NEURAL STRUCTURE OF LANGUAGE
01:185:335

Meets: Monday and Wednesday 3:50-5:10pm, LSH B269 (LIV)

Format: In-Person

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

Instructor: Ryan Rhodes (ryan.rhodes@rutgers.edu)

Office Hours: Wednesday 1-3pm, or by appointment. RuCCS, Room A111.

Course Site: [Canvas](#)

TA : Shannon Bryant (sgb103@ruccs.rutgers.edu)

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](#).

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

Annotations: 5%

Every week there will be an assigned reading. These will be published papers in the field of neurolinguistics. You will be expected to read the weekly reading before class, so we can discuss it. Each week you will contribute to a collaborative annotation of the reading on Canvas. This is done via hypothes.is—simply add comments directly to the reading via the link on Canvas. This is required! It's important for me to have a sense of what is troubling you so we can address it in class.

There will be 13 annotation assignments in total, but you can miss up to 3 without penalty. These are graded as complete/incomplete.

Responses: 30%

For each module you will write a response to a prompt on that module's topic, synthesizing material from the readings and lectures (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. The responses must address the

prompt and raise new questions, drawing from the module's readings, lectures, and at least one outside source.

There will be 4 responses total.

Responses will be graded according to the following rubric:

Great 10-9	Proficient 8-7	Developing 6-5	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.

Peer Review: 15%

For each module you will review and comment on two (2) of your classmates' responses. These reviews will be anonymized (you will not know whose paper you are reviewing, and you will not know who is reviewing your paper). Your review should be substantive with the aim of improving your classmate's response. You should draw from the readings, lectures, and any outside material to add insights or raise new questions.

Midterm Exam: 25%

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: 25%

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.

Schedule

Week	Date	Module	Lecture	Reading	Assignment
1	9/7	Overview	How language works	Pinker (1994) Ch. 4	Introductions
2	9/12 914	Words	The mental dictionary	Altmann (1998)	
3	9/19 9/21		Semantic maps	Huth et al. (2016)	
4	9/26 9/28		Words and rules	Ullman (2015)	Response 1
5	10/3 10/5	Sentences	From words to sentences	Kutas & Federmeier (2011)	
6	10/10 10/12		Negation	Fischler et al. (1983)	Peer Review 1
7	10/17 10/19		Access and integration	Delogu et al. (2019)	Response 2
8	10/24 10/26	Midterm	Midterm review		Midterm Exam
10	10/31 11/2	Complexity	Universal grammar	Musso et al. (2003)	
11	11/7 11/9		Measuring complexity	Bahlmann et. al (2008)	Peer Review 2
12	11/14 11/16		Dynamic functional modularity	Petersson et al. (2012)	Response 3
13	11/21	Structure	Neural oscillations	Ding et al. (2016)	
14	11/28 11/30		Structure building	Nelson et al. (2017)	Peer Review 3
15	12/5 12/7		Cortical organization of syntax	Matchin & Hickok (2020)	Response 4
16	12/12 12/14	Final	Final Exam Review		Final Exam

Class Policies

Attendance

This is a synchronous, in-person lecture-and-discussion class. If you can't make the lecture, feel free to email me any time or come to office hours to find out what you missed.

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 Rutger's academic integrity policies, you can find them here: http://academicintegrity.rutgers.edu/academic-integrity-policy/.

Mask Mandate

Due to the ongoing pandemic, Rutgers University has issued a mask mandate for all in-person instruction. When you come to class, you must wear a mask. If you forget your mask, there will be masks available in the classroom. If you refuse to wear a mask, you will be asked to leave.

Masks must be worn over nose and mouth!

Consult these university guidelines on mask usage if you have any questions: https://coronavirus.rutgers.edu/health-and-safety/community-safety-practices/

How **NOT** to Wear a Mask

"The Escape Hatch"

"The Earring"

"The Sniffer"

"The Stache"

"The Nose Plug"

"The Neckbeard"

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/

Readings

Altmann, G. T. (1998). *The ascent of Babel: An exploration of language, mind, and understanding*. OUP.

Bahlmann, J., Schubotz, R. I., & Friederici, A. D. (2008). Hierarchical artificial grammar processing engages Broca's area. *NeuroImage*, *42*(2), 525–534. https://doi.org/10.1016/j.neuroimage.2008.04.249

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

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.

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

Kutas, M., & Federmeier, K. D. (2011). Thirty years and counting: Finding meaning in the N400 component of the event related brain potential (ERP). *Annual Review of Psychology*, *62*, 621–647. https://doi.org/10.1146/annurev.psych.093008.131123.Thirty

Matchin, W., & Hickok, G. (2020). The Cortical Organization of Syntax. *Cerebral Cortex*, *30*(3), 1481–1498. https://doi.org/10.1093/cercor/bhz180

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.

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.