Psych 4360 /6260 - Visuospatial Memory and Goal Directed Action

Date	Tentative Topics	Suggested Readings / Presentations
Jan 8	**Course Introduction**	Crawford et al. **Annual Review of neuroscienc 2011.**
	PART 1: Basic Concepts	Crawford et al. **Geometric Foundations pp.310-313.**
Jan 15	**Reference frames, coordinate systems, kinematics of translation and rotation.**	Soechting JF, Flanders M. **Annu Rev Neurosci. 1992;15:167-91.**
Jan 22	**Coordination, eye-head shoulder geometry, 2-D vs. 3-D control, Donders' laws for gaze and reach.**	Tweed D, Vilis T. **J Neurophysiol. 1987 Oct;58(4):832-49.** Geometric computations underlying eye-hand coordination: orientations of the two eyes and the head. Henriques DY, Medendorp WP, Gielen CC, Crawford JD. **Exp Brain Res. 2003 Sep;152(1):70-8.** Neural control of three-dimensional eye and head movements. Crawford JD, Martinez-Trujillo JC, Klier EM. **Curr Opin Neurobiol. 2003 Dec;13(6):655-62. Review.**
Jan 29	**Cortical organization for gaze vs. reach.**	Human parietal cortex in action. Culham JC, Valyear KF. **Curr Opin Neurobiol. 2006 Apr;16(2):205-12. Epub 2006 Mar 24. Review.** Imaging the premotor areas. Picard N, Strick PL. **Curr Opin Neurobiol. 2001 Dec;11(6):663-72. Review.** Anatomical organization of the eye fields in the human and non-human primate frontal cortex. Amiez C, Petrides M. **Prog Neurobiol. 2009 Oct;89(2):220-30. Epub 2009 Aug 7. Review.**

		VESIA M, & CRAWFORD JD (2012) Specialization of Reach function in Human Posterior Parietal Cortex. **Experimental Brain Research 221(1):1-18.**
	PART 2: Encoding and Updating Visual Goals	Crawford et al. **"Spatial Coding and Updating of the Goal" pp.313-319**
Feb 5	**A: Coding visual direction (egocentric, allocentric, extrapolation)**	Human parietal "reach region" primarily encodes intrinsic visual direction, not extrinsic movement direction, in a visual motor dissociation task. Fernandez-Ruiz J, Goltz HC, DeSouza JF, Vilis T, Crawford JD. **Cereb Cortex. 2007 Oct;17(10):2283-92. Epub 2007 Jan 10.**
		BYRNE P. & CRAWFORD JD (2010) Cue reliability and a landmark stability heuristic determine relative weighting between egocentric and allocentric visual information in memory-guided reach. **Journal of Neurophysiology 103(6): 3054-3069.**
		Combination of neuronal signals representing object-centered location and saccade direction in macaque supplementary eye field. Moorman DE, Olson CR. **J Neurophysiol. 2007 May;97(5):3554-66. Epub 2007 Feb 28.**
Feb 12	**Updating visual direction: behaviour and neural mechanism.**	Gaze-centered remapping of remembered visual space in an open-loop pointing task. Henriques DY, Klier EM, Smith MA, Lowy D, Crawford JD. **J Neurosci. 1998 Feb18(4):1583-94.**
		Gaze-centered updating of visual space in human parietal cortex. Medendorp WP, Goltz HC, Vilis T, Crawford JD. **J Neurosci. 2003 Jul16;23(15):6209-14.**
		The updating of the representation of visual space in parietal cortex by intended eye movements. Duhamel JR, Colby CL, Goldberg ME.

		Science. 1992 Jan 3;255(5040):90-2.
Feb 19	Reading Week	
Feb 26	**Encoding and updating in 3-D**	Updating target distance across eye movements in depth. Van Pelt S, Medendorp WP. **J Neurophysiol. 2008 May;99(5):2281-90. Epub 2008 Mar 19.**
		Motion parallax is computed in the updating of human spatial memory. Medendorp WP, Tweed DB, Crawford JD. **J Neurosci. 2003 Sep 3;23(22):8135-42.**
		Postsaccadic activities in the posterior parietal cortex of primates are influenced by both eye movement vectors and eye position. Genovesio A, Brunamonti E, Giusti MA, Ferraina S. **J Neurosci. 2007 Mar 21;27(12):3268-73.**
	PART 3: Feedforward Transformations	Crawford et al. " **Transformation of the goal into a Movement Command" pp. 319-323**
Mar 5	**Caculating the desired movement vector from goal and gaze/hand position.** **Calculations of the Movement Vector**	Flexible strategies for sensory integration during motor planning. Sober SJ, Sabes PN. **Nat Neurosci. 2005 Apr;8(4):490-7. Epub 2005 Mar 27.**
		Direct visuomotor transformations for reaching. Buneo CA, Jarvis MR, Batista AP, Andersen RA. **Nature. 2002 Apr 11;416(6881):632-6.**
Mar 12	**Reference Frame transformations: Behaviour**	Human oculomotor system accounts for 3-D eye orientation in the visual-motor transformation for saccades. Klier EM, Crawford JD. **J Neurophysiol. 1998 Nov;80(5):2274-94.**
		Computations for geometrically accurate visually guided reaching in 3-D space. Blohm G, Crawford JD. **J Vis. 2007 May 4;7(5):4.1-22**.

Mar 19	**Reference Frame transformations: neural mechanisms**	The superior colliculus encodes gaze commands in retinal coordinates. Klier EM, Wang H, Crawford JD. **Nat Neurosci. 2001 Jun;4(6):627-32.** DeSouza et al. 2011 Intrinsic reference frames of superior colliculus visuomotor receptive fields during head-unrestrained gaze shifts. **J.Neuroscience 2011 Dec 14;31(50)18313-26** Decoding the cortical transformations for visually guided reaching in 3D space. Blohm G, Keith GP, Crawford JD. **Cereb Cortex. 2009 Jun;19(6):1372-93. Epub 2008 Oct 8.**
Mar 26	**2-D to 3-D transformations**	Three Dimensional Eye-Head Coordination is Implemented Downstream From the Superior Colliculus Eliana M. Klier, Hongying Wang, and J. Douglas Crawford **J Neurophysiol 89: 2839-2853, 2003; 10.1152/jn.00763. 2002.** Neural Control of Three-Dimensional Gaze Shifts J. Douglas Crawford and Eliana M. Klier **Everling et al. Eds., Oxford Handbook on Eye Movements**
	Review	
April 2	Review Session (and any make-up presentations as required)	

Most classes will consist of an introduction by the professor, followed by informal, interactive powerpoint presentations on the assigned papers, led by a student.

EVALUATION

Undergraduate student evaluation:
10% for participation in the class discussion about the selected articles.
30% for formal seminar presentations topical to the lecture at two different times.
10% for essay proposal with annotated bibliography, due six weeks before last class
50% for final essay, due **April 4. 1% will be deducted for each day late.**
Students will be responsible for giving an oral presentation on a topical article pertinent to the lecture of the day. They will do this twice so that they will have the opporunity to learn from their first presentation. The essay will be 3000-4000 words (not including references). It will describe a real-life situation (like catching a baseball, for example) in scientific terms, incorporating

something from each lecture section. The purpose of this essay is not only to test the students knowledge, but more importantly to help them synthesize and apply this knowledge to real-world situations in a useful and memorable way. Undergraduates will be required to cite 15 papers and these may be review articles and/or papers covered in class. They will need to be able to coherently demonstrate that they understood the main concepts and where they apply. Undergraduates will receive formal feedback about their essay proposal.

Graduate Student evaluation:
20% for presentating articles and participation in the class discussion about the selected articles.
20% for formal seminar presentations topical to the lecture at two different times.
60% for final essay, due **April 4. 1% will be deducted for each day late.**
In the final essay (5000-6000 words), graduate students will be required to properly cite at least 30 journal articles. At least 20 of these must be original research papers (not reviews), including at least 10 papers that were not covered in the class. Graduate students will be required to show a greater depth of original synthesis and application of the concepts to a real life situation. Graduate students will require approval of their essay topic, but will not have to submit a formal proposal.