PSYC GU4222 – The Cognitive Neuroscience of Aging
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I. Bulletin description

PSYC GU4222. The Cognitive Neuroscience of Aging (seminar). 4 pts. Mondays: 10.10 AM-12.00 PM. Room 200C SCH. Prerequisites: Courses in introductory psychology, cognitive psychology, and instructor permission.

This course is a comprehensive overview of conceptual and methodological approaches to studying the cognitive neuroscience of aging. The course emphasizes the importance of combining information from cognitive experimental designs, epidemiologic studies, neuroimaging, and clinical neuropsychological approaches to understand individual differences in both healthy and pathological aging.

II. A full description of the content of the course

Each individual class will begin with background information provided by one of the primary instructors, or a guest lecturer, followed by discussion. The overall progression of class throughout the term is as follows.

Introduction to the course (Drs. Eich and Gazes)
This lecture will give an overview of the course schedule; discuss different approaches to the study of cognitive aging with a broad listing of the most noticeable behavioral changes in cognitive aging. Furthermore, organizational details will be discussed as well as grading and plagiarism policies.

Cognitive Aging (Dr. Eich)
Deficits in cognitive functioning are considered to be one of the most debilitating aspects of aging. Although many cognitive functions decline with age, there are pockets of preserved, and even improved cognitive function. The session will discuss how stereotypes about age-related memory loss impact memory in older adults, how different learning schedules (massed versus distributed learning) affects memory in older adults, and how and when older adults correct errors.

Neuropsychological testing (Dr. Cosentino)
This class will cover the ways in which cognitive testing in a clinical setting can be used to dissociate AD from normal aging and other dementias, and to make inferences about the distribution of neuropathology in individual patients.

Imaging the aging brain (Dr. Gazes)
This session addresses specific considerations when performing an imaging study in an aged population including age-related physiological alterations in the functional imaging signal such as alterations in neurovascular coupling and decreases in grey matter. Aging also alters the networks of brain regions involved in performance of a task resulting in either increased or decreased brain activity in older adults compared with younger participants. Different imaging modalities will be introduced to present a multimodal approach towards aging research.

Cognitive Reserve, the brain's ability to cope with pathology (Dr. Stern)
This session serves as an overview of many of the remaining topics. This discussion will review the epidemiologic evidence for the concept of cognitive reserve as well as functional imaging studies that explore the neural basis of cognitive reserve. There will be emphasis on imaging modalities, the selection of cognitive activation tasks, and image analysis.

Integrity versus Despair: The psychiatry of cognitive aging (Dr. Huey)

Summary of the most common dementias including Alzheimer's disease, Vascular dementia, Lewy Body dementia, Frontotemporal dementia, Normal Pressure Hydrocephalus, and Prion diseases. Topics include the frequencies and risk factors of the various syndromes, symptomatology, clinical signs, diagnostic work-up, underlying neuropathological alterations and genetic abnormalities, treatment, clinical course and prognosis. Students will gain an overview of the field, including features distinguishing dementias from healthy aging and from each other as well.

Imaging of Dementia (Dr. Oh)
We will discuss behavioral and neural changes in cognitively normal elderly with Alzheimer's disease (AD) pathology ("preclinical AD"). Pathological markers will be reviewed from postmortem brain tissues, cerebral spinal fluid, and positron emission tomography (PET) measures collected in living human individuals. Behavioral/experimental and structural/functional magnetic resonance imaging (MRI) studies will be introduced to help students to understand cognitive and neural changes observed in preclinical AD. Significance and implications of these studies will be discussed.

Imaging biomarkers (Dr. Habeck)
Imaging-based biomarkers of aging and dementia will be presented starting with a brief and easy-to-understand methodological introduction about Receiver Operator Curve statistics and cross-validation. Further, the possible conceptual and methodological differences of deriving biomarkers versus understanding disease mechanisms will be covered. After this preparation, some real-world examples from our neuroimaging practice will be shown and discussed.

Cognitive interventions (Dr. Mackay-Brandt)
This session will discuss interventional approaches to maximize cognitive health in older adulthood. We will review the basic methodology for interventional studies and interpret evidence for the efficacy of cognitive training and exercise interventions.

Cardiovascular fitness and neurocognitive function (Dr. Colcombe)
In this session, we will discuss the current state of research regarding the impact of cardiovascular fitness on neurocognitive function and brain structure in older adults, as well as their putative biological bases. The lecture will cover findings from both human and nonhuman models, largely emphasizing findings from MRI methodologies. We will discuss the implications of these findings, as well as potential future directions for investigation in both cardiovascular fitness and potential alternative plasticity manipulations.

Gait and Cognition (Dr. Blumen)
We will examine the relationship between gait, cognition, dementia and gait disorders. She will talk about the behavioral and neural correlates of simple (walking) and complex (walking while talking) gait performance in aging. She will also discuss the potential for using motor imagery – or imagined gait – to examine the neural correlates of simple and complex gait performance, and as a therapeutic tool for improving gait and cognition in aging.

Aging, Culture, and Cognition (Dr. Manly)
This lecture will be dedicated to describing the value of cross-cultural research in understanding issues of measurement, validity, universals of cognitive processes, and cognitive flexibility. Research on cognitive aging across cultural groups must contend with the fact that assessment of cognitive function is susceptible to culturally-dependent definitions and are quantified by measures that are sensitive to cultural and educational background. Students will gain an appreciation for how to consider cultural and educational factors when assessing cognitive function among older adults.

Epidemiology of Alzheimer's Disease (Dr. Gu)
This session will expose students to the fundamentals of goals, design, and analysis of epidemiological research in aging, focusing on observational studies. Understanding the epidemiologic approach is critical for cognitive aging research because these studies strive to understand how biological factors and social conditions affect the onset or course of cognitive outcomes. Older adults have accumulated the effects of a lifetime of exposure, and studies must be designed in a way that exposures of interest can be measured in a valid manner, critical periods of influence can be identified, and cognitive outcomes can be measured cross-sectionally and longitudinally. Causal inference in epidemiological studies of cognitive aging will be discussed.

Methodological overview (Dr. Habeck)

The course will conclude with a didactic lecture to review elementary concepts of statistical inference that are needed in age-related comparisons frequently found in brain-imaging, epidemiological, psychological, and medical research dealing with aging. Linear regression, confounders, type-I and type-II error and bias-variance trade-off will be explained simple non-technical language. The common problem of "double dipping", i.e. false-positive inflation through incorrect statistical inference, will be discussed too.

III. The rationale for giving the course

This course provides a comprehensive overview of conceptual and methodological approaches to studying the cognitive neuroscience of aging and is intended to introduce students to the relevance and challenges of studying the aging brain. The primary instructors as well as guest lecturers will come from the interdisciplinary faculty of the Cognitive Neuroscience Division in the Sergievksy Center at Columbia University Medical Center. The course emphasizes the importance of combining information from cognitive experimental designs, epidemiologic studies, neuroimaging, and clinical neuropsychological approaches to understand individual differences in both healthy and pathological aging.

This advanced seminar is best suited to students who have completed two or more lecture courses beyond W1001, such as W1010 (Mind, Brain, and Behavior), W2210 (Cognition: Basic Processes), W2215 (Cognition and the Brain), W2220 (Cognition: Memory and Stress), or W2480 (Developing Brain). It will complement seminar offerings in cognitive neuroscience, and provide an important developmental component to students' training.

PSYC GU4222 is an advanced seminar, designed particularly for graduate students, for advanced undergraduates who are majoring in Psychology or in Neuroscience and Behavior, and for students participating in the Postbac Psychology Program. These students will have priority in registration, followed by junior majors followed by non-majors.

It fulfills the following degree requirements:
• For Psychology Graduate Students, PSYC GU4222 will apply toward the "two seriously graded seminars" requirement of the Master's degree.
• For the Psychology major or concentration in the College and in G. S., for the Psychology minor in Engineering, and for the Psychology Postbac, GU4222 meets the Group I (Perception and Cognition) distribution requirement.
• For the Neuroscience and Behavior joint major, GU4222 will fulfill the 5th Psychology requirement: "one advanced psychology seminar from a list approved by the Psychology Department advisor to the program."
• For non-majors in the College and GS, GU4222 will count as one term of the natural science requirement, provided that students obtain the necessary permission and have taken the prerequisite psychology courses. Students who are majoring in Psychology or in Neuroscience and Behavior will have priority over students who are taking the course for the science requirement, and we anticipate the course will rarely be used for the latter.
• For the Psychology Postbac certificate, PSYC GU4222 will fulfill the advanced seminar requirement.
• For the Barnard Psychology major, PSYC GU4222 will fulfill the senior seminar requirement.

IV. The reading list and weekly syllabus
Each class session will be roughly organized as**:**
- 15 minute recap
- 45 - 60 minute invited presentation
- 15 - 30 minute student presentation
- Discussion of the presentation and student questions

Readings are available as PDFs on https://courseworks.columbia.edu and are posted at least two weeks prior to the corresponding lecture date.

Session Topic and Speaker (subject to revision):
9/12   Introduction (Eich & Gazes)
9/19   Cognitive aging (Eich)
9/26   Neuropsychological evaluations (Cosentino)
10/3   Imaging of aging (Gazes)
10/10   Cognitive Reserve (Stern)
10/17   Pathological Aging (Huey); **1 page topic proposal for final paper due.**
10/24   Imaging of dementia (Oh)
10/31   Imaging biomarker (Habeck)
11/7   Cognitive intervention (Mackay-Brandt)

11/14   Exercise as intervention (Colcombe)
11/21   Gait and cognition (Blumen)
11/28   Cultural diversity and aging (Manly)
12/5   Epidemiological study of aging (Gu)
12/12   Statistical inference (Habeck); **Final paper due**.

V. Course requirements and grading

Discussion leadership

On the first day of class, students will sign up for 2 class meeting during which he/she will make a presentation. Students should prepare a presentation as well as thought-provoking questions addressed to the class. The presentation should be comprehensive, but be open enough in format to allow for ongoing discussion. In advance, students will meet to discuss the topic and format of the presentation with the lecturer affiliated with the class for which they signed up. Typically, the student will present an article related to the topic; however, the format and content is somewhat open and should be coordinated with the primary lecturer for the chosen class.

Questions generated by the readings

Each student is required to read assigned papers before class in order to ensure lively discussion in class. Each student will also be responsible for composing one substantive question relevant to each of the readings and posting their questions on Courseworks each week **by Saturday 5PM**. Students are not allowed to replicate already posted questions. Discussion leaders should incorporate these questions into their presentation, but are not required to post questions the week they are presenting. Evaluation of the quality and quantity of participation will be included in final grade.

Research paper

This should take the form of a critical review paper. The topic can be of your choosing; however we strongly recommend that you do your paper on the topic that you will be presenting in class. Although you can discuss your paper with one of the instructors anytime during the semester, it is required that you **submit your paper idea Oct. 17**. and meet with an instructor once, at least one month prior to the due date, for discussion. Your paper should be based not only on the assigned readings, but also on any suggested readings and a set of additional readings to be agreed upon during this meeting. Important criteria for grading will be evidence that you are not simply outlining or regurgitating the readings, but are attempting to synthesize them, organize them around a theoretical perspective, point out areas of controversy and most importantly, suggest a novel perspective or avenue for future research. 15 pages maximum. Any pages exceeding 15 will be disregarded. Even if the class presentation of your chosen topic is toward the end of the semester, you should begin research on your topic fairly early in the semester so that you can develop and reflect on your ideas throughout the class. The paper is **due on the last day of class, 12/12**.

Class Participation

Active participation in class discussion is essential to gaining a full understanding of the course materials. Absences from class will cause you to lose up to 10% total from the final course grade. This will encourage you to come to class.

Bonus Points. After each class, there will be a short quiz posted on courseworks, asking a question that will be easy to answer if you were in class. These quizzes will be worth ¼ of a percent each, enabling you to raise you grade by a maximum of 3.5% (e.g, if your final grade in the class is an 87%, and you have correctly answered all 14 of the quizzes, your grade will be bumped to a 90.5%). These quizzes are designed to encourage you to be active and pay attention in class. Sharing of the answers with fellow classmates is not permitted. The quiz will be open until 5PM on Tuesday each week (leaving you more than 24 hours to respond).

Grading will be determined as follows:

10%	Class Participation
20%	Content and Timeliness of Posted Discussion Questions
35%	Presentation / Discussion leadership
35%	Paper