Cognitive Neuroscience of Attention
PSYC 768: Advanced Topics in Cognitive Science

Last updated 1/6/2017

Instructor: **Matt Peterson**
2058 David King Hall
Ph: 993-4255
Email: mpeters2 at gmu dot edu
Office Hours: Wed. 11-11:50

Time: 1:30 – 4:10pm Thursdays

Classroom: David King ArchLab Conference Room (2073a)

Recommended Text: none

Prerequisites: Psychology 530, 701, graduate standing in HFAC or CBN, or consent of instructor.

Objectives: In this course we will be exploring cognitive neuroscience of attention. Topics will include:

- Neurophysiology and computation in early vision (retina through V4)
- The effects of attention on higher-level vision
- Orienting/switching
- Attention and eye movements
- Cross-modal attention
- Working Memory
- Cognitive Control & Conflict Resolution
- Development and Aging
- Brain Training and Stimulation
- Disorders of Attention
- Brain Stimulation

This course will be taught in a combined lecture and seminar format -- the classes will be largely discussion, with two (or more students) leading a discussion of one of the papers each week. At times, I will lead the discussion or lecture on background topics (e.g. explaining steady-state visual evoked potentials, fMRI, or neuroanatomy). I expect everyone (especially the discussion leaders!) to read the assigned articles before class.

Official Communications via GMU E-mail: Mason uses electronic mail to provide official information to students. Examples include communications from course instructors, notices form the library, notices about academic standing, financial aid information, class materials, assignments, questions, and instructor feedback. Students are responsible for the content of university communication sent to their mason e-mail account, and are required to activate that account and check it regularly. I will communicate only through GMU email accounts.

Attendance Policy: Although I do not grade on attendance, this is a graduate level course and I expect (barring unforeseen circumstances) to see you in class each week. Having said that, I do understand

that there are occasionally situations that take precedent over this class (conference presentations, job interviews, illness).

Cancellation Policy: This course follows GMU cancellation policy for inclement weather, and GMU will send an alert to your GMU email account and/or cell phone if any of their facilities are closing for inclement weather. If *I* need to cancel a class meeting, I will email the class about the cancellation.

GMU Honor Code: George Mason University has a code of Honor that each of you accept by enrolling as a student. My expectation is that all of the work you do for me in this class will be the work of one individual. Having said that, I fully encourage you to discuss the readings and topics raised in this class with your fellow students.

Disabilities: If you are a student with a disability and you need academic accommodations, please see me and contact the Disability Resource Center (DRC) at 703-993-2474. All academic accommodations must be arranged through that office."

A+	97+			
A	93-96	**Grading**	Anatomy Quiz	5
A-	90-92		Discussion Lead (x2)	30
B+	87-89		Participation	20
B	83-86		Final Paper or Presentation	25
B-	80-82		Summaries (2)	20
C	70-79			100 points total
F	0-69			

Discussion Lead and Commentary (30%): 30% of the grade will be based on preparing, leading, presenting, and participating in class discussions. Most classes will follow a format in which the instructor will present information and conduct activities to demonstrate principles and techniques. The remainder of the class will consist of discussing the reading materials, providing feedback on the applicability and value of the techniques and concepts presented in the readings, and developing ideas that can be applied to eye movement research. All students are expected to read the assigned materials before class, and participate in the class discussion. If you miss the class, or fail to read the assigned materials, your class discussion grade will be adjusted accordingly.

To facilitate class discussion, non-presenting students will be responsible for posting on Blackboard, at least 24 hours prior to the date and time of the assigned discussion, a question or comment about the assignment that would be an interesting point for discussion. The presenters, of course, do not have to address each of the questions or comments, but the information from non-presenters can form the basis for some of the discussion of each article.

Discussion leaders will prepare presentations to organize the class discussion and ensure that enough time is allotted for each topic. Presentations should cover the following: *summary* of the material, *research questions* under investigation, experimental *techniques* used, specific *variables* investigated, *measurements* used, the *analysis approach* to find meaning in the measurements,

findings reported, *applicability* of the techniques to the research problem, *additional research questions* that can be investigated, and specific points and questions for class discussion.

Each student will need to lead **2** discussion during the semester.

Participation (20%): Part of the class time will be spent having lively discussions about the papers covered in class. If you do not participate, it *will* affect your grade.

Summaries (20%): Students are required to write a 2-page summary of a week's readings. Two summaries will be due – it is your choice of which weeks you wish to summarize.

Project Presentation/Parper (25%): Your grade for this class will be based in part on either a paper in which you will either *write* a literature review or *present* a propose a(n) experiment(s) investigating the cognitive neuroscience of attention to the class.

To ensure that all group members contribute equally to the project, each member will submit a confidential evaluation of each team member's contribution. If there is a clear trend that an individual did not contribute equally, then the portion of the group grade for that individual will be adjusted accordingly.

Calendar:

Note: The schedule below is tentative, and though I will try to follow it as closely as possible changes may occasionally be necessary.

Note that January 30th is the last day to add this class and February 24th is the last day to drop.

Date	Topic	Assignment Due
26-Jan	Introduction	
2-Feb	In the beginning	Anatomy Quiz
9-Feb	Early Visual Attention	
16-Feb	Higher-level Visual Attention	
23-Feb	Orienting, Switching, & Eye movements	
2-Mar	Multimodal Attention	
9-Mar	Working Memory	
16-Mar	SPRING BREAK	Relax!
23-Mar	Multitasking and Cognitive Control	
30-Mar	Cognitive Control and Conflict	
6-Apr	Attention across the lifespan	
13-Apr	ADHD and Attention Disorders	
20-Apr	Training and brain stimulation	
27-Apr	Presentation	
4-May	Presentation	Paper Due
11-May	Presentation	

Week	Readings	Overview
26-Jan	***Extra readings (too high level for the beginning)***	
	• Petersen, S. E., & Posner, M. I. (2012). The attention system of the human brain: 20 years after. Annual review of neuroscience, 35, 73.	
	• Russel Barkley on ADHD • http://www.greatschools.org/pdfs/2200_7-barktran.pdf?date=4-12-05	
2-Feb	***In the beginning...***	Effects of attention
	• Chun, M. M., Golomb, J. D., & Turk-Browne, N. B. (2011). A taxonomy of external and internal attention. *Annual review of psychology*, *62*, 73-101.	
	• Kane, M. J., & Engle, R. W. (2002). The role of prefrontal cortex in working-memory capacity, executive attention, and general fluid intelligence: An individual differences perspective. *Psychonomic Bulletin & Review*, 9, 637-671.	
9-Feb	***Early Vision***	Effects of attention
	• Fischer, J., & Whitney, D. (2009). Attention narrows position tuning of population responses in V1. Current biology, 19(16), 1356-1361.	
	• Motter, B. (1993). Focal attention produces spatially selective processing in visual cortical areas V1, V2, and V4 in the presence of competing stimuli. *Journal of Neurophysiology*. 70, 909-919.	
	• Keitel, C., Andersen, S. K., Quigley, C., & Müller, M. M. (2013). Independent effects of attentional gain control and competitive interactions on visual stimulus processing. Cerebral Cortex, 23(4), 940-946.	
16-Feb	***Higher Vision***	Effects of attention
	• Davidesco, I., Harel, M., Ramot, M., Kramer, U., Kipervasser, S., Andelman, F., ... & Malach, R. (2013). Spatial and object-based attention modulates broadband high-frequency responses across the human visual cortical hierarchy. The Journal of Neuroscience, 33(3), 1228-1240.	
	• Baldauf, D., & Desimone, R. (2014). Neural mechanisms of object-based attention. Science, 344(6182), 424-427.	
23-Feb	***Orienting / switching / Eye movements***	Effects of attention
	• Swisher, J. D., Halko, M. A., Merabet, L. B., McMains, S. A., & Somers, D. C. (2007). Visual topography of human intraparietal sulcus. The Journal of neuroscience, 27(20), 5326-5337.	
	• Morawetz, C., Holz, P., Baudewig, J., Treue, S., & Dechent, P. (2007). Split of attentional resources in human visual cortex. *Visual neuroscience*, 24(06), 817-826.	
	• Golomb, J. D., Marino, A. C., Chun, M. M., & Mazer, J. A. (2011). Attention doesn't slide: spatiotopic updating after eye movements instantiates a new, discrete attentional locus. Attention, Perception, & Psychophysics, 73(1), 7-14.	
2-Mar	***Multimodal***	Representation system

	• Yang, Z., & Mayer, A. R. (2014). An event-related FMRI study of exogenous orienting across vision and audition. Human brain mapping, 35(3), 964-974.	
	• Langner, R., Kellermann, T., Eickhoff, S. B., Boers, F., Chatterjee, A., Willmes, K., & Sturm, W. (2012). Staying responsive to the world: Modality-specific and-nonspecific contributions to speeded auditory, tactile, and visual stimulus detection. Human brain mapping, 33(2), 398-418.	
9-Mar	***Working Memory***	Representation system
	• Gazzaley, A., & Nobre, A. C. (2012). Top-down modulation: bridging selective attention and working memory. *Trends in cognitive sciences*, 16(2), 129-135.	
	• Sprague, Thomas C., Edward F. Ester, and John T. Serences. "Restoring Latent Visual Working Memory Representations in Human Cortex." Neuron 91, no. 3 (2016): 694-707.	
	• (**Maybe**) Chun, M. M. (2011). Visual working memory as visual attention sustained internally over time. *Neuropsychologia*, 49(6), 1407-1409.	
23-Mar	***Multitasking and Cognitive Control***	Control of Attention
	• Garner, K. G., & Dux, P. E. (2015). Training conquers multitasking costs by dividing task representations in the frontoparietal-subcortical system. Proceedings of the National Academy of Sciences, 112(46), 14372-14377.	
	• Kim, C., Cilles, S. E., Johnson, N. F., & Gold, B. T. (2012). Domain general and domain preferential brain regions associated with different types of task switching: A Meta-Analysis. Human brain mapping, 33(1), 130-142.	
	• **(maybe)** Spreng, R. N., Sepulcre, J., Turner, G. R., Stevens, W. D., & Schacter, D. L. (2013). Intrinsic architecture underlying the relations among the default, dorsal attention, and frontoparietal control networks of the human brain. Journal of cognitive neuroscience, 25(1), 74-86.	
30-Mar	***Cognitive control and Conflict Resolution***	Control of Attention
	• Shenhav, A., Botvinick, M. M., & Cohen, J. D. (2013). The expected value of control: an integrative theory of anterior cingulate cortex function. *Neuron*, 79(2), 217-240.	
	• Yeung, N. (2013). Conflict monitoring and cognitive control. *Oxford Handbook of Cognitive Neuroscience*, 2, 275-299.	
6-Apr	***Attention across the lifespan***	Attentional Changes
	• Rubia, K. (2013). Functional brain imaging across development. European child & adolescent psychiatry, 22(12), 719-731.	
	• Turner, G. R., & Spreng, R. N. (2012). Executive functions and neurocognitive aging: dissociable patterns of brain activity. Neurobiology of aging, 33(4), 826-e1.	
	• Greenwood, P. M., Espeseth, T., Lin, M. K., Reinvang, I., & Parasuraman, R. (2014). Longitudinal change in working memory as a function of APOE genotype in midlife and old age. *Scandinavian journal of psychology*, 55(3), 268-277.	

13-Apr	***Attention disorders***	Attentional Changes
	• Shaw, P., Malek, M., Watson, B., Greenstein, D., de Rossi, P., & Sharp, W. (2013). Trajectories of cerebral cortical development in childhood and adolescence and adult attention-deficit/hyperactivity disorder. Biological psychiatry, 74(8), 599-606.	
	• Fair, D. A., Nigg, J. T., Iyer, S., Bathula, D., Mills, K. L., Dosenbach, N. U., ... & Buitelaar, J. K. (2012). Distinct neural signatures detected for ADHD subtypes after controlling for micro-movements in resting state functional connectivity MRI data.	
	• Mueller, S., Keeser, D., Samson, A. C., Kirsch, V., Blautzik, J., Grothe, M., ... & Hennig-Fast, K. (2013). Convergent findings of altered functional and structural brain connectivity in individuals with high functioning autism: a multimodal MRI study. PLoS One, 8(6), e67329.	
20-Apr	***Brain Training and Stimulation***	Attentional Changes
	• Anguera, J. A., Boccanfuso, J., Rintoul, J. L., Al-Hashimi, O., Faraji, F., Janowich, J., ... & Gazzaley, A. (2013). Video game training enhances cognitive control in older adults. *Nature*, 501(7465), 97-101.	
	• Schweizer, S., Grahn, J., Hampshire, A., Mobbs, D., & Dalgleish, T. (2013). Training the emotional brain: improving affective control through emotional working memory training. The Journal of Neuroscience, 33(12), 5301-5311.	
	• Coffman, B. A., Trumbo, M. C., & Clark, V. P. (2012). Enhancement of object detection with transcranial direct current stimulation is associated with increased attention. BMC neuroscience, 13(1), 1.	