Seminar in Cognitive Neuroscience: Brain Development

PSYC 3233-401 / NRSC4233-402
Fall 2023, Thursdays 1:45-4:45pm
Classroom: David Rittenhouse Laboratory 3N6

Instructor: Mike Arcaro (marcaro@sas.upenn.edu)
Office: Goddard 422
Office hours: by appointment

Course description: This discussion-based seminar will focus on the neural bases of sensory and cognitive development. Each week the class will discuss a selection of papers that consider the roles of intrinsic and environmental factors on topics including the development of perceptual abilities, language, and cognition. The course will cover several aspects of pre- and postnatal brain and behavioral development with particular emphasis on primates. This course is intended for students interested in neurobiology, cognitive psychology, and development. Prerequisites: Cognitive Neuroscience (PSYC 1230-401); Recommended: Introduction to Brain and Behavior (PSYC 1210-402).

Course materials: All readings will be posted on Canvas.
Background lectures: Nancy Kanwisher - Neuroanatomy

Course Canvas Web Page: Announcements, class recordings, additional readings, and other important course information will be posted routinely on Canvas. Please monitor this website regularly.

---------- Course overview ----------

Typical weekly in-class sessions

- There will be synchronous sessions Thursdays 1:45-4:45pm. Each week, 4 students will lead discussion of weekly readings. Each student will present one article. Each presentation + class discussion should last 35-40 mins.

Typical weekly out-of-class activities and workload

- Read 3 scientific articles per week (each student chooses 3 of 4 options from reading list).
- Each week, students will prepare one thoughtful discussion question for each assigned reading. Discussion questions must be posted on Canvas "Discussions" by **11:59PM Tuesday**
- Additional prep for students assigned to lead weekly discussion. (~3-5 hours).

○ A (hopefully) useful guide for reading a science paper is posted on Canvas under Files/course materials/Roediger-gallo-2004.pdf. Direct link.

---------- Assignments and grading ----------

Grades:

20% Weekly participation
20% Leading class discussion on weekly reading assignment
30% Poster presentations (15% each)
30% Final paper (15%) & presentation (15%)

Weekly Participation (20% total: 10% discussion questions & 10% in-class participation): This is a small group learning experience, and to get the full benefits you must attend class. You will learn the most, and have the most fun, if you are an active participant! That means sharing your thoughts on readings, commenting in class on other student's posted responses to readings, and listening and reflecting on your classmates' comments and concerns.

Four scientific articles are assigned for each week. Students are required to select and read 3 of the 4 articles, submit one follow-up question / comment for each of the readings, and participate in the weekly in-class discussion.

○ (10% of final grade) Students are expected to engage in class discussion each week. Participation each week is worth 1 point. There are 12 opportunities for in-class participation. Leading class discussion (see next section) will count towards participation. Students can miss two weeks and still achieve full credit.

○ (10% of final grade) Most weeks (see schedule below) students will submit one question or comment for each of the selected 3 readings **by 11:59PM ET Tuesday**. **Late questions will not be accepted.** Questions must be posted to Canvas' "Discussions" section. Each week has its own discussion thread. These questions will be used to facilitate in-class discussion. Students who are assigned to lead class discussion (see next section) will be excused from submitting questions on other articles assigned that week.

○ Questions will be evaluated based on quality of the question.

○ What makes a good question/comment? A good comment will engage with specific content and provide content to facilitate discussion. Example formats of good questions/comments: "I do not understand why this study uses X type of stimuli – I think this would lead to Y confound." "I wonder whether X process might relate to Y process that we studied last week, because I see Z similarity." "I am concerned that this result would not generalize to X situation because Y." "I wish the study had included X condition, because that would allow us to know Y." "I am having trouble thinking through whether X is a good example of Y phenomenon/concept because Z."

○ Bad questions/comments: "I did not understand this experiment." "I liked the writing in the paper." "This paper had many confounds."

Leading class discussions on weekly reading assignment (20% total, 10% each presentation): Each week, 4 students will be assigned to present one of the readings. Across the semester, each student will lead class discussion on 2 papers. Presenters should prepare a PowerPoint, Keynote, or comparable presentation of the assigned paper. For empirical papers, presenters should prepare a synopsis of the motivation for the study, the authors' hypothesis, experimental design, results, and interpretation of results / discussion of main findings. For theory, perspective, and review papers, presenters should prepare a synopsis of the motivation for the paper, the authors' hypothesis, discuss evidence cited in the paper supporting the main argument, and its relevance to the field. Presentation of the assigned article should last 25 minutes. After discussing the article, presenters should also prepare 1-2 slides containing several reflections about the article to facilitate in-class discussion. These can include but shouldn't be limited to questions submitted by classmates. Presenters should prepare 3 points on their own. Presenters can select a subset of the questions submitted by classmates but should be thorough enough to facilitate 10-15 minutes of discussion. Article presentation and discussion should last 35-40 minutes in total.

Poster presentations (30% total, 15% each poster presentation): Students will choose a paper related to one of the prior week's topics and present as a scientific poster (not a multi-slide presentation). Students will assume the role of the paper's authors and make a poster as if they were presenting the results at a scientific conference. The poster should contain a brief introduction outlining the motivation for the study and hypothesis, a methods section detailing the experimental design, a results section (should be largest part of poster), and a conclusion highlighting the main findings and importance. Poster presentations should be limited to 5 minutes and plan for 3-4 minutes of post discussion. Part of the challenge of this assignment is to be able to digest the complexity of a scientific study and distill it down to a coherent, brief presentation as one would give at a scientific conference. Papers can be selected from the "Poster Presentation Articles" folders on Canvas (under files for each week) or from a lit search (e.g. Google Scholar or PubMed). There will be two poster presentations: **Oct. 5th & Nov. 2nd**. To ensure no overlap between posters, students must post to the Canvas Discussion thread (or e-mail the instructor) for approval one week prior to the presentation (**Sept. 28th & Oct. 26th**). Here are some examples of poster presentations: 1, 2 that illustrate the typical content and format of a scientific poster.

Final paper (30% total, 15% for paper and 15% for in-class presentation): Single-spaced, 3–5-page critique of major topic on brain development covered during the course. Please use standard, 11 or 12-point font. Students are encouraged to include figures if useful. Figures should not count towards total page count. Students will also give a ~5 min slide presentation during the final class and plan for 3-4 minutes of post discussion. Topic chosen by student. Students must e-mail instructor by **November 5** with topic proposal. Students will lose 1 point on the assignment for each day late on submitting the topic proposal and 5 points per day late on submitting the final paper.

Attendance: Since this is a discussion-based course, showing up to class weekly is **mandatory**. Students must e-mail the instructor if unable to attend due to illness or other reasons. Students are excused for missing one class. Any additional missed classes will require a 2000-word summary of the week's readings due one week after the missed class. Missing more than 3 classes in the absence of a major health / personal event will result in automatic failure. Please be mindful of this policy as you arrange your fall schedule.

Numeric to letter grade conversion:

A+	>=97
A	>=93, < 97
A-	>=90, <93
B+	>=87, <90
B	>=83, <87
B-	>=80, <83
C+	>=77, <80
C	>=73, <77
C-	>=70, <73
D+	>=67, <70
D	>=63, <67
D-	>=60, <63
F	< 60

---------- Schedule ----------

Week #	Date	Weekly readings & class discussion	Assignment due
1	August 31	Syllabus & course intro	N/A
2	September 7	Nature & Nurture: Stiles 2009, Johnston & Edwards. 2002. Greenough et al. 1987. Gottlieb. 1998.	Discussion questions
3	September 14	Protomap & Protocortex: Rakic 1988, O'Leary 1989, Sur et al. 1988, Katz & Schatz 1996.	Discussion questions
4	September 21	Plasticity & Reorganization: Pons et al. 1991. Hubel et al. 1976. Blakemore et al. 1970, Constantine-Patton & Law 1978	Discussion questions
5	September 28	Evolution & Expansion: Garcia et al. 2018, Krubitzer & Seelke 2012, Chaplin et al. 2013, Dehaene & Cohen 2007.	Discussion questions
6	October 5	**1st Poster presentation**	
	October 9	**Drop period ends.** Students will have grades from 1 poster presentation and class participation. Additionally, about 2/3 of the class will have completed one paper presentation.	
7	October 12	**Fall Term Break**	
8	October 19	Dynamic development: Kiorpes 2016, Fausey 2016, Bourne & Rosa 2006, Smith & Thelen 2003.	Discussion questions
9	October 26	Functional specialization: Polk et al. 2007, Sugita 2008, Dobs et al. 2022, Srihasam et al. 2014.	Discussion questions
	October 27	**Grade type change deadline.** Students will have grades from 1 poster presentation, at least one paper presentation, and class participation.	
10	November 2	**2nd Poster presentation**	
	November 5	**Due date for submitting final paper topic**	
	November 6	**Withdrawal deadline.** Students will have grades from both poster presentations, at least one paper presentation, and class participation.	

11	November 9	"Core" systems: Kinzler & Spelke 2007, D'Souza & Karmiloff-Smith. 2011, Johnson 2001, Siegler 2007	Discussion questions
12	November 16	Guest lecture: Allyson Mackey & TBD	Discussion questions on papers by speakers
13	November 21	Language development. Kim et al. 1997, Saffran et al. 1996, Riling et al. 2014, Iverson 2010.	Discussion questions
	November 23	**No class**	
14	November 30	Executive function. Baum et al. 2017, Blair 2016, Selemon 2013, Scherf et al. 2006	Discussion questions
15	December 7	**Final week paper presentations**	

---------- Reading assignments ----------

Reading assignments are posted to Canvas under Files. Each week students must select 3 of 4 articles to read and submit discussion questions / comments.

Week 2. Nature and Nurture

Stiles. **On Genes, Brain, and Behavior: Why should developmental psychologists care about brain development?** 2009. Child Development Perspectives

Johnston & Edwards. **Genes, Interactions, and the Development of Behavior.** 2002. Psychological Review.

Greenough et al. **Experience and Brain Development.** 1987. Child Development.

Gottlieb. **Normally occurring environmental and behavioral influences on gene activity: from central dogma to probabilistic epigenesis.** 1998. Psychological Review.

Additional resources:
Joan Stiles – Brain Development
John Gabrieli – Child Development
Nancy Kanwisher – Development, Nature & Nurture, Adult Plasticity

Week 3. Protomap & Protocortex

Rakic. **Specification of Cerebral Cortical** Areas. 1988. Science

O'Leary. **Do cortical areas emerge from a protocortex?** 1989. TINS.

Sur et al. **Experimentally induced visual projections into auditory thalamus and cortex.** 1988. Science.

Katz & Schatz. **Synaptic Activity and the construction of cortical circuits**. 1996. Science

Additional resources:
Arnold Kriegstein – New concepts of human brain development
Christopher Walsh – Genes, Cognition, and Human Brain Evolution

Week 4. Plasticity & reorganization

Constantine-Paton & Law. **Eye-specific termination bands in tecta of three-eyed frogs.** 1978. Science.

Pons et al. **Massive cortical reorganization after sensory deafferentation in adult macaques.** 1991. Science.

Hubel et al. **Functional architecture of area 17 in normal and monocularly deprived macaque monkeys.** 1976. Cold Spring Harbor Symposium.

Blakemore et al. **Development of the brain depends on the visual environment.** 1970. Nature.

Additional resources:
Torsten Wiesel – The postnatal development of visual cortex

Week 5. Evolution & expansion

Garcia et al. **Dynamic patterns of cortical expansion during folding of the preterm human brain.** 2018. PNAS.

Krubitzer & Seelke. **Cortical evolution in mammals: The bane and the beauty of phenotypic variability.** 2012. PNAS.

Chaplin et al. **A conserved pattern of differential expansion of cortical areas in simian primates.** 2013. J Neuroscience.

Dehaene & Cohen. **Cultural recycling of cortical maps.** 2007. Neuron.

Additional resources:
Leah Krubitzer – Cortical plasticity within and across lifetimes

Week 8. Dynamic Development

Kiorpes. **The puzzle of visual development: behavior and neural limits.** 2016. J Neuroscience.

Fausey et al. **From faces to hands: changing visual input in the first two years**. 2016. Cognition.

Bourne & Rosa. **Hierarchical development of the primate visual cortex, as revealed by neurofilament immunoreactivity: early maturation of the middle temporal area (MT)**. 2006. Cerebral Cortex.

Smith & Thelen. **Development as a dynamic system**. 2003. Trends in Cognitive Sciences.

Additional resources:
Linda Smith – Cognition, Communication, and Learning

Week 9. Functional specialization

Polk et al. **Nature versus nurture in ventral visual cortex: a functional magnetic resonance imaging study of twins.** 2007. J Neuroscience.

Sugita. **Face perception in monkeys reared with no exposure to faces.** 2008. PNAS.

Srihasam et al. **Novel domain formation reveals proto-architecture in inferotemporal cortex**. 2014. Nature Neuroscience

Dobs et al. **Brain-like functional specialization emerges spontaneously in deep neural networks**. 2022. Science Advances

Additional resources:
Nancy Kanwisher – Human Cognitive Neuroscience

Week 11. "Core" systems

Kinzler & Spelke. **Core systems in human cognition.** 2007. Progress in Brain Research.

D'Souza & Karmiloff-Smith. **When modularization fails to occur: A developmental perspective.** 2011. Cognitive Neuropsychology.

Johnson MH. **Functional brain development in humans.** 2001. Nature Reviews.

Siegler. **Cognitive variability**. 2007. Developmental Science

Additional resources:

Liz Spelke – Cognition in Infancy, Part 2

Week 13. Language development

Kim et al. **Distinct cortical areas associated with native and second languages.** 1997. Nature.

Saffran et al. **Statistical learning in 8-month-old infants.** 1996. Science.

Riling et al. **The evolution of the arcuate fasciculus revealed with comparative DTI**. 2014. Nature Neuroscience.

Iverson. **Developing language in a developing body: the relationship between motor development and language development.** 2010. J Child Language

Additional resources:

Stanislas Dehaene – Reading the Brain

Week 14. Executive function

Baum et al. **Modular segregation of structural brain networks supports the development of executive function in youth**. 2017. Current Biology.

Blair. **Executive function and early childhood education**. 2016. Behavioral Sciences.

Selemon. **A role for synaptic plasticity in the adolescent development of executive function.** 2013. Translational Psychiatry

Scherf et al. **Brain basis of developmental change in visuospatial working memory**. 2006. J Cog Neuro

Additional resources:

Beatriz Luna – Adolescent Neurocognitive Specialization

---------- Other information and resources ----------

Students unable to attend class due to COVID positivity: Please notify instructor ASAP and we will try to run a zoom in the background to record class discussions.

Mask policy: Masks currently are not required in this course. However, if you have cold symptoms, you are strongly encouraged to wear a mask – the classroom is small! This policy is subject to change over the course of the semester depending on the prevalence of COVID. If you have concerns, please reach out to discuss!

Support, resources, and practical tools for wellness at Penn: https://www.wellnessatpenn.com/

Accommodations for students with disabilities:
The University of Pennsylvania provides reasonable accommodations to students with disabilities who have self-identified and received approval from the Office of Student Disabilities Services (SDS). If SDS has approved your request for accommodations, please get in touch with me as soon as possible in order to discuss the arrangements for your accommodations.

If you have not yet contacted Student Disabilities Services, and would like to request accommodations or have questions, you can make an appointment by calling (215) 573-9235. Please visit the SDS website at https://wlrc.vpul.upenn.edu/sds/

SDS services are free and confidential.

Code of Academic Integrity:
Since the University is an academic community, its fundamental purpose is the pursuit of knowledge. Essential to the success of this educational mission is a commitment to the principles of academic integrity. Every member of the University community is responsible for upholding the highest standards of honesty at all times. Students, as members of the community, are also responsible for adhering to the principles and spirit of the following Code of Academic Integrity. Please note that Penn has strict rules on academic integrity (see www.upenn.edu/academicintegrity). Violations of the rules will be reported to the Office of Student Conduct and will likely result in automatic failure of the course.

Academic Dishonesty Definitions - activities that have the effect or intention of interfering with education, pursuit of knowledge, or fair evaluation of a student's performance are prohibited. Examples of such activities include but are not limited to the following definitions:

- Cheating: using or attempting to use unauthorized assistance, material, or study aids in examinations or other academic work or preventing, or attempting to prevent, another from using authorized assistance, material, or study aids. Example: using a cheat sheet in a quiz or exam, altering a graded exam and resubmitting it for a better grade, etc.

- Plagiarism: using the ideas, data, or language of another without specific or proper acknowledgment. Example: copying another person's paper, article, or computer work and submitting it for an assignment, cloning someone else's ideas without attribution,

failing to use quotation marks where appropriate, etc.

• Fabrication: submitting contrived or altered information in any academic exercise. Example: making up data for an experiment, fudging data, citing nonexistent articles, contriving sources, etc.

• Multiple submission: submitting, without prior permission, any work submitted to fulfill another academic requirement.

• Misrepresentation of academic records: misrepresenting or tampering with or attempting to tamper with any portion of a student's transcripts or academic record, either before or after coming to the University of Pennsylvania. Example: forging a change of grade slip, tampering with computer records, falsifying academic information on one's resume, etc.

• Facilitating academic dishonesty: knowingly helping or attempting to help another violate any provision of the Code. Example: working together on a take-home exam, etc.

• Unfair advantage: attempting to gain unauthorized advantage over fellow students in an academic exercise. Example: gaining or providing unauthorized access to examination materials, obstructing or interfering with another student's efforts in an academic exercise, lying about a need for an extension for an exam or paper, continuing to write even when time is up during an exam, destroying or keeping library materials for one's own use, etc.

If a student is unsure whether their action(s) constitute a violation of the Code of Academic Integrity, then it is that student's responsibility to consult with the instructor to clarify any ambiguities.