

Origins of Intelligence

Seminar:

MW, 1:25pm-2:35pm

Room: BH 342F or on Zoom (see Canvas for location)

Instructor:

Jessica Cantlon

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Office: Baker 327M

Office Hours: by appointment



Course Objectives and Learning Outcomes

The nature and origins of human intelligence is a much-debated topic. Questions about the evolution and development of intelligence in humans, how intelligence compares among animals, the basis of intelligence in the brain, how to create intelligence in machines, the role of genes and experience, and individual variability in intelligence are all areas of vigorous scientific inquiry. Popular “folk” views of intelligence (that may be misguided or incorrect) have shaped all levels of society from parenting to politics. There is no universally accepted definition of human intelligence but one conceptualization is “the ability to remember, reason, plan, and solve novel problems”. This course will explore scientific and popular views of the origins of intelligence.

The approach will be to read popular science articles and books that deal with intelligence in humans, animals, and machines and locate the primary scientific and scholarly work on which those claims are made in order to evaluate the rigor and validity of intelligence theories. The course assignments will primarily consist of oral and written critiques of theories and data on the science of intelligence.

The goal of this course is to try to separate the wheat from the chaff on people’s thinking about ‘intelligence’. We will critically compare insights written for a general audience with the primary scientific data on which they are putatively based in order to separate *questionable conclusions* from *sound reasoning* in the field.

Our goal is that, by the end of this course, students will have improved critical thinking skills and be able to:

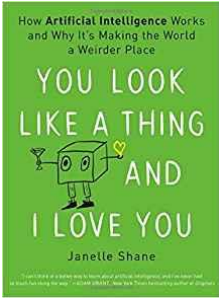
- o Critically evaluate media interpretations of data on intelligence
- o Distinguish pseudoscientific versus scientific claims about intelligence
- o Explain central theories of intelligence in humans, animals, and machines.
- o Read and interpret data from graphs and empirical articles
- o Articulate and compare theory versus evidence in intelligence research
- o Reason through a range of causes of individual differences in intelligence
- o Recount the fraught history of research on “intelligence”
- o Evaluate the applications of intelligence research to social problems

Required Texts



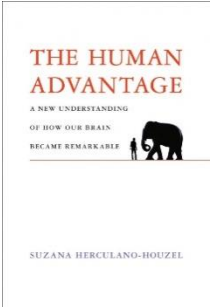
The Mismeasure of Man by Steven Jay Gould

Gould, S. J. (1996). *The Mismeasure of Man*. New York: WW Norton & Company.



You Look Like a Thing and I Love You: How Artificial Intelligence Works and Why It's Making the World a Weirder Place by Janelle Shane

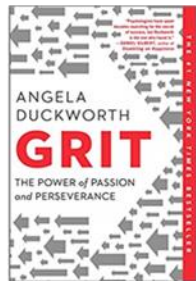
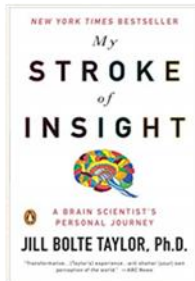
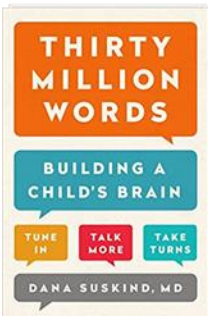
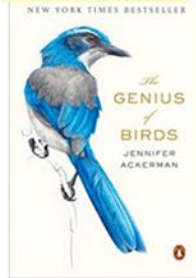
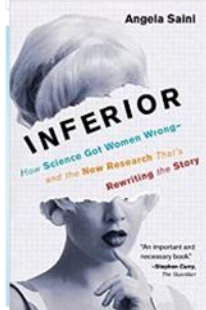
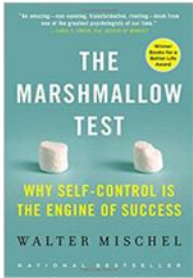
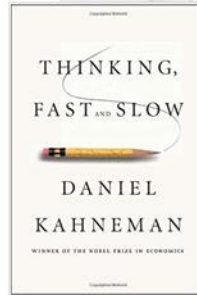
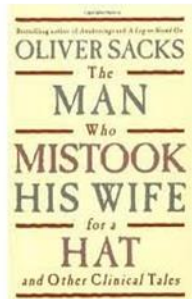
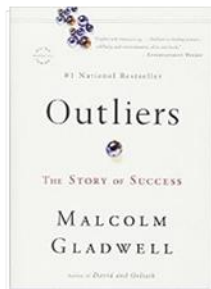
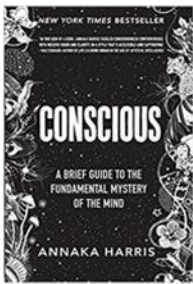
Shane, J. (2019). You Look Like a Thing and I Love You. New York: Hachette Book Group.



The Human Advantage by Suzana Herculano-Houzel

Herculano-Houzel, S. (2016). The Human Advantage. Cambridge: MIT Press.

Pick One From:



Articles

Links and citations for additional readings, as well as viewings (videos) and listenings (to podcasts) are provided in the syllabus schedule.

You are responsible for getting media (articles and podcasts) from the CMU library and other web hosts as needed. Searches for primary scientific articles can be conducted on [GoogleScholar](#), [PubMed](#), or [ISI Web of Science](#).

A very smart and useful thing to do is to investigate other papers that have cited or discussed a book or paper you are reading, speaking, or writing about. You can find papers that have cited or discussed a book or paper by using the Web of Science Cited Reference Search, described by CMU Library [here](#).

Here is some good advice about reading scientific work: [How to Read a Scientific Paper](#)

Grades & Assignments

Attendance & Participation (20% of total grade)

- Attendance is required and will be monitored.
- Class discussion and questions will factor strongly in participation grade. Some discussion will occur in the Discussion Board on Canvas. Be sure to comment and respond to questions there.
- If you don't participate it will not be possible to get an A in the class.

Article/Podcast Presentation (20% of total grade)

- Make a PowerPoint: Using visual slides including text, audio and video clips, graphs, research photos, and/or research videos in PowerPoint and movie editing software, **creatively** summarize the claims in your assigned media (article or podcast) and comment on the **strengths and weaknesses** of the methods and arguments. At the end of the presentation tell us: What is the "big deal" about this paper? Submit a **movie file (eg., mp4) shared link using your CMU Box account**. It should be 20 minutes.

Book Presentation (20% of total grade)

- Make a PowerPoint: Using visual slides including graphs, video and audio clips, podcast clips, research photos, and research videos in PowerPoint or any movie editing software, **creatively** narrate the claims in your assigned book and readings. Present your critique of the book using the primary scientific literature that either does or does not support the claims of the book. It should be 30 minutes. Submit a **movie file shared link using your CMU Box account**. Here are guidelines for how to give a good scientific presentation: [How to Give a Dynamic Scientific Presentation](#)

Final Essay (20% of total grade)

- A final essay is **due in class March 16 on Google Docs & Canvas (pdf)** and a revised version of the essay is due in the last week, **by April 29 ON CANVAS (pdf)**. The length of the paper will be 5 pages, double-spaced, Arial 11pt font, 1-inch margins. The essay is a scientific critique of your book assignment. You will summarize the main gist of your book, and then will provide **3 major scientific claims** from the book for which you have looked up the primary scientific articles on which the claims are based, and write your evaluation of how well those claims represent the primary data. A model for how to write this essay is a long-form investigative book review like [this](#). Here is some advice on [How to Write a Scientific Book Review](#).

Final Exam (20% of total grade)

- A final exam is given in the second-to-last week of class, **April 25**. The format of the exam will be brief essay answers. Material from the whole semester will be fair-game in the exam so be sure to keep up with the reading. A list of possible exam questions will be provided at the beginning of the semester.

All late assignments are given a 20% penalty unless a doctor's note is provided.

Absence Policies

Attendance is monitored, and participation in class is a major part of the final grade.

If you are absent due to illness, you can receive participation credit for the day by listening to one of the following podcasts and writing a 2-page commentary summarizing the content of episode, and critically evaluating the arguments of the speakers. What points were good and what points were bad, and why? Full credit is given for a good quality commentary.

Carnegie Mellon Honor Code

In this course, all students will be held to the standards of the [CMU Honor Code](#), a code that you pledged to honor when you matriculated at this institution. If you are unfamiliar with the details of this code and how it is administered, you should consult the Handbook at <https://www.cmu.edu/policies/student-and-student-life/academic-integrity.html>. This handbook outlines the University's expectations for the integrity of your academic work, the procedures for resolving alleged violations of those expectations, and the rights and responsibilities of students and faculty members throughout the process.

Disability Resource Center

If you have a documented disability or other condition that may affect academic performance you should: 1) make sure this documentation is on file with the [Disability Resource Center](#) to determine the accommodations you need; and 2) talk with me to discuss your accommodation needs.

Syllabus Change Policy

This syllabus is only a guide for the course and is subject to change with advanced notice.

Diversity Statement

Each of us is responsible for creating a safer, more inclusive environment. If you experience or observe unfair or hostile treatment on the basis of identity please speak out for support, within the moment of the incident or after the incident has passed. You also can communicate these experiences using the following resources:

Center for Student Diversity and Inclusion: csdi@andrew.cmu.edu

Report-It online: reportit.net username: tartans password: plaid

PSY Major and Research

If you are interested in pursuing research in psychology you can set up a meeting to talk with me (jcantlon@andrew.cmu.edu) or the undergraduate programs coordinator for Psychology, Emilie O'Leary (emilier@andrew.cmu.edu).

Health and Well-being

All of us benefit from support during times of struggle. If you or anyone you know experiences any academic stress, difficult life events, or feelings like anxiety or depression, we strongly encourage you to seek support. Counseling and Psychological Services (CaPS) is here to help: call 412-268-2922 and visit their [website](#). Consider reaching out to a friend, faculty or family member you trust for help getting connected to the support that can help.

Introduction

January 19

Syllabus & Introduction

Syllabus; Article & Book Choices

Contemporary problems in intelligence research, **Read:**

[Gebru, T. \(2020\). Race and Gender. *The Oxford Handbook of Ethics of AI*, 251-269.](#)

January 24

Correlation and Causation: Case of Music & Mind

Gould, S. J. (1996). *The Mismeasure of Man*. WW Norton & Company. Read Pages: 19-141

Discussion

Mehr, S. A., Schachner, A., Katz, R. C., & Spelke, E. S. (2013). Two randomized trials provide no consistent evidence for nonmusical cognitive benefits of brief preschool music enrichment. *PloS One*, 8(12), e82007.

Mehr, S. A. (2015). Miscommunication of science: Music cognition research in the popular press. *Frontiers in Psychology*, 6, 988.

Foundations

January 26

Brain Development

Chapter 1: Pages 4-29. Nelson, C. A., De Haan, M., & Thomas, K. M. (2006). *Neuroscience of cognitive development. The role of experience and the developing brain*. New Jersey: John Wiley & Sons.

Discussion

Presenters: Make a 20-minute PowerPoint integrating your narration of this paper (authors' background, study background, hypothesis, methods, results, conclusions, and assessment of strengths and weaknesses of the conclusions) with audio/video clips and media of your choice:

Sage Cho Senior author: [Jay Giedd](#); Shaw, P., Greenstein, D., Lerch, J., Clasen, L., Lenroot, R., Gogtay, N. E. E. A., ... & Giedd, J. (2006). Intellectual ability and cortical development in children and adolescents. *Nature*, 440(7084), 676+.

May Li Senior author: [Philip Landrigan](#); Grandjean, P., & Landrigan, P. J. (2014). Neurobehavioural effects of developmental toxicity. *The Lancet Neurology*, 13(3), 330-338.

January 31

Brain Evolution

Herculano-Houzel, S. (2016). *The Human Advantage*. Cambridge: MIT Press.

February 2

Discussion

Presenters: Make a 20-minute PowerPoint integrating your narration of these papers (authors' background, study background, hypothesis, methods, results, conclusions, and assessment of strengths and weaknesses of the conclusions) with audio/video clips and media of your choice:

Alejandro Krishnamurthy Senior Author: [Mathias Osvath](#); Kabadayi, C., Taylor, L. A., von Bayern, A. M., & Osvath, M. (2016). Ravens, New Caledonian crows and jackdaws parallel great apes in motor self-regulation despite smaller brains. *Royal Society Open Science*, 3(4), 160104.

Isabel Brum Senior Author: [Manger, P. R.](#) (2006). An examination of cetacean brain structure with a novel hypothesis correlating thermogenesis to the evolution of a big brain. *Biological Reviews*, 81(2), 293-338.

Matthew Clapp Senior Author: [Suzana Herculano-Houzel](#) (2017). Numbers of neurons as biological correlates of cognitive capability. *Current Opinion in Behavioral Sciences*, 16, 1-7.

February 7

Human Evolution

H Pontzer, H. (2012) Overview of Hominin Evolution. *Nature Education Knowledge* 3(10):8.

McNulty, K. P. (2016) Hominin Taxonomy and Phylogeny: What's In A Name? *Nature Education Knowledge* 7(1):2.

February 9

Discussion

Presenters: Make a 20-minute PowerPoint integrating your narration of these papers (authors' background, study background, hypothesis, methods, results, conclusions, and assessment of strengths and weaknesses of the conclusions) with audio/video clips and media of your choice:

Mohammad Bank Tavakoli Senior author: [Thierry Chaminade](#); Stout, D., Passingham, R., Frith, C., Apel, J. & Chaminade, T. (2011). Technology, expertise and social cognition in human evolution. *European Journal of Neuroscience*, 33(7), 1328-1338.

Dominique Aruede Senior Author: [Andrew Whiten](#); Whiten, A., & Van Schaik, C. P. (2007). The evolution of animal 'cultures' and social intelligence. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 362(1480), 603-620.

Leeroy Senior Author: [Barbara Finlay](#) (2019). Human exceptionalism, our ordinary cortex and our research futures. *Developmental Psychobiology*, 61(3), 317-322.

February 14

Animal Cognition

Premack, D. (2007). Human and animal cognition: Continuity and discontinuity. *Proceedings of the National Academy of Sciences*, 104(35), 13861-13867.

February 16

Discussion

Presenters: Make a 20-minute PowerPoint integrating your narration of these papers (authors' background, study background, hypothesis, methods, results, conclusions, and assessment of strengths and weaknesses of the conclusions) with audio/video clips and media of your choice:

Susan Guo Senior author: [Michael Tomasello](#); Krupenye, C., Kano, F., Hirata, S., Call, J., & Tomasello, M. (2016). Great apes anticipate that other individuals will act according to false beliefs. *Science*, 354(6308), 110-114.

Mohammad Shahmeer Ahmad Senior author: [Nicky Clayton](#); Emery, N. J., & Clayton, N. S. (2004). The mentality of crows: convergent evolution of intelligence in corvids and apes. *Science*, 306(5703), 1903-7.

Andy Poon Senior author: [Claudio Tennie](#), Call, J., & Tomasello, M. (2009). Ratcheting up the ratchet: on the evolution of cumulative culture. *Philosophical Transactions of the Royal Society*, 364(1528), 2405-2415.

February 21

Human IQ

Gould, S. J. (1996). *The Mismeasure of Man*. WW Norton & Company. Read Pages: 176-263.

Podcast: [Sam Harris & Charles Murray. A Conversation with Charles Murray. Making Sense Podcast.](#)

Critique: [Charles Murray is once again peddling junk science about race and IQ](#) by Turkheimer, Harden, and Nisbett

February 23

Discussion

Presenters: Make a 20-minute PowerPoint integrating your narration of this paper (authors' background, study background, hypothesis, methods, results, conclusions, and assessment of strengths and weaknesses of the conclusions) and podcasts, with audio/video clips and media of your choice:

Meet Wadhwa Lead Authors: [Paige Harden](#), [Erik Turkheimer](#); Critique: [Charles Murray is once again peddling junk science about race and IQ](#) by Turkheimer, Harden, and Nisbett

Bhavishya Banda Lead Author: [Joseph Fagan](#); Fagan, J. F., & Holland, C. R. (2009). [Culture-fair prediction of academic achievement](#). *Intelligence*, 37(1), 62-67.

Adriana Ribota Podcast: [RadioLab. \(2019\). G: The Miseducation of Larry P. WNYC Studios.](#)

February 28

Brain Damage & Neural Plasticity

"Neural Plasticity: The Effects of Environment on the Development of the Cerebral Cortex" by Peter R. Huttenlocher.

Ch 4: Plasticity in Sensory Systems

Tessa Vermeulen Senior Author: [Michael Dorman](#). Gilley, P. M., Sharma, A., & Dorman, M. F. (2008). Cortical reorganization in children with cochlear implants. *Brain Research*, 1239, 56-65.

Katherine Buchan Senior Author: [Mel Goodale](#). Thaler, L., & Goodale, M. A. (2016). Echolocation in humans: an overview. *Wiley Interdisciplinary Reviews: Cognitive Science*, 7(6), 382-393.

March 2

Discussion

Presenters: Make a 20-minute PowerPoint integrating your narration of these papers (authors' background, study background, hypothesis, methods, results, conclusions, and assessment of strengths and weaknesses of the conclusions), with audio/video clips and media of your choice:

Elektra Petrakis Senior Author: [Marlene Behrmann](#); Liu, T. T., Nestor, A., Vida, M. D., Pyles, J. A., Patterson, C., Yang, Y., ... & Behrmann, M. (2018). Successful reorganization of category-selective visual cortex following occipito-temporal lobectomy in Childhood. *Cell Reports*, 24(5), 1113-1122.

Lauryn Patt Senior author: [Andrej Kral](#); Lomber, S. G., Meredith, M. A., & Kral, A. (2010). Cross-modal plasticity in specific auditory cortices underlies visual compensations in the deaf. *Nature Neuroscience*, 13(11), 1421.

March 14

Artificial Intelligence

Shane, J. (2019). *You Look Like a Thing and I Love You*. New York: Hachette Book Group.

[Marcus, G. \(2020\). *Deep Learning: A critical appraisal*.](#)

Discussion

Presenters: Make a 20-minute PowerPoint integrating your narration of this paper (authors' background, study background, hypothesis, methods, results, conclusions, and assessment of strengths and weaknesses of the conclusions) and commentary article, with audio/video clips and media:

Kayla Leung Lead author: [Brenden Lake](#); Lake, B., Salakhutdinov, R., Gross, J., & Tenenbaum, J. (2011). One shot learning of simple visual concepts. *Proceedings of the Cog Sci Society* (33(33)).

Julia Shuih Lead author: [Gary Marcus](#). Marcus, G. (2017). Am I Human? *Scientific American*.

March 16

Final Essay about your book Due – PUT IT IN A GOOGLE DOC TO SHARE

Workshop essays: outline, reverse outline, peer review, edit

Analysis

March 21

No Class: Schedule Individual Meetings about Paper Feedback [Here](#)

March 23

Andy Poon The Marshmallow Test by Walter Mischel

Readings:

1. [Review of The Marshmallow Test](#)
2. Kidd, C., Palmeri, H., & Aslin, R. N. (2013). Rational snacking: Young children's decision-making on the marshmallow task is moderated by beliefs about environmental reliability. *Cognition*, 126(1), 109-114.

TEACHER NOTES: One issue is that 'self control' might not really predict your success later in life, see this article by [Watts & Duncan \(2018\)](#). A second issue is some have argued that self-control as measured by the marshmallow test isn't a pure measure of self control and that it's affected by a prediction the individual is making about how stable the environment is – for example, if someone promises to give you a marshmallow later how likely is it they will keep their promise (if it's not likely then you should eat it now because the environment is unstable).

March 28

Julia Shuih and **Matthew Clapp** Conscious by Annaka Harris

Readings:

1. [Review of Conscious](#)
2. Haggard, P., Clark, S., & Kalogeras, J. (2002). Voluntary action and conscious awareness. *Nature Neuroscience*, 5(4), 382-385.

TEACHER NOTES: Are you letting the author off too easy on her lengthy discussion of "panpsychism"? What is a scientific perspective on this concept? Here is a blog post by a geneticist about it: <http://www.wiringthebrain.com/2018/02/panpsychism-not-even-wrong-or-is-it.html>

March 30

Meet Wadhwa and **Tessa Vermeulen** The Man Who Mistook His Wife for a Hat by Oliver Sacks

Readings:

1. [Review of The Man Who Mistook His Wife for a Hat](#)
2. Snyder, L. (2020). A case study of Oliver Sacks. *Science*, 369 (6510), p. 1439.
3. Marshall, J., & Newcombe, F. (1984). Putative problems and pure progress in neuropsychological single-case studies. *Journal of Clinical and Experimental Neuropsychology*, 6(1), 65-70.

TEACHER NOTES: A clinical neurologist, Arthur Shapiro, once said that Oliver Sacks is "a much better writer than a clinician" – what does he mean by that, and what does that mean for how seriously we take this book as a scientific work? Case studies are an important method in neuropsychology (see Marshall & Newcombe article above) – are Oliver Sacks's case studies in the same category?

April 4

Elektra Petrakis Outliers by Malcolm Gladwell

Readings:

1. Review of Outliers

2. Reardon, S. F., Robinson, J. P., & Weathers, E. S. (2008). Patterns and trends in racial/ethnic and socioeconomic academic achievement gaps. *Handbook of research in education finance and policy*, 497-516.

TEACHER NOTES: Experience matters but some studies show that the number of hours of practice is not the best predictor of skill. How do we resolve these contradictory reports? Here is a summary and links to the primary studies: <https://www.vox.com/science-and-health/2019/8/23/20828597/the-10000-hour-rule-debunked>

April 6

Katherine Buchan The Genius of Birds by Jennifer Ackerman

Readings:

1. Review of The Genius of Birds

2. Sol, D., Duncan, R. P., Blackburn, T. M., Cassey, P., & Lefebvre, L. (2005). Big brains, enhanced cognition, and response of birds to novel environments. *Proceedings of the National Academy of Sciences*, 102(15), 5460-5465.

TEACHER NOTES: Read Suzana Herculano-Houzel's discussion of bird brains – how are they so small yet so powerful? Here is a short piece on it: <https://www.science.org/doi/abs/10.1126/science.abe0536>

April 11

Bhavishya Banda and **May Li** Thinking Fast and Slow by Daniel Kahneman

Readings:

1. Review of Thinking Fast and Slow

2. A meta-scientific perspective on 'Thinking Fast and Slow'. Retraction Watch.

TEACHER NOTES: There is a lot to critique in this book – many of its cited studies do not replicate. A lot of the claims are based on subconscious social priming effects (e.g., seeing 'a frown' makes me more likely to be skeptical) but social priming effects are notoriously unstable. Perhaps people do not make decisions in the way the author describes? Which scientific claims hold up and which don't?

April 13

Isabel Brum and **Leeroy Zhang** Inferior by Angela Saini

Readings:

1. Review of Inferior in The Guardian

2. Joel, D., Berman, Z., Tavor, I., Wexler, N., Gaber, O., Stein, Y., ... & Assaf, Y. (2015). Sex beyond the genitalia: The human brain mosaic. *Proceedings of the National Academy of Sciences*, 112(50), 15468-15473.

TEACHER NOTES: Effect sizes in studies of sex or gender differences in cognition are notoriously small – meaning that most men and most women don't differ in cognitive performance. Here are data showing that effect sizes for gender differences in math are around 0 across countries – meaning no differences between gender groups: <https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.888.6177&rep=rep1&type=pdf>

April 18

Susan Guo and **Mohammad Shahmeer Ahmad** My Stroke of Insight by Jill Bolte-Taylor

Readings:

1. Review of My Stroke of Insight

2. Corballis, M. C. (2014). Left brain, right brain: facts and fantasies. *PLoS Biology*, 12(1), e1001767.

3. Dromerick, A. W., Geed, S., Barth, J., Brady, K., Giannetti, M. L., Mitchell, A., ... & Edwards, D. F. (2021). Critical Period After Stroke Study (CPASS): A phase II clinical trial testing an optimal time for motor recovery after stroke in humans. *Proceedings of the National Academy of Sciences*, 118(39).

TEACHER NOTES: The author has a particular view of left versus right brain function that might not be entirely correct. Which of the author's claims about left versus right brain are solid versus flimsy – and how does this affect the scientific quality of the book? Another core claim of this book is that there is a 'critical period' for stroke recovery (6 months) – is this true? See articles above.

April 20

Dominique Aruede and **Lauryn Patt** Grit by Angela Duckworth

Readings:

1. [Review of Grit 1](#)

2. [Review of Grit 2](#)

3. Werner, K. M., Milyavskaya, M., Klimo, R., & Levine, S. L. (2019). Examining the unique and combined effects of grit, trait self-control, and conscientiousness in predicting motivation for academic goals: A commonality analysis. *Journal of Research in Personality*, 81, 168-175.

TEACHER NOTES: Some have argued that "grit" is just another word for concepts that have been studied by psychologists for decades – like 'conscientiousness' and 'self-control'. Is this true and does this debate undermine the scientific claims in the book? Another (implied) claim is that grit can lead to success no matter what environment an individual is in – what is the evidence that grit is as powerful as, for example, SES?

April 25 Final Exam

April 27 No Class – Revise Final Essay

April 29 Revised Final Essay Due before or on April 29