

# Neurolinguistics

Fall 2024

Welcome to Neurolinguistics! The Fall 2024 course information and materials are below. Course materials from previous semesters are archived [here](#).

## Syllabus

**Course Description:** Neurolinguistics is a seminar on language and the brain. For the first few weeks, you will build a foundation of knowledge, first on how brains work (neurons, networks, and anatomy) and later on the methods researchers use to study language in the brain. The remainder of the course will explore the literature on different topics in language and the brain, including various levels of linguistics (phonology, morphology, syntax), acquisition, evolution, signed languages, and more.

**Prerequisites:** This course is open to all graduate students and upper-level undergraduates. No specific background in neuroscience or linguistics is necessary to participate in the course. However, this is an advanced seminar-style course; students looking for a lecture format will not enjoy this course.

**Instructor:** [Dr. Katie Schuler \(she/her\)](#)

- You can call me **Katie**

**Seminars:** Thursday at 1:45pm in TBD

**Office Hours:** The linguistics department is located on the 3rd floor of 3401-C Walnut street, between Franklin's Table and Modern Eye.

- Katie Schuler: TBD in 314C

**Requirements:** This is an advanced STEM seminar. Below are the major requirements, but please read the [tips for seminars](#) to understand further:

- **Reading prep:** Each week, you will be responsible for preparing for the discussion by completing the assigned reading. As you read, you are responsible for ~~asking questions and beginning the discussion of the paper in our reading annotation tool, Perusall~~ keeping a [reading log](#) including a brief summary of main points, your critical reflections, and a few discussion questions for class.
- **Discussion leader:** Several times throughout the semester (but not every week), you will serve as discussion leader for a paper with one or two other students. As discussion leader, your group will be responsible for presenting the paper, including summarizing (motivation, research questions, approach, and findings) and leading a discussion of the work.
- **Final paper:** You will select a paper of interest to you (within the bounds of language and the brain) and write a research analysis of the work (in the form of a nature “News & Views” paper; example [here](#)). There are a few checkpoints leading up to this final paper (including peer review) to help you make progress.

### Grading:

- 30% Participation in discussion (including reading prep ~~in Perusall~~ via your reading log)
- 40% Discussion leader
- 30% Final paper (including several check-points throughout the semester: paper selection, outline, drafts, and peer review)

**Extensions:** For assignments related to the final paper, extensions of up to 1 week will be granted for any reason. Beyond that, you can turn in any missed writing assignment for half-credit (50%).

**Accommodations:** I will support any accommodations arranged through Disability Services via the [Weingarten Center](#) and to make alternate arrangements when class conflicts with a religious holiday. Please notify me as soon as possible if you require accommodations.

**Extra credit:** There is no extra credit in the course. However, students can submit any missed reading prep by the end of the semester for half credit (50%). To ensure fair treatment, all students will receive a 1% “bonus” to their final course grade: 92.54% will become 93.54%.

**Support:** Asking for help is a sign of strength! I hope you’ll reach out to me if you need help (academically or otherwise). I also want you to be aware of Penn’s Academic & Wellness Resources

### Resources

In addition to our course website, we will use the following:

- [canvas](#)- for posting grades
- [perusall](#) - for reading annotations
- [ed discussion](#) - for announcements and questions

Other helpful materials and resources:

- [tips for seminars](#)

Please consider using these Penn resources this semester:

- [Weingarten Center](#) for academic support and tutoring.
- [Wellness at Penn](#) for health and wellbeing.

## Schedule

| Week | Date   | Topic & Discussion Leaders   | Due                            |
|------|--------|--|--------------------------------|
| 1    | Aug 29 | <a href="#">Getting started</a> Katie (Instructor)   |                                |
| 2    | Sep 5  | <a href="#">CNS, neurons, and methods</a> Katie (Instructor)   |                                |
| 3    | Sep 12 | <b>Perspective</b> Krakauer et al (2017): Chloe, Dillon, Erica Embick & Poeppel (2015): Esther, Mahir, Sophia  |                                |
| 4    | Sep 19 | <b>Networks</b> <a href="#">Malik-Moraleda et al 2022</a> - Esther, Jo, Na <a href="#">Fedorenko et al 2024</a> - Mahir, Sophia, Jason   |                                |
| 5    | Sep 26 | <b>Phonemes &amp; Syntax</b> <a href="#">Fitch &amp; Martins (2014)</a> - Daniel, Dillon, Tali <a href="#">Makuuchi et al (2009)</a> - Aymeric, Ninjin, Jason  | CP1 Topic selection (due 9/23) |
| 6    | Oct 3  | <b>Fall break (no class)</b>   |                                |
| 7    | Oct 10 | <b>Acquisition I</b> <a href="#">Perani et al 2011</a> - Carey, Leann, Katie <a href="#">Leroy et al 2011</a> - Karis, Ninjin <a href="#">Skeide &amp; Friederici 2016</a> - Tali, Nwai, Na          | CP2 Outline (due 10/7)         |
| 8    | Oct 17 | <b>No class (Katie @ conference)</b>   |                                |
| 9    | Oct 24 | <b>Acquisition II</b> <a href="#">Cheng et al 2023</a> - Alyssa, Esther, Jason <a href="#">Schipke et al 2012</a> - Dillon, Daniel, Aymeric <a href="#">Petitto et al 2012</a> - Chloe, Jo, Kamelija |                                |
| 10   | Oct 31 | <b>Bilingualism I</b> Alyssa, Erica, Kamelija, Sophia, Daniel, Aymeric   | CP3 Peer review (due 10/08)    |

| Week | Date   | Topic & Discussion Leaders  | Due  |
|------|--------|---|--|
| 11   | Nov 7  | <b>Symposium (Zoom):Neural Coding in Speech, Language and Cognition</b> |  |
| 12   | Nov 14 | <b>Bilingualism II</b> Carey, Chloe, Leann, Katie, Na, Karis, Jo        |  |
| 13   | Nov 21 | <b>Sign language</b> Carey, Leann, Katie, Karis, Tali, Nwai             | <a href="#">CP4 Paper draft (due 11/18)</a>  |
| 14   | Nov 28 | <b>Thanksgiving break (no class)</b>                                    | Peer Review II (Tues)                        |
| 15   | Dec 5  | <b>Evolution</b> Alyssa, Erica, Ninjin, Kamelija, Nwai, Mahir           | <a href="#">CP6 Peer review 2 (due 12/5)</a> |
| 16   | Dec 9  | No class  |  |
| 17   |        | <a href="#">CP7 Final paper (due 12/16)</a>                             |  |

## Readings

Full list of papers **read by** or of interest to the class this semester

- Weeks 1 & 2: Gettings started and basic neuroscience
- Week 3: Perspective
  - Krakauer, J. W., Ghazanfar, A. A., Gomez-Marin, A., MacIver, M. A., & Poeppel, D. (2017). Neuroscience needs behavior: correcting a reductionist bias. *Neuron*, 93(3), 480-490.
  - Embick, D., & Poeppel, D. (2015). Towards a computational (ist) neurobiology of language: correlational, integrated and explanatory neurolinguistics. *Language, cognition and neuroscience*, 30(4), 357-366.
  - Poeppel, D., & Adolfs, F. (2020). Against the epistemological primacy of the hardware: The brain from inside out, turned upside down. *Eneuro*, 7(4).
- Week 4: Networks
  - Malik-Moraleda, S., Ayyash, D., Gallée, J., Affourtit, J., Hoffmann, M., Mineroff, Z., ... & Fedorenko, E. (2022). An investigation across 45 languages and 12 language families reveals a universal language network. *Nature Neuroscience*, 25(8), 1014-1019.
  - Fedorenko, E., Ivanova, A. A., & Regev, T. I. (2024). The language network as a natural kind within the broader landscape of the human brain. *Nature Reviews Neuroscience*, 1-24.

- Fedorenko, E., & Thompson-Schill, S. L. (2014). Reworking the language network. *Trends in cognitive sciences*, 18(3), 120-126.
- Friederici, A. D., & Gierhan, S. M. (2013). The language network. *Current opinion in neurobiology*, 23(2), 250-254.
- Week 5: Phonemes, Syntax, Semantics (3)
  - Brodbeck, C., Hong, L. E., & Simon, J. Z. (2018). Rapid transformation from auditory to linguistic representations of continuous speech. *Current Biology*, 28(24), 3976-3983.
  - Ding, N., Melloni, L., Zhang, H., Tian, X., & Poeppel, D. (2016). Cortical tracking of hierarchical linguistic structures in connected speech. *Nature neuroscience*, 19(1), 158-164.
  - Scott, S. K., Blank, C. C., Rosen, S., & Wise, R. J. (2000). Identification of a pathway for intelligible speech in the left temporal lobe. *Brain*, 123(12), 2400-2406.
  - **Fitch, W. T., & Martins, M. D. (2014). Hierarchical processing in music, language, and action: Lashley revisited. *Annals of the New York Academy of Sciences*, 1316(1), 87-104.**
  - Lau, E. F., Phillips, C., & Poeppel, D. (2008). A cortical network for semantics:(de)constructing the N400. *Nature reviews neuroscience*, 9(12), 920-933.
  - Makuuchi, M., Bahlmann, J., Anwender, A., & Friederici, A. D. (2009). **Segregating the core computational faculty of human language from working memory. *Proceedings of the National Academy of Sciences*, 106(20), 8362-8367.**
  - Kaan, E., & Swaab, T. Y. (2002). The brain circuitry of syntactic comprehension. *Trends in cognitive sciences*, 6(8), 350-356.
- Week 6: No class, fall break
- Week 7: Acquisition 1 (3)
  - Catani, M., Jones, D. K., & Ffytche, D. H. (2005). Perisylvian language networks of the human brain. *Annals of Neurology: Official Journal of the American Neurological Association and the Child Neurology Society*, 57(1), 8-16.
  - Perani, D., Saccuman, M. C., Scifo, P., Anwender, A., Spada, D., Baldoli, C., ... & Friederici, A. D. (2011). **Neural language networks at birth. *Proceedings of the National Academy of Sciences*, 108(38), 16056-16061.**
  - Leroy, F., Glasel, H., Dubois, J., Hertz-Pannier, L., Thirion, B., Mangin, J. F., & Dehaene-Lambertz, G. (2011). **Early maturation of the linguistic dorsal pathway in human infants. *Journal of Neuroscience*, 31(4), 1500-1506.**
  - Skeide, M. A., & Friederici, A. D. (2016). **The ontogeny of the cortical language network. *Nature Reviews. Neuroscience*, 17(5), 323-332.**
- Week 8: No class, Katie @ conference
- Week 9: Acquisition 2 (3)

- Cheng, Q., Roth, A., Halgren, E., Klein, D., Chen, J.-K., & Mayberry, R. I. (2023). [Restricted language access during childhood affects adult brain structure in selective language regions](#). *Proceedings of the National Academy of Sciences of the United States of America*, 120(7), e2215423120.
- Schipke, C. S., Knoll, L. J., Friederici, A. D., & Oberecker, R. (2012). [Preschool children’s interpretation of object-initial sentences: neural correlates of their behavioral performance: Children’s interpretation of object-initial sentences](#). *Developmental Science*, 15(6), 762–774.
- Petitto, L. A., Berens, M. S., Kovelman, I., Dubins, M. H., Jasinska, K., & Shalinsky, M. (2012). [The “Perceptual Wedge Hypothesis” as the basis for bilingual babies’ phonetic processing advantage: new insights from fNIRS brain imaging](#). *Brain and Language*, 121(2), 130–143.
- Werker, J. F., & Hensch, T. K. (2015). Critical periods in speech perception: new directions. *Annual review of psychology*, 66(1), 173-196.
- Martin, K. C., Seydell-Greenwald, A., Berl, M. M., Gaillard, W. D., Turkeltaub, P. E., & Newport, E. L. (2022). A weak shadow of early life language processing persists in the right hemisphere of the mature brain. *Neurobiology of Language* (Cambridge, Mass.), 3(3), 364–385.
- Friedrich, M., & Friederici, A. D. (2005). Phonotactic knowledge and lexical-semantic processing in one-year-olds: Brain responses to words and nonsense words in picture contexts. *Journal of Cognitive Neuroscience*, 17(11), 1785-1802.
- Lenneberg, E. H. (1969). On Explaining Language: The development of language in children can best be understood in the context of developmental biology. *Science*, 164(3880), 635-643.
- Week 10: Bilingualism 1 (3)
  - Pierce, L. J., Klein, D., Chen, J. K., Delcenserie, A., & Genesee, F. (2014). Mapping the unconscious maintenance of a lost first language. *Proceedings of the National Academy of Sciences*, 111(48), 17314-17319.
  - Weber-Fox, C. M., & Neville, H. J. (1996). Maturational constraints on functional specializations for language processing: ERP and behavioral evidence in bilingual speakers. *Journal of cognitive neuroscience*, 8(3), 231-256.
- Week 11: No class, Katie @ conference
- Week 12: Bilingualism 2 (2)
  - Papers TBD
- Week 13: Sign language (3)
  - Mayberry, R. I., Chen, J. K., Witcher, P., & Klein, D. (2011). Age of acquisition effects on the functional organization of language in the adult brain. *Brain and language*, 119(1), 16-29.

- Nishimura, H., Hashikawa, K., Doi, K., Iwaki, T., Watanabe, Y., Kusuoka, H., ... & Kubo, T. (1999). Sign language 'heard' in the auditory cortex. *Nature*, 397(6715), 116-116.
- Petitto, L. A., Zatorre, R. J., Gauna, K., Nikelski, E. J., Dostie, D., & Evans, A. C. (2000). Speech-like cerebral activity in profoundly deaf people processing signed languages: implications for the neural basis of human language. *Proceedings of the National Academy of Sciences*, 97(25), 13961-13966.
- Week 14: No class, Thanksgiving break
- Week 15: Evolution (2)
  - Rilling, J. K., Glasser, M. F., Preuss, T. M., Ma, X., Zhao, T., Hu, X., & Behrens, T. E. (2008). The evolution of the arcuate fasciculus revealed with comparative DTI. *Nature neuroscience*, 11(4), 426-428.
  - Fitch, W. T. (2018). The biology and evolution of speech: a comparative analysis. *Annual review of linguistics*, 4(1), 255-279.
  - Fisher, S. E., & Scharff, C. (2009). FOXP2 as a molecular window into speech and language. *Trends in Genetics*, 25(4), 166-177.
  - Wilson, B., Marslen-Wilson, W. D., & Petkov, C. I. (2017). Conserved sequence processing in primate frontal cortex. *Trends in neurosciences*, 40(2), 72-82.
- Week 16: No class, reading period
- Not covered this year: Cerebellum
  - Lesage, E., Morgan, B. E., Olson, A. C., Meyer, A. S., & Miall, R. C. (2012). Cerebellar rTMS disrupts predictive language processing. *Current Biology*, 22(18), R794-R795.
  - Mariën, P., Ackermann, H., Adamaszek, M., Barwood, C. H., Beaton, A., Desmond, J., ... & Ziegler, W. (2014). Consensus paper: language and the cerebellum: an ongoing enigma. *The Cerebellum*, 13, 386-410.

## Reading log

As of Friday September 20th, please keep a reading log ([sample](#)) instead of tracking reading in Perusall.

1. Create a single google doc you will update throughout the semester.
2. Set share permissions to “anyone with the link”
3. Each week, add a heading that says “Week X: Topic (Date)” (or similar) to your existing document.
4. Under the week’s heading, include the full citation for each paper.
5. Under each paper, include a 250-500 word reflection, including (at least):
  - a few sentences about the main findings
  - a few sentences of your own critical reflections on the paper

- and 2 discussion questions you have in mind
6. Submit the link to your google doc on Canvas by class time each Thursday.

### **Final paper**

There are 7 checkpoints leading up to (and including) the final paper, due on the following Mondays at noon. Extensions of up to 1 week will be granted for any reason. Beyond that, you can turn in any missed checkpoint for half-credit (50%) by the end of the semester.

- Checkpoint 1: Topic selection due Sep 23
- Checkpoint 2: Outline due Oct 7
- Checkpoint 3: Peer review 1 due ~~Oct 21~~ Oct 28
- Checkpoint 4: Paper draft due Nov 18
- Checkpoint 5: Peer review 2 due Dec 5
- Checkpoint 6: Final paper due Dec 16