

Spring 2021

# Neural Structure of Language

## 01:185:335

**Meets:** Monday and Thursday 10:20-11:40am (online only)

**Prereqs:** 01:185:201 Cognitive Science: A Multidisciplinary Introduction

**Instructor:** Ryan Rhodes ([ryan.rhodes@rutgers.edu](mailto:ryan.rhodes@rutgers.edu))

**Office Hours:** TBA

**Course Site:** <https://rutgers.instructure.com/courses/104414>

## Course Materials

**This course has no textbook.** We will be reading scientific articles published in peer-reviewed journals, which will be available on canvas.

All relevant materials can be found on the course canvas site (see above).

## Course Description

Language is a deceptively complex computational system. In this course, we will explore how linguistic structure is represented and processed in the brain, and how the computational machinery that generates language intersects with different cognitive capacities and brain structures. We will focus on a few major themes: neural evidence of linguistic structures and structure-building; major brain regions associated with language and competing models of their functions; and the underlying cognitive resources necessary for producing and comprehending language.

This course incorporates both lecture and discussion, and we will be reading and discussing primary scientific literature.

## Course Learning Outcomes

This course has two primary goals. Reading and understanding primary scientific literature is challenging. A primary objective of this course is to develop the skill of reading scientific papers, extracting meaningful information, and integrating that new information with our prior knowledge. We will be viewing this literature with a critical lens to better understand scientific reasoning as it is applied to very difficult questions.

The other goal of this course is to develop a deep understanding of language and the brain, viewed through a framework informed by theoretical linguistics, cognitive psychology, and neuroscience. We will adopt a “levels of analysis” approach – common in cognitive science – to understand language as the output of a complex computational system.

## Assignments

### Reading Journal: 10%

You will be required to keep a journal, where you will make notes about the readings. The journal is important because it gives you well-structured notes to reference for discussion and reading responses. Please have it with you when you come to class.

### Reading Responses: 30%

Each week you will write a short response on the week’s reading (500-1000 words). These must be submitted to Canvas. The purpose of the response is to get you thinking about the readings, connecting the new material to other readings and discussion, and offering your own thoughts.

There will be 12 reading responses total. The highest 10 will be counted towards your final grade.

Responses will be graded according to the following rubric:

Great 3	Proficient 2	Developing 1	Unsatisfactory 0
The response is well-developed. It indicates that the material was read and understood. It expands on, elaborates, or offers a unique insight on the material.	The response is adequate. There is evidence that the material was read and understood. Elaboration or unique insights may be less developed.	The response is not adequate. There may be little evidence that the material was read or understood. There is no elaboration.	The response was not submitted properly to Canvas by the deadline.

## Midterm Exam: 30%

The midterm exam will cover material from the first six weeks of class, including material from the readings, lectures, and class discussions. The format of the exam will be mixed, consisting of multiple choice, short answer, and essay questions.

## Final Exam: 30%

The final exam will be cumulative, covering material from the readings, lectures, and our discussions. The format of the final exam will be mixed, consisting of multiple choice, short answer, and essay questions.

Your reading journal will serve as a valuable resource while studying for the exams. Please utilize it! Keep up with the readings and use your journal to make notes about each reading as we read/discuss them.

## Schedule

Week	Date	Module	Reading
1	1/21	Introductions	Pinker (1994) Ch. 4
2	1/25 1/28	Brain Basics	Libben (1997)
3	2/1 2/4	The Goal of Neurolinguistics	Embick & Poeppel (2015)
4	2/8 2/11	Where Do We Store Words?	Huth et al. (2016)
5	2/15 2/18	From Words to Sentences	Delogu et al. (2019)
6	2/22 2/25	Words and Rules	Ullman (2015)
7	3/1 3/4	Unaccusatives	Shetreet et al. (2010)
8	3/8 3/11	Midterm	Midterm Review
9	3/13- 3/21	<i>Spring Break</i>	
10	3/22 3/25	Negation	Fischler et al. (1983)
11	3/29 4/1	Universal Grammar	Musso et al. (2003)
12	4/5 4/8	Complexity	Hagoort (2005)
13	4/12 4/15	Complexity	Petersson et al. (2012)
14	4/19 4/22	Neural Oscillations	Ding et al. (2016)
15	4/26 4/29	Parsing Strategies	Nelson et al. (2017)
16	5/3	Final	Final Exam Review

## Class Policies

### Attendance

This is a synchronous, online-only lecture-and-discussion class. If you can't make the lecture, the class session will be recorded, and the recording will be uploaded to Canvas. You can also feel free to email me any time or come to office hours to find out what you missed.

However—I love class participation. This class consists of both lecture and discussion, and I'd like to have the liveliest discussion possible. I want to hear your thoughts and insights! So please come to the live lecture sessions and feel free to participate!

I want our class to be an open forum and a safe space to engage in discussion and speculation on topics related to language and the brain. We will engage in discussion in a positive and non-judgmental way while we explore interesting new ideas. Everyone's diverse backgrounds and knowledge will give unique insights that may benefit all of us!

### Collaboration

Collaboration is at the heart of good science! I encourage you to collaborate with each other - but every student must always turn in their own work. Your work must be written solely by you!

### Academic Integrity

Cheating or plagiarism of any kind will not be tolerated. University policies on academic dishonesty are draconian – please don't put me in a position where I have to enforce them. If you are not familiar with Rutgers's academic integrity policies, you can find them here: <http://academicintegrity.rutgers.edu/academic-integrity-policy/>.

## Student Resources

### Accommodation of Disabilities

I am very happy to offer any kind of accommodation you may need. Please let me know if you have any special needs by coordinating with me and ODS: <https://ods.rutgers.edu/students/registering-for-services>

## Student wellbeing

Your mental health, comfort, and wellbeing are important! Please be aware and if needed avail yourselves of the counseling, psychiatric services, and crisis intervention resources Rutgers makes available for students.

*Mental health services:* <http://health.rutgers.edu/medical-counseling-services/counseling/>  
CAPS is a University mental health support service that includes counseling, alcohol and other drug assistance, and psychiatric services staffed by a team of professional within Rutgers Health services to support students' efforts to succeed at Rutgers University. CAPS offers a variety of services that include: individual therapy, group therapy and workshops, crisis intervention, referral to specialists in the community and consultation and collaboration with campus partners.

*Crisis intervention:* <http://health.rutgers.edu/medical-counseling-services/counseling/crisis-intervention/>

The Office for Violence Prevention and Victim Assistance provides confidential crisis intervention, counseling and advocacy for victims of sexual and relationship violence and stalking to students, staff and faculty. To reach staff during office hours when the university is open or to reach an advocate after hours, call 848-932-1181.

*Violence prevention and victim assistance:* [www.vpva.rutgers.edu/](http://www.vpva.rutgers.edu/)

## Readings

- Delogu, F., Brouwer, H., & Crocker, M. W. (2019). Event-related potentials index lexical retrieval (N400) and integration (P600) during language comprehension. *Brain and Cognition*, 135(October 2018), 103569. <https://doi.org/10.1016/j.bandc.2019.05.007>
- 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. <https://doi.org/10.1038/nn.4186>
- 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. <https://doi.org/10.1080/23273798.2014.980750>
- Fischler, I., Bloom, P. A., Childers, D. G., Roucos, S. E., & Perry, N. W. J. (1983). Brain potentials related to stages of sentence verification. *Psychophysiology*, 20(4), 400–409.
- Hagoort, P. (2005). On Broca, brain, and binding: a new framework. *Trends in Cognitive Sciences*, 9(9), 416–423. <https://doi.org/10.1016/j.tics.2005.07.004>
- Huth, A. G., De Heer, W. A., Griffiths, T. L., Theunissen, F. E., & Gallant, J. L. (2016). Natural speech reveals the semantic maps that tile human cerebral cortex. *Nature*, 532(7600), 453–458. <https://doi.org/10.1038/nature17637>
- Libben, G. (1997). Brain and Language. In W. O'Grady, M. Dobrovolsky, & F. Katamba (Eds.), *Contemporary linguistics* (pp. 415–436). St. Martin's.
- Musso, M., Moro, A., Glauche, V., Rijntjes, M., Reichenbach, J., Büchel, C., & Weiller, C. (2003). Broca's area and the language instinct. *Nature Neuroscience*, 6(7), 774–781.
- Nelson, M. J., El, I., Giber, K., Yang, X., Cohen, L., Koopman, H., Cash, S. S., Naccache, L., Hale, J. T., Pallier, C., & Dehaene, S. (2017). Neurophysiological dynamics of phrase-structure building during sentence processing. *Proceedings of the National Academy of Sciences*, 114(18), 1–10. <https://doi.org/10.1073/pnas.1701590114>
- Petersson, K. M., Folia, V., & Hagoort, P. (2012). What artificial grammar learning reveals about the neurobiology of syntax. *Brain and Language*, 120(2), 83–95. <https://doi.org/10.1016/j.bandl.2010.08.003>
- Pinker, S. (1994). *The language instinct: How the mind creates language*. William Morrow and Company.
- Shetreet, E., Friedmann, N., & Hadar, U. (2010). The neural correlates of linguistic distinctions: Unaccusative and unergative verbs. *Journal of Cognitive Neuroscience*, 22(10), 2306–2315. <https://doi.org/10.1162/jocn.2009.21371>
- Ullman, M. T. (2015). The declarative/procedural model. In B. VanPatten & J. Williams (Eds.), *Theories in Second Language Acquisition: An Introduction* (Second, pp. 135–160). Routledge.

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