COURSE SYLLABUS
PSY 51500 - Neuroscience of Consciousness
Mon 1:30 – 4:20

INSTRUCTOR

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MATERIALS

• Damasio, A. (1999). *The feeling of what happens: Body and emotion in the making of consciousness.* A Harvest Book, Harcourt, Inc.

• Journal articles and book chapters that can be downloaded from Brightspace (see the tentative schedule below).

TENTATIVE SCHEDULE

Week 1 (1/25):

Introduction

Week 2 (2/1):

Damasio, Chapter 1, "Stepping into the light"

Philosophical perspectives on consciousness
Nagel, T. (1974). What Is It Like to Be a Bat? *The Philosophical Review, 83(4),* 435-450.

Chalmers, D. J. (1995). Facing up to the problem of consciousness. *Journal of Consciousness Studies, 2(3),* 200-219.

Dennett, D. C. (2018). Facing up to the hard question of consciousness. *Phil.Trans. R. Soc. B, 373,* 20170342.

Week 3 (2/8):

Damasio, part of Chapter 2, pp 35 – 59, "Emotion and Feeling"

Philosophical perspectives on consciousness (cont.)

Ramachandran, V.S. & Hirstein, W. (1997). Three laws of qualia: What neurology tells us about the biological functions of consciousness. *Journal of Consciousness Studies, 4,* 429-457.

Churchland, P. S. & Churchland, P. M. (2002). Neural worlds and real worlds. *Nat Rev Neurosci., 11,* 903-907.

Theories of consciousness
Crick, F., & Koch, C. (2003). A framework for consciousness. *Nature Neuroscience, 6(2),* 119-126.

Week 4 (2/15):

Damasio, part of Chapter 2, pp 59 - 81, "Emotion and Feeling"

Theories of consciousness (cont.)
Crick, F., & Koch, C. (1995). Are we aware of neural activity in primary visual cortex? *Nature, 375,* 121-123.

Gray, C. M., & Singer, W. (1989). Stimulus-specific neuronal oscillations in orientation columns of cat visual cortex. *Proc. Nati. Acad. Sci. USA,* 86, 1698-1702.

Melloni, L., Molina, C., Pena, M., Torres, D., Singer, W., & Rodriguez, E. (2007). Synchronization of Neural Activity across Cortical Areas Correlates with Conscious Perception. *Journal of Neuroscience, 27(11),* 2858 –2865.

Optional readings:
Engel, A. K., & Singer, W. (2001). Temporal binding and the neural correlates of sensory awareness. *Trends in Cognitive Sciences, 5(1),* 16-25.

Week 5 (2/22):

Damasio, Chapter 3, "Core consciousness"

Theories of consciousness (cont.)
Ramesh Srinivasan, R., Russell, D. P., Edelman, G. M., & Tononi, G. (1999). Increased Synchronization of Neuromagnetic Responses during Conscious Perception. Journal of Neuroscience, *19*(13), 5435–5448.

Sporns, O., Tononi, G., & Edelman, G. M. (2000). Connectivity and complexity: the relationship between neuroanatomy and brain dynamics. *Neural Networks 13,* 909–922.

Massimini, M., Ferrarelli, F., Huber, R., Esser, S.K., Singh, H., & Tononi, G. (2005). Breakdown of cortical effective connectivity during sleep. *Science, 309,* 2228-2232.

Optional readings:
Tononi, G., & Edelman, G.M. (1998). Consciousness and complexity. *Science, 282,* 1846-1851.

Week 6 (3/1):

Damasio, Chapter 4, "The hint half hinted"

Theories of consciousness (cont.)
Baird, B., Castelnovo, A,. Gosseries, O., & Tononi, G. (2018). Frequent lucid dreaming associated with increased functional connectivity between frontopolar cortex and temporoparietal association areas. *Sci Rep., 8(1),* 17798.

Baars, B. J., Franklin, S., & Ramsoy, T. Z. (2013). Global workspace dynamics: cortical "binding and propagation" enables conscious contents. *Frontiers in Psychology, 4*, 200.

Berkovitch, L., Charles, L., Del Cul, A., Hamdani, N., Delavest, M. … Dehaene, S. … et al. (2020). Disruption of conscious access in psychosis is associated with altered structural brain connectivity. J Neurosci. Online ahead of print.

Optional readings:
Baars, B. J. (1993). How does a serial, integrated and very limited stream of consciousness emerge from a nervous system that is mostly unconscious, distributed, parallel and of enormous capacity? Ciba Found Symp.,174, 282-290; discussion 291-303.

Mashour GA, Roelfsema P, Changeux JP, Dehaene S. (2020). Conscious Processing and the Global Neuronal Workspace Hypothesis. Neuron, 105(5), 776-798.

Week 7 (3/8):

Damasio, part of Chapter 5, pp 133 – 149, "The organism and the object"

Measurement of consciousness
Aru, J., Bachmann, T., Singer, W., & Melloni, L. (2012). Distilling the neural correlates of consciousness. *Neuroscience and Biobehavioral Reviews, 36,* 737-746.

Theories of consciousness (cont.)
Graziano, M. S., & Kastner, S. (2011). Human consciousness and its relationship to social neuroscience: A novel hypothesis. *Cogn Neurosci., 2(2),* 98-113. (note – beyond pg 113 is Discussion)

Guterstam, A., Wilterson, A. I., Wachtell, D., & Graziano, M.S.A. (2020). Other people's gaze encoded as implied motion in the human brain. *Proc Natl Acad Sci U S A., 117(23),* 13162-13167.

Optional readings:
Block, N. (2014). Consciousness, Big Science and Conceptual Clarity. In Marcus, G., & Freeman, J. (eds.), *in The Future of the Brain: Essays by the World's Leading Neuroscientists*, Princeton University Press, 161-176.

Wilterson, A. I., Kemper, C. M., Kim, N., Webb, T. W., Reblando, A. M. W., Graziano, M. S. A. (2020). Attention control and the attention schema theory of consciousness. *Prog Neurobiol., 195,* 101844.

Kelly, Y.T., Webb, T.W., Meier, J.D., Arcaro, M.J., & Graziano, M.S.A. (2014). Attributing awareness to oneself and to others. *Proceedings of the National Academy of Sciences, 111,* 5012-5017.

Week 8 (3/15):

Damasio, part of Chapter 5, pp 149 - 167, "The organism and the object"

Theories of consciousness (cont.)
Richardson, H., Lisandrelli, G., Riobueno-Naylor, A., & Saxe, R. (2018). Development of the social brain from age three to twelve years. *Nat Commun., 9(1),* 1027.

Prinz, J. (2000). A Neurofunctional Theory of Visual Consciousness. *Consciousness and Cognition, 9,* 243–259.

Awareness in Blindsight
Weiskrantz, L., Warrington, E. K., Sanders, M. D. & Marshall, J. (1974). Visual Capacity in the Hemianopic Following a Restricted Occipital Ablation, *Brain, 97,* 709-728.

Optional readings:
Saxe, R., & Powell, L. J. (2006). It's the thought that counts: specific brain regions for one component of theory of mind. *Psychol Sci., 17(8),* 692-9.

Todd E Feinberg. T. E., & Jon Mallatt, J. (2020). Phenomenal Consciousness and Emergence: Eliminating the Explanatory Gap. *Front Psychol., 11,* 1041.

Week 9 (3/22):

Damasio, Chapter 6, "The making of core consciousness"

Awareness in Blindsight (cont.)
Sahraie A, Weiskrantz L, Barbur JL, Simmons A, Williams SC, Brammer MJ. (1997). Pattern of neuronal activity associated with conscious and unconscious processing of visual signals, *Proc. Natl. Acad. Sci. USA, 94,* 9406–9411.

Schurger, A., Cowey, A., & Tallon-Baudry, C. (2006). Induced gamma-band oscillations correlate with awareness in hemianopic patient GY. *Neuropsychologia, 44,* 1796–1803.

Self consciousness:
Churchland, P.S. (2002). Self-Representation in Nervous Systems. *Science, 296,* 308-310.

Week 10 (3/29):

Damasio, Chapter 7, "Extended consciousness"

Self consciousness (cont.):
Blanke, O., Landis, T., Spinelli, L., Seeck, M. (2004). Out-of-body experience and autoscopy of neurological origin. *Brain, 127(Pt 2),* 243-58.

Jenkinson, P. M., Haggard, P., Ferreira, N., & Fotopoulou, A. (2013). Body ownership and attention in the mirror: Insights from somatoparaphrenia and the rubber hand illusion. *Neuropsychologia, 51,* 1453-1462.

Gentile, G., Björnsdotter, M., Petkova, V. I., Abdulkarim, Z., & Ehrsson, H. H. (2015) Patterns of neural activity in the human ventral premotor cortex reflect a whole-body multisensory percept. *Neuroimage, 109,* 328-40.

Optional readings:
Cogliano, R., Crisci, C., Conson, M., Grossi, D., & Trojano, L. (2012). Chronic somatoparaphrenia: A follow-up study on two clinical cases. *Cortex, 48,* 758-767.

Ehrsson, H.H. (2012). The concept of body ownership and its relation to multisensory integration. In B. Stein (ed.), *The new handbook of multisensory processes* (pp. 775-792). Cambridge, MA: MIT Press.

Ronchi, R., Park, H.Y-D., & Blanke, O. (2018). Bodily self-consciousness and its disorders. In Handbook of Clinical Neurology, The Parietal Lobe. Volume 151, G. Vallar and H.B. Coslett, Editors, Elsevier.

Week 11 (4/5):

Damasio, Chapter 8, pp 234 – 255 or 260, "The neurology of consciousness"

Self consciousness (cont.):
Guterstam, A., Collins, K. L., Cronin, J. A., Zeberg, H., Darvas, F., Weaver, K. E., Ojemann, J. G., & Ehrsson, H. H. (2019). Direct Electrophysiological Correlates of Body Ownership in Human Cerebral Cortex. *Cerebral Cortex, 29(3),* 1328-1341.

Collins, K. L., Guterstam, A., Cronin, J., Olson, J. D., Ehrsson, H. H., & Ojemann, J. G. (2017). Ownership of an artificial limb induced by electrical brain stimulation. *Proc Natl Acad Sci USA, 114(1),* 166-171.

Craig, A.D. (2009). How do you feel–now? The anterior insula and human awareness. *Nature Reviews Neuroscience, 10,* 59-70.

Optional readings:

Craig, A.D. (2002). How do you feel? Interoception: the sense of the physiological condition of the body. *Nature Reviews Neuroscince, 3,* 655-6667.

Khalsa, S.S., Rudrauf, D., Feinstein, J.S. & Tranel, D. (2009). The pathways of interoceptive awareness. *Nature Neuroscience, 12,* 1494-1496.

Damasio, A., Damasio, H., & Tranel, D. (2013). Persistence of Feelings and Sentience after Bilateral Damage of the Insula. *Cerebral Cortex, 23,* 833-846.

Week 12 (4/12):

Damasio, Chapter 9, "Feeling feelings"

Self consciousness (cont.):

Craig, A.D., Chen, K., Bandy, D., & Reiman, E.M. (2000). Thermosensory activation of insular cortex. *Nature Neuroscience, 3,* 184-190.

Aspell, J. E., Heydrich,, L., Marillier, G., Lavanchy, T., Herbelin, B., & Blanke, O. (2013). Turning body and self inside out: visualized heartbeats alter bodily self-consciousness and tactile perception. *Psychol Sci., 24(12)*:2445-53.

Ronchi, R., Bello-Ruiz, J., Lukowska, M., Herbelin, B., Cabrilo, I., Schaller, K., Blanke, O. (2015). Right insular damage decreases heartbeat awareness and alters cardio-visual effects on bodily self-consciousness. *Neuropsychologia, 70,* 11-20.

Week 13 (4/19):

Altered states of consciousness

Fletcher, P.C., & Frith, C.D. (2009). Perceiving is believing: A Bayesian approach to explaining the positive symptoms of schizophrenia. *Nature Reviews Neuroscience, 10,* 48-58.

Silvanto, J., Lavie, N., Walsh V. (2005). Double dissociation of V1 and V5/MT activity in visual awareness. *Cerebral Cortex, 15(11),* 1736-41.

Adams, R. A. , Stephan, K. E., Brown, H. R., Frith, C. D., & Friston, K. J. (2013). The computational anatomy of psychosis. *Frontiers in Psychiatry, 4,* 47. **Section: "The Psychopharmacology of Precision", pp 4-7).**

Shergill, S. S., White, T. P., Joyce, D. W., Bays, P. M., Wolpert, D. M., Frith, C. D. (2014). Functional Magnetic Resonance Imaging of Impaired Sensory Prediction in Schizophrenia. *JAMA Psychiatry, 71(1),* 28-35.

Optional readings:

Pascual-Leone, A., Walsh, V. (2001). Fast backprojections from the motion to the primary visual area necessary for visual awareness. *Science, 292(5516),* 510-2.

Week 14 (4/26):

Altered states of consciousness (cont.)

Thakkar, K. N., Mathalon, D. H., & Ford, J. M. (2021). Reconciling competing mechanisms posited to underlie auditory verbal hallucinations. *Phil. Trans. R. Soc. B 376,* 20190702.

Hirvonen, J., Wibral, M., Palva, J. M., Singer, W., Uhlhaas, P., & Palva, S. (2017). Whole-Brain Source-Reconstructed MEG-Data Reveal Reduced Long-Range Synchronization in Chronic Schizophrenia. *eNeuro 4(5),* e0338-17.

Hamilton, H. K., Roach, B. J., Cavus, I., Teyler, T. J., Clapp, W. C., Ford, J. M., Tarakci, E., Krystal, J. H., & Mathalon, D. H. (2020). Impaired potentiation of theta oscillations during a visual cortical plasticity paradigm in individuals with schizophrenia. *Frontiers in Psychiatry, 11,* 590567.

Preller, K. H., Razi, A., Zeidman, P., Stämpfli, P., Friston, K. J., & Vollenweider, F. X.. (2019). Effective connectivity changes in LSD-induced altered states of consciousness in humans. *Proc Natl Acad Sci USA, 116(7),* 2743-2748.

Optional readings:
Ford, J.M., & Mathalon, D.H. (2012). Anticipating the future: Automatic prediction failures in schizophrenia. *International Journal of Psychophysiology, 83,* 232-239.

Uhlhaas, P.J., & Singer, W. (2013). High-frequency oscillations and the neurobiology of schizophrenia. *Dialogues in Clinical Neuroscience, 15,* 301-313.

BACKGROUND AND GOALS

The main purpose of the course is to introduce students to the exciting field of inquiry about the nature of consciousness. To accomplish this we will read and discuss a book that espouses a neurobiological theory of consciousness and representative articles in the literature. Some of the topics we will cover include: Can consciousness be solved? How does your brain generate your uniquely subjective experience of the world? Is it possible to identify neurobiological signatures of your awareness of things you see, hear, touch, or taste? What is the neurobiological basis of your sense of self with a first-person point of view that is grounded in a body? What is the role of emotions in consciousness? How does brain activity change in altered states of consciousness?

REQUIREMENTS AND GRADING

Everyone is expected to come to each class fully prepared to participate in discussions of all the assigned readings.

During each class, there will be a group discussion of the relevant material from Damasio's book. In addition, there will be several more focused discussions of related readings. Students will take turns

guiding the latter discussions, and this will usually if not always require PowerPoint presentations that capture the key points of what are often very technical experimental studies. The presentations should also include clear representations of the key figures to aid discussing points related to those figures. It is essential that students work very hard to make these presentations as clear and engaging as possible, because even though everyone will have read the material, everyone will also want that material to be carefully distilled for purposes of further analysis by the whole group. To facilitate this, I have provided a list of questions below, which should act as a guide for preparing your presentations. Note, this includes attempts to stimulate discussion. Furthermore, students' grades will depend to a large extent on the quality of their presentations. For all of these reasons, students are strongly encouraged to consult with Professor Fox about any issues that arise during the preparation of their presentations.

The following questions should be addressed in each presentation:

For research papers:
- Why was the study done?
- How was the study done?
- What was found?
- What was the interpretation(s) of the findings?
- Do you agree with interpretation(s)? Why or why not?
- Critique:
  - positive: strengths of study
  - negative: weaknesses of study
- Stimulate discussion; e.g., use slide with discussion questions

For review papers:
- What is the main purpose of the review paper?
- Review the key points, providing key supportive evidence
- Do you agree with key points? Why or why not?
- Stimulate discussion; e.g., use slide with discussion questions

At the beginning of each class, all students, except those giving presentations that day, must turn in a 1-to-2-page single-spaced paper reflecting on some aspect(s) of that day's assigned readings. These papers will be graded on the following three-point scale: check-plus (good), check (adequate), check-minus (poor).

Final course grades will be determined as follows:

- Presentations: 50%
- Weekly papers: 20%
- Group discussion: 30%

OTHER ISSUES

Students with Disabilities If anyone has a disability that may require special arrangements, please see Professor Fox.

Campus Emergency In the event of a major campus emergency, course requirements, deadlines, and grading percentages are subject to changes that may be necessitated by a revised semester calendar or other circumstances.