

Philosophy of Neuroscience

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Course summary

How, precisely, can we explain the mind in terms of the brain? This question, simple at first glance, turns out to be remarkably difficult to answer. In this course, we will not even pretend to approach the answer. Instead, we will characterize in painstaking detail just how many problems are hidden underneath this simple question.

Course texts

Poeppel, D., Mangun, G., and Gazzaniga, M.S. (eds.) *The Cognitive Neurosciences*, 6th ed. (MIT)

*The textbook is designated as *CN* on the reading schedule. Other readings will be made on Canvas.

Grading

Participation (0%): There is no formal attendance policy. More than 4 unexcused absences could result in an F, as per the College's policy.

Short responses (15%; *Due each Friday*): Every Friday, please submit a short (~150 words) response to the readings *for the previous week*. Responses should summarize common themes across the readings and can, at times, situate them within broader course themes. These can be submitted on Canvas.

Paper 1 (15%; *Due 2/16*): 3 – 4 page paper on the neuron doctrine.

Paper 2 (20%; *Due 3/19*): 3 – 4 page paper on bottom-up approaches to cognitive neuroscience.

Paper 3 (20%; *Due 4/30*): 3 – 4 page paper on the problem of cognitive ontology.

Final exam (30%; *TBD*): There will be one cumulative final at the end of the term. A study guide will be made available before the end of the semester.

Academic Integrity

All students pledge to abide by the guidelines on academic integrity outlined in the *Undergraduate Catalogue* (in the aptly titled section “Academic Integrity”). Violations of the academic integrity policy will be referred to Fr. Nowel's office.

Schedule

(*This schedule is subject to change; all modifications will be announced in class)

1/16 Introduction
No reading

Unit 1: Conceptual and empirical foundations of cognitive neuroscience

1/17 What are we even doing here?

- CN, xiii – xvi

1/19 Basic overview of cognitive neuroscience

- CN, 233 – 41

1/23 Overview of the nervous system

- Glickstein, *Neuroscience*, ch. 2

1/24 Overview of neurons and synapses

- Glickstein, *Neuroscience*, ch. 3

1/26 The classical computational theory

- Posner et al. (1988), “Localization of cognitive operations in the human brain”
- CN, 587 – 96

1/30 Decomposition and localization

- CN, 451 – 68

1/31 Neuroimaging

- Poldrack (2010), “The logic of experimental designs for neuroimaging”

2/2 *No class – Sam at Brown*

Unit 2: A second look at the neuron doctrine

2/6 How much of the neuron doctrine survives today?

- Bullock, Bennett, Johnston et al. (2005). “The neuron doctrine, redux”
- London and Häusser (2005) “Dendritic computation”

2/7 Is the neuron the foundation of the nervous system?

- Cao (2014), “Signaling in the brain: In search of functional units”

2/9 A multi-layered approach to the brain?

- Janacek et al. (2022), “Subcortical cognition: The fruit below the rind”
- Fields (2015), “A new mechanism of nervous system plasticity: activity-dependent myelination”

2/13 The brain goes socialist

- Becket Ebitz & Hayden (2021) “The population doctrine in cognitive neuroscience”

Unit 3: Finding mechanisms for functions

- 2/14 **What are we looking for?**
- McCaffrey (2015), “The brain’s heterogeneous functional landscape”
- 2/16 **Time to give up on localization?**
- Friston et al. (2010). “A critique of functional localizers”
 - **PAPER 1 DUE!**
- 2/20 **No class – Monday schedule! Remember to honor your presidents!**
- 2/21 **What, if anything, does a double dissociation show?**
- Machery (2012), “Dissociations in neuropsychology and cognitive neuroscience”
- 2/23 **Causal density**
- Klein (2010) “Images are not the evidence in neuroimaging”

Unit 4: Starting at the bottom

- 2/27 **The cognitive atlas**
- Varoquaux et al. (2018). “Atlases of cognition with large-scale human brain mapping”
- 2/28 **Neuroimaging and discovery**
- Mather et al. (2013) “How fMRI can inform cognitive theories”
- 3/1 **Structures without functions?**
- Genon et al. (2018). “How to characterize the function of a brain region”
- 3/5 **Dynamic Causal Modeling**
- Dezhina et al. (2023) “Establishing brain states in neuroimaging data”
- 3/6 **Dynamic systems**
- Favela (2021) “The dynamical renaissance in neuroscience”

Unit 5: How far up can we get?

- 3/8 **The limits of causal inference**
- Jonas and Kording (2018) “Could a neuroscientist understand a microprocessor?”
- 3/12 *Spring break*
- 3/13 *Spring break*
- 3/15 *Spring break*

- 3/19 **The threat of reduction**
- Krakauer et al. (2018) “Neuroscience needs behavior”
 - **PAPER 2 DUE!**
- 3/20 **The resting state**
- Klein (2012), “The brain at rest: What it’s doing and why it matters”
- 3/22 **Neural decoding**
- Ritchie et al. (2021) “Neural representation and the limits of multivariate pattern analysis in cognitive neuroscience”

Unit 6: *The problem of cognitive ontology*

- 3/26 **Defining the problem**
- Anderson (2015) “Mining the brain for a new taxonomy of mind”
- 3/27 **Is this a neuroscience problem or psychology problem?**
- Burnston (2024) “Cognitive ontologies, task ontologies, and explanation in cognitive neuroscience”
- 3/29 *Good Friday; No class*
- 4/2 **Finding the right functions**
- Poldrack (2010) “Mapping mental function to brain structure”
- 4/3 *No class; Monday schedule!*
- 4/5 **Pitching the solution at the right level**
- Klein (2012) “Cognitive ontology and region- versus network-oriented analyses”
- 4/9 **Contextual functionalism**
- Khalidi (2022) *Cognitive Ontology: Taxonomic practices in the mind-brain sciences*, ch. 1
- 4/10 **Cross-cutting psycho-neural taxonomies**
- Khalidi (2022) *Cognitive Ontology: Taxonomic practices in the mind-brain sciences*, ch. 5
- 4/12 **A harder problem?**
- Francken et al. (2022) “Cognitive ontology and the search for neural mechanisms”
- 4/16 **Another look at neural mechanisms**
- Van Bree (2023) “A critical perspective on neural mechanisms in cognitive neuroscience”

- 4/17 **Stabilizing cognitive systems**
- De Brigard (2017) “Cognitive systems and the changing brain”
- 4/19 **A big data problem?**
- Poldrack and Yarkoni (2016) “From brain maps to cognitive ontology”
- 4/23 **The pluralistic approach**
- McCaffrey & Wright (2022) “Neuroscience and cognitive ontology”
- 4/24 **The radical view**
- Anderson (2014) *After phrenology*, pp. xiii - 48
- 4/26 **The radical view, redux**
- Hutto et al. (2017) “Cognitive ontology in flux”
- 4/30 **The neural personality**
- Anderson (2014) *After phrenology*, ch. 4
- 5/1 **Some responses to the radical view**
- Kaplan & Craver (2016) “A registration problem for functional fingerprinting”
 - Stanley & De Brigard (2016) “Modularity in network neuroscience and neural reuse”
 - Shine et al. (2016) “Computational specificity in the human brain”
 - McCaffrey & Machery (2016) “The reification objection to bottom-up cognitive ontology revision
 - **PAPER 3 DUE!**
- 5/3 **Back to the neuron doctrine**
- Barack & Krakauer (2021) “Two views on the cognitive brain”

Final Exam TBD