpanzees and Human Evolution, eds. Muller MM, Wrangham RW, Pilbeam DR. Belknap Press.
f) Jaeggi AV et al. 2017. Cooperation between the sexes. Chapter 15 (pp. 548–571) in Chimpanzees and Human Evolution, eds. Muller MM, Wrangham RW, Pilbeam DR. Belknap Press.

Week 10, March 27: Cognition

1) Rosati AG. 2017. Chimpanzee cognition and the roots of the human mind. Chapter 19 (pp. 703–745) in Chimpanzees and Human Evolution, eds. Muller MM, Wrangham RW, Pilbeam DR. Belknap Press.
2) Stout D, Hecht EE. 2017. Evolutionary neuroscience of cumulative culture. *PNAS* 114: 7861–7868.
3) Slocombe KE, Scott–Phillips T. 2017. Communication and language. Chapter 21 (pp. 791–823) in Chimpanzees and Human Evolution, eds. Muller MM, Wrangham RW, Pilbeam DR. Belknap Press.
4) Sampson TR, Mazmanian SK. 2015. Control of brain development, function, and behavior by the microbiome. *Cell Host & Microbe* 17: 565–576.

For further information – not assigned:

a) Putt SS et al. 2017. The functional brain networks that underlie Early Stone Age tool manufacture. *Nature Human Behaviour* 1: 0102.
b) Hecht EE et al. 2019. Significant neuroanatomical variation among domestic dog breeds. *Journal of Neuroscience* 39: 7748–7758.
c) Hare B. 2017. Survival of the friendliest: *Homo sapiens* evolved via selection for prosociality. *Annual Review of Psychology* 68: 155–186.
d) Krupenye C et al. 2016. Great apes anticipate that other individuals will act according to false beliefs. *Science* 354: 110–114.
e) vonHoldt BM et al. 2017. Structural variants in genes associated with human Williams–Beuren syndrome underlie stereotypical hypersociability in domestic dogs. *Science Advances* 3: e1700398.
f) Searcy WA. 2019. Animal communication, cognition, and the evolution of language. *Animal Behaviour* 151: 203–205.
g) Rosati AG et al. 2020. Social selectivity in aging wild chimpanzees. *Science* 370: 473–476.

Week 11, April 3: Culture and cultural evolution

1) Henrich J, Tennie C. 2017. Cultural evolution in chimpanzees and humans. Chapter 18 (pp. 645–702) in Chimpanzees and Human Evolution, eds. Muller MM, Wrangham RW, Pilbeam DR. Belknap Press.
2) Laland KN et al. 2010. How culture shaped the human genome: bringing genetics and the human sciences together. *Nature Reviews Genetics* 11: 137–148.
3) Ségurel L, Bon C. 2017. On the evolution of lactase persistence in humans. *Annual Review of Genomics and Human Genetics* 18: 297–319.
4) Perry GH et al. 2007. Diet and the evolution of human amylase gene copy number variation. *Nature Genetics* 39: 1256–1260.

For further information – not assigned:

a) Tishkoff SA et al. 2007. Convergent adaptation of human lactase persistence in Africa and Europe. *Nature Genetics* 39: 31–40.
b) Creanza N et al. 2017. Cultural evolutionary theory: how culture evolves and why it matters. *PNAS* 114: 7782–7789.
c) Legare CH. 2017. Cumulative cultural learning. *PNAS* 114: 7877–7883.
d) Whiten A et al. 1999. Cultures in chimpanzees. *Nature* 399: 682–685.
e) Muthukrishna M et al. 2018. The Cultural Brain Hypothesis: how culture drives brain expansion, sociality, and life history. *PLoS Computational Biology* 14: e1006504.

Week 12, April 10: The rise and spread of *Homo sapiens*

1) Hublin J-J et al. 2017. New fossils from Jebel Irhoud, Morocco and the pan-African origin of *Homo sapiens*. *Nature* 546: 289–292.
2) Harvati K et al. 2019. Apidima Cave fossils provide earliest evidence of *Homo sapiens* in Eurasia. *Nature* **571**, 500–504.
3) Nielsen R et al. 2017. Tracing the peopling of the world through genomics. *Nature* 541: 302–310.
4) Liu YC et al. 2022. Ancient DNA reveals five streams of migration into Micronesia and matrilocality in early Pacific seafarers. *Science* 377: 72–79.
5) Reilly PF et al. 2022. The contribution of Neanderthal introgression to modern human traits. *Current Biology* 32: R970–R983.

For further information – not assigned:

a) Myriad recent research papers from the Reich lab: https://reich.hms.harvard.edu/publications
b) Alpaslan-Roodenberg et al. 2021. Ethics of DNA research on human remains: five globally applicable guidelines. *Nature* 599: 41–46.
c) Harney É et al. 2023 Ethical consideration when co-analyzing ancient DNA and data from private genetic databases. *American Journal of Human Genetics* 110: 1447–1453.
d) Slon V et al. 2018. The genome of the offspring of a Neanderthal mother and a Denisovan father. *Nature* 561: 113–116.
e) Wei X et al. 2023. The lingering effects of Neanderthal introgression on human complex traits. *eLife* 12: e80757.
f) Petr M et al. 2019. Limits of long-term selection against Neandertal introgression. *PNAS* 116: 1639–1644.
g) Dannemann M, Racimo F. 2018. Something old, something borrowed: admixture and adaptation in human evolution. *Current Opinion in Genetics & Development* 53: 1–8.
h) Moreno-Mayar JV et al. 2018. Early human dispersals within the Americas. *Science* 362: eaav2621.
i) Falush D et al. 2003. Traces of human migrations in *Helicobacter pylori* populations. *Science* 299: 1582–1585.

Note: Final paper drafts due on Monday, April 15th by 5:00 pm

Week 13, April 17: Peer-reviews (no meeting)

No class meeting. This week, I have built in protected time for you to read and provide written peer-reviews for two final paper drafts.

Notes:

(1) Final paper drafts due on Monday, April 15th by 5:00 pm
(2) Peer-reviews due on Monday, April 22nd by 5:00 pm
(3) No subfield perspectives required this week

Week 14, April 24: Evolutionary perspectives on human health

1) Wells JCK et al. 2017. Evolutionary public health: introducing the concept. *Lancet* 390: 500–509.
2) Jasienska G et al. 2017. Human reproduction and health: an evolutionary perspective. *Lancet* 390: 510–520.
3) Rook G et al. 2017. Evolution, human-microbe interactions, and life history plasticity. *Lancet* 390: 521–530.
4) Lieberman DE. 2015. Is exercise really medicine? An evolutionary perspective. *Current Sports Medicine Reports* 14: 313–319.
5) Carmody RN et al. 2021. Gut microbiota through an evolutionary lens. *Science* 372: 462–463.

For further information – not assigned:

a) Eaton SB, Konner M. 1985. Paleolithic nutrition — a consideration of its nature and current implications. *New England Journal of Medicine* 312: 283–289.
b) Lieberman DE et al. 2023. Comparing measured dietary variation within and between tropical hunter-gatherer groups to the Paleo diet. *American Journal of Clinical Nutrition* 118: 549–560.
c) Wallace IJ et al. 2017. Knee osteoarthritis has doubled in prevalence since the mid–20th century. *PNAS* 114: 9332–9336.
d) Yetish G et al. 2015. Natural sleep and its seasonal variations in three pre-industrial societies. *Current Biology* 25: 2862–2868.
e) Poole AC et al. 2019. Human salivary amylase gene copy number impacts oral and gut microbiomes. *Cell Host & Microbe* 25: 553–564.

Note: Final papers due on Wednesday, May 8th by 5:00 pm