Music & Cognitive Neuroscience

Fall 2024

Schedule	Date	Tuesday
	Time	12:10 pm – 2:00 pm EST
	Location	Schermerhorn 405
Instructor	Name	John Thorp
	Email	jnt2136@columbia.edu
	Office Hours	By appointment https://calendly.com/jnt2136/30min

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Course description

This seminar will provide a broad survey of how principles of cognition are represented in music and the ways music has been used to study those principles in the psychology and neuroscience literature.

Detailed description

Music is an incredibly powerful and elusive force in our lives. Seemingly every aspect of human cognition is called upon to its highest degree to perform and listen to music. We'll be specifically covering: prediction; visual inference; motor learning; episodic memory; emotion; and social coordination. Each class will consist of a student presentation on an empirical paper examining each topic outside of the context of music, followed by a student presentation on an empirical paper examining that topic within the context of music. This should provide a relatively holistic overview of the approaches and topics of cognitive neuroscience broadly, while also allowing us to fully consider the myriad components of the human experience stored within and exemplified through music.

Teaching philosophy

The central philosophy of my approach to teaching is to treat each of you as an active, embodied agent. My classroom is interested in deliverables in so far as they offer insight into your learning process and create opportunities for reflection and critical thinking. I believe the role of higher education is not exclusively to prepare you all for the current job market, but to prepare you to create and adapt to jobs that don't yet exist. As such, I have built an approach focused on the critical problem-solving necessary for an informed citizenry. Through these means, I encourage us to collectively resist the industrialization of the classroom that has gripped education within the past century. If any of these ideas are exciting to you, I encourage you to come to office hours for some readings.

Communicating with me

For all concerns, email me, your instructor, with subject line

<center>3461: <Subject></center>

It's almost always helpful to put a **bolded, direct, answerable question** somewhere in the email.

Learning objectives

The overall learning objectives for this class are

- **Critically engaging with primary literature**
    - It is the responsibility of us all as scientists to assess the validity and contribution of empirical results. The only way to develop this ability is to regularly engage with and discuss scientific articles.

- **Communicating primary literature to peers**
    - Communication of scientific results is a crucial component of their dissemination. Here, we'll practice critically reading articles, summarizing the authors' main points, and providing points of concern, confusion, and future inquiry.

- **Proposing novel experiments within the field**
    - Participating in science also requires we synthesize questions and ideas into our own novel contributions.

Course Components

The course can be separated into 4 interdependent components:
- Preparation and application of material (as assessed by Canvas Posts)
- Citizenry in the course (as assessed by Class Participation)
- Deep engagement with and communication of primary articles (as assessed by the Class Presentations)
- Creative development of novel primary research (as assessed by Experiment Proposal)

Assessment	Canvas Posts	Class Participation	Class Presentations	Experiment Proposal
Percentage of Final Grade	25%	25%	25%	25%

Canvas Posts

Every student will be responsible for posting a discussion post on Canvas before class. These are intended to motivate you to come to class with questions in mind so we all might more readily engage with the material. This discussion post should be 1-2

paragraphs. Each response will be graded out of 5 points: 2 points for posting **the night before class**, and one point for each unique contribution that can be brought to class. These discussion points can be (but are not limited to):

- questions of application and generalizability of the findings
- questions about the rationale behind the design, proposing alternative designs
- future points of inquiry and suggestions for follow-up
- comments on particularly interesting or surprising results
- questions about the analysis you were confused by
- anything you would feel comfortable bringing up during discussion of the papers that week.

Again, 3 points are necessary to achieve full credit on the post. Brief feedback will be given on posts at the beginning of the semester.

Class Participation

You are expected to contribute to the discussion in class every week. The Canvas Posts are intended to lower the threshold of contribution, as you all will be walking in with at least one point or question to contribute for each paper. The presenters for that week will not have access to your discussion points, so it's critical you raise your hand to bring them up! If you anticipate this being a challenging category for you, initiate a conversation with me as early in the semester as possible. I am committed to this course being a safe environment for us all to challenge each other in the beautiful and always imperfect project of engaging with nature through science.

Excused absences are permitted. As we have so few classes, however, any absence requires a conversation between you and I to ensure you'll be able to stay on top of the material throughout the course. More than one absence will inspire a conversation of whether this is the right time for you to take full advantage of this course.

Class Presentations

Students will present on two separate occasions in class. One will concern a paper outside of the musical literature, and another will concern a paper within the musical literature. This is to spread your own workload throughout the semester while exposing you to a variety of primary literatures. Papers will be chosen on the first day of class.

A great format to follow for your slides and presentation is the QuALMRI, covered on the first day of class and in the handout on Canvas. Presentations and discussions

should be around 45 minutes in length. This might seem daunting but remember that much of this time ought to be discussion with your peers.

Presenters are required to meet with me (preferably during my office hours but feel free to schedule another time with me) **at least by the Friday before presenting** to go over the topic. For this meeting, presenters should bring the slides and discussion questions you've prepared for class. I will use this meeting to give you literature that will assist your introduction of the topic to the class, answer any questions regarding the methods used, as well as refine your existing discussion questions.

All presentations are graded out of 60 points, 10 points for each element of the Qualmri:

- **Question**: What specific question is being asked in this paper? For papers outside of the music literature, the presentation should begin with ~10 minutes introducing the topic studied and why it matters. For papers within the music literature, spend your introduction discussing how that topic or construct is encoded in music, how it differs from what's been studied outside of music, and why it matters to study it in music. You can glean this from the introduction of the assigned paper, and it will almost certainly help to read a review paper cited in that introduction as well as any paper cited multiple times or explicitly summarized.
- **Alternative Hypotheses:** What hypotheses are being presented? Are there multiple ways the experiment ought to be able to play out? Multiple theories being assessed?
- **Logic:** A crucial step in engaging with the primary literature is assessing the logic with which the psychological constructs are linked to experimental variables. Carefully go through what each element of the experiment or study is supposed to represent, exemplify, or activate. This is a great time to build in discussion questions as to how successful this logic is and to what contexts we expect the results to be able to generalize.
- **Method:** Time for the nitty gritty. In most communication contexts this gets quickly summarized or even skipped. Not today. We're all here to closely engage with how experiments are actually conducted. This should almost always begin with an overview of the phases of the experiment and then walk through the very concrete information of how each of those phases was conducted. We want to know timing and number of stimuli, number of participants, etc. It's only after knowing what they actually did that we can assess their results.

- **Results:** Each figure should be walked through carefully. But also ensure that critical information not presented in the figures is represented in the presentation somehow (these will often be successful or failed controls or other supplementary results necessary for critically assessing the article). Try to prepare at least one point of discussion for each figure.
- **Inference**: Points of discussion covering: what have we learned? What would we feel comfortable telling people about the human experience? What studies are we inspired to run next? How is this connected to other material we've covered, or you've seen covered in other classes? Are there notable weaknesses or strengths of the study?

Experiment Proposal

The final piece of this course is to propose an experiment directly or indirectly inspired by the material we've covered in class. The abstract of this proposal (300 words summarizing the QuALMRI of your study) is due **10/21 by 5pm**. The abstract is worth 6 points, 1 point per factor of the QuALMRI (rubric on canvas).

The final paper is due a week following the final class. Proposals should be 8-10 pages in length, double-spaced, 12-point Arial font, with 1-inch margins. It should be written in Professional APA format in the future tense, with at least one figure representing the hypothesized results. The proposal is worth 60 points total, split evenly for each factor of the Qualmri (rubric on canvas).

Everyone will also give a short 5-minute presentation on the last day of class on their proposed experiment that should also follow the QuALMRI format, worth 6 points total. The total 72 points will be worth 25% of the final grade.

Course policies

Grades

Grades will be rounded only to the nearest 0.1%, and assigned letter grades as follows:

A+: 97-100%	B+: 87-89.9%	C+: 77-79.9%	D: 60-69.9%
A: 93-96.9%	B: 83-86.9%	C: 73-76.9%	F: 0-59.9%
A-: 90-92.9%	B-: 80-82.9%	C-: 70-72.9%	

Late work

Canvas Posts that are turned in late will be docked 50%. This is to ensure you're coming to class prepared to contribute.

For the Experiment Proposal, you will need to email me at least **24 hours before it is due** to be granted an extension. Otherwise, it will be docked 10% per day.

Religious holidays

If you will be participating in any religious holidays you know will stop you from being able to attend class, **please reach out to me in the first week of the course** so we can come up with a plan to keep you on schedule. The only other requirement is to choose Class Presentation dates that will not conflict with your expected absences in class.

Health

Many of us have periods in which our mental and/or physical health suffer. As we accumulate more and more responsibilities and relationships in this life, it can often be too easy to feel like every one of them is supposed to be our first priority. Never forget that you alone are your first priority. Please prioritize your mental health and wellbeing and know that there are many resources available to you both within our classroom community and throughout the university:

https://health.columbia.edu/content/counseling-and-psychological-services

http://blogs.cuit.columbia.edu/nightline/

https://universitylife.columbia.edu/student-resources-directory#health

Being healthy and energized is necessary for learning. This course, like any course, can only be helpful to you so long as that necessity is met. I am always open to learning more about how to best tailor the class to that necessity while keeping the progression of the course in mind.

Fostering an inclusive classroom

I strongly aim to foster a learning environment that is supportive of each of your perspectives and set of experiences. In this way, I hope to broaden everyone's understanding of others and their positionality in relation to them. Please reach out to

me with any concerns or suggestions you may have to better address your learning needs and to improve the effectiveness and inclusivity of this course. Building trust and mutual respect is a project we are excited to work together with you on.

Students who may require accommodations should contact me before or during the first week of class. You should also contact the Office of Disability Services (ODS) in Lerner Hall before the start of the course to register for these accommodations. The procedures for registering with ODS can be found at https://health.columbia.edu/content/disability-services or by calling (212) 854-2388.

Academic integrity

As we are all members of an academic community, it is up to each of us to uphold the academic integrity necessary for our collective development. You can find detailed definitions and examples of this integrity in Columbia University's Guide to Academic Integrity. In short, violations of academic integrity are treated incredibly seriously by both myself and the University.

This specter has donned a new mask recently with the rise of large language models (ChatGPT, Bard, etc.). As these models are still moving targets, it's worth clarifying that **passing off LLM responses as your own is a violation of academic integrity.**

This course is meant to challenge you so as to contribute to your personal growth. If this challenge becomes overwhelming to the point that you feel tempted to pass off others' work as your own, please reach out to me. We're committed to reconciling your personal growth with the progression and content of this course.

Date	Topic	Non-music reading	Music reading
09/03	Introduction	QuALMRI handout on courseworks	–
09/10	Predictive Processing: Harmony	Hahne, A., & Friederici, A. D. (1999). Electrophysiological evidence for two steps in syntactic analysis. Early automatic and late controlled processes. Journal of Cognitive Neuroscience, 11(2), 194–205.	Koelsch, S., Gunter, T., Friederici, A. D., & Schröger, E. (2000). Brain indices of music processing: "nonmusicians" are musical. Journal of Cognitive Neuroscience, 12(3), 520–541.
09/17	Predictive Processing: Rhythm	Sherman, B. E., DuBrow, S., Winawer, J., & Davachi, L. (2023). Mnemonic Content and Hippocampal Patterns Shape Judgments of Time. Psychological Science, 34(2), 221–237.	Vuust, P., Ostergaard, L., Pallesen, K. J., Bailey, C., & Roepstorff, A. (2009). Predictive coding of music--brain responses to rhythmic incongruity. Cortex; a Journal Devoted to the Study of the Nervous System and Behavior, 45(1), 80–92.
09/24	Motor Learning	King, B. R., Dolfen, N., Gann, M. A., Renard, Z., Swinnen, S. P., & Albouy, G. (2019). Schema and motor-memory consolidation. Psychological Science, 30(7), 963–978.	Palmer, C., & Meyer, R. K. (2000). Conceptual and motor learning in music performance. Psychological Science, 11(1), 63–68.
10/01	Visual inference	Cohen, L., Dehaene, S., Naccache, L., Lehéricy, S., Dehaene-Lambertz, G., Hénaff, M. A., & Michel, F. (2000). The visual word form area: spatial and temporal characterization of an initial stage of reading in normal subjects and posterior split-brain patients. Brain: A Journal of Neurology, 123 (Pt 2), 291–307.	Mongelli, V., Dehaene, S., Vinckier, F., Peretz, I., Bartolomeo, P., & Cohen, L. (2017). Music and words in the visual cortex: The impact of musical expertise. Cortex; a Journal Devoted to the Study of the Nervous System and Behavior, 86, 260–274.

10/08	Emotion	Wilson-Mendenhall, C. D., Barrett, L. F., & Barsalou, L. W. (2013). Neural evidence that human emotions share core affective properties. Psychological Science, 24(6), 947–956.	Kragel, P. A., & LaBar, K. S. (2015). Multivariate neural biomarkers of emotional states are categorically distinct. Social Cognitive and Affective Neuroscience, 10(11), 1437–1448.
10/15	Event Perception	Baldassano, C., Chen, J., Zadbood, A., Pillow, J. W., Hasson, U., & Norman, K. A. (2017). Discovering Event Structure in Continuous Narrative Perception and Memory. Neuron, 95(3), 709–721.e5.	Williams, J. A., Margulis, E. H., Nastase, S. A., Chen, J., Hasson, U., Norman, K. A., & Baldassano, C. (2022). High-order areas and auditory cortex both represent the High-Level event structure of music. Journal of Cognitive Neuroscience, 34(4), 699–714.
10/22	Event Segmentation	Heusser, A. C., Ezzyat, Y., Shiff, I., & Davachi, L. (2018). Perceptual boundaries cause mnemonic trade-offs between local boundary processing and across-trial associative binding. Journal of Experimental Psychology. Learning, Memory, and Cognition, 44(7), 1075–1090.	McClay, M., Sachs, M. E., & Clewett, D. (2023). Dynamic emotional states shape the episodic structure of memory. Nature Communications, 14(1), 6533.
10/29	Episodic reactivation	Schechtman, E., Heilberg, J., & Paller, K. A. (2023). Memory consolidation during sleep involves context reinstatement in humans. Cell Reports, 42(4), 112331.	Kubit, B. M., & Janata, P. (2022). Spontaneous mental replay of music improves memory for incidentally associated event knowledge. Journal of Experimental Psychology. General, 151(1), 1–24.
11/12	Neural Synchrony	Davidesco, I., Laurent, E., Valk, H., West, T., Milne, C., Poeppel, D., & Dikker, S. (2023). The temporal dynamics of brain-to-brain synchrony between students and teachers	Hou, Y., Song, B., Hu, Y., Pan, Y., & Hu, Y. (2020). The averaged inter-brain coherence between the audience and a violinist predicts the popularity of

		predict learning outcomes. Psychological Science, 34(5), 633–643.	violin performance. NeuroImage, 211(116655), 116655.
11/19	Creativity	Beaty, R. E., Benedek, M., Wilkins, R. W., Jauk, E., Fink, A., Silvia, P. J., Hodges, D. A., Koschutnig, K., & Neubauer, A. C. (2014). Creativity and the default network: A functional connectivity analysis of the creative brain at rest. Neuropsychologia, 64, 92–98.	Vergara, V. M., Norgaard, M., Miller, R., Beaty, R. E., Dhakal, K., Dhamala, M., & Calhoun, V. D. (2021). Functional network connectivity during Jazz improvisation. Scientific Reports, 11(1), 19036.
11/26	Curiosity	Hsiung, A., Poh, J.-H., Huettel, S. A., & Adcock, R. A. (2023). Curiosity evolves as information unfolds. Proceedings of the National Academy of Sciences of the United States of America, 120(43), e2301974120.	Cheung, V. K. M., Harrison, P. M. C., Meyer, L., Pearce, M. T., Haynes, J.-D., & Koelsch, S. (2019). Uncertainty and surprise jointly predict musical pleasure and amygdala, hippocampus, and auditory cortex activity. Current Biology: CB, 29(23), 4084-4092.e4.
12/03	Final Presentations	-	-