

Cognitive Neuroscience

Course number: 22173 – Trimester: 2nd

Brief description:

This course will cover basic concepts and key findings about the neural basis of human behavior, with an emphasis on human perception and cognition. Methodological issues will also be addressed, in particular brain imaging techniques such as fMRI, EEG and MEG.

Time and Place:

Lectures: Wednesdays 10:30am- 12:30pm
Seminars: Thursdays 10:30am- 12:30pm

Instructor:

Prof. Nava Rubin Nava.Rubin@upf.edu

Lectures:

There will be ten 2-hour lectures, each addressing a different topic in cognitive neuroscience, providing an overview of the basic issues and central findings. A list of the topics and main issues to be covered in each lecture is given overleaf. For most lectures (1-5 and 7-10), the material will be based on the textbook listed below, but note that the lectures will not follow the book 1-to-1 (ie, additional material may be included, and some material from the book may be omitted.) Lecture 6 is not based on the textbook but rather on a set of journal articles. The slides presented in class will be made available online after each lecture.

Seminars:

There will be eight 2-hour meetings conducted in the format of a "journal club", where we will discuss journal articles reporting studies that pertain to the topic covered in the lectures. To facilitate class discussions, all students are required to read the assigned articles before each seminar meeting. In addition, for each article 1-2 students will be assigned as "Discussants" (well in advance of the relevant seminar date). Discussants will be expected to explain to the class the main findings of the article, and discuss any comments they may have about it, as well as open questions. All discussants will have the option to meet with the Instructor (Prof. Rubin) before the seminar date, in case they have any questions or need clarifications about their assigned article.

Textbook:

"The Student's Guide to Cognitive Neuroscience" by Jamie Ward, Psychology Press, 2nd edition, 2010. (Available for 41€ on Amazon:
<http://www.amazon.es/The-Students-Guide-Cognitive-Neuroscience/dp/1848720033>

Assignments and Evaluation:

Participation: 50% [inc. lectures, seminars *and* pop-quiz(s), if applicable; see below]
Final Exam: 50%

Note: "participation" means more than "attendance"; it means students are expected to be *engaged* during class, ask questions when they need clarification or want to know more about certain material presented in class, and be ready to answer questions posed by the instructor and/or by other students. To insure good levels of participation, a brief pop-quiz *may* be given occasionally, to test whether students understood the lectures and read the articles in advance of seminars; the questions will be straightforward, ie they should be easy for those who paid attention during lectures and invested 1-2 hours in the readings before each seminar.

(Schedule and Readings overleaf --->)

Schedule by Week: Topics and Readings List

Week #	Class date	Seminar date	Room	Topic	Reading book chap	Readings: article(s)
1	2014-01-08		52.429	Intro: concepts and some history	1-2	
			n/a			
2	2014-01-15		52.429	Methods: electrophys, func brain imaging	3-4	
		2014-01-16	52.105	" (jclub)		Dale and Buckner 1997, Menon et al. 1998
3	2014-01-22		52.113	Organic and virtual brain lesions	5	
		2014-01-23	52.221	" (jclub)		Farah 1992, Pascual-Leone & Walsh 2001
4	2014-01-29		52.429	Vision: Object Recognition	6	
		2014-01-30	52.105	" (jclub)		Haxby et al, Tong et al 1998
5	2014-02-05		52.113	Motor Control & Action Understanding	8	
		2014-02-06	52.105	" (jclub)		Blakemore et al 1998, Kilner et al. 2009
6	2014-02-12		52.105	Recurrency, Feedback and.. C---	n/a	Lamme 2004, Pascual-Leone and Walsh 2001
		2014-02-13	52.105	" (jclub)		Boyer et al. 2005, Fahrenfort et al 2007
7	2014-02-19		52.113	Plasticity & recovery from lesions	16*	
		2014-02-20	52.105	" (jclub)		Bavelier et al. 2001, Amedi et al. 2003
8	2014-02-26		52.105	Memory	9	
		2014-02-27	52.105	n/a		
9		2014-03-05	52.211	Memory (Jclub)		Wagner et al 1998, Brewer et al 1998
	2014-03-06		52.105	Language & Audition	10-11	
10	2014-03-12		52.429	Executive function	14	
		2014-03-13		" (jclub)		Fornito et al. 2004, Owen et al. 2006
11	2014-03-19			Evaluation Period: Review (optional)		
		2014-03-20				
12	2014-03-26			Evaluation Period: Final Exam		
		2014-03-27				

Lectures: summary of material to be covered in each topic

Topic 1: Basic concepts and some history

- The mind and brain problem
- Brief history of neuroscience in the pre-modern era
- Late-19th century: Broca, Wernicke and the discovery of "functional specialization"
- Mid-20th century: the computer metaphor and the brain as an information processing device
- Late-20th century: the rise of brain imaging
- Cognitive neuroscience in the 21st century: integrating brain imaging with network modeling to explain the neural basis of behavior
- case study: visual word recognition and the word superiority effect

Topic 2: Imaging techniques

- Electrical and metabolic markers of neural activity
- Electrophysiological techniques: single cell recordings and EEG
- PET and fMRI: using metabolic markers to measure brain activity
- Other methods in brief: MEG, Optical Imaging (magnetic and optical markers, respectively)
- Three critical axes of comparison: spatial resolution, temporal resolution and invasiveness

Topic 3: organic and virtual brain lesions

- Historical insights from neuropsychology
- Group studies vs case studies
- Single- and double dissociation
- Transcranial Magnetic Stimulation (TMS)

Topic 4: visual perception and object recognition

- Seeing as a constructive process
- The hierarchical-anatomical view of visual processing
- Retinotopic organization in early visual cortex
- Perceptual organization and mid-level vision
- modularity in visual processing
- The ventral and dorsal pathways
- computational models of vision

Topic 5: Motor control and action understanding

- Action versus movement
- Action is computationally challenging
- A hierarchical view of action
- The neural basis of action: from frontal to posterior and back again
- Action understanding and mirror neurons

Topic 6: Recurrency, feedback and awareness

- The feed-forward view of neural processing: vision as a case study
- Feedback in cortical connectivity
- Two different hypotheses for the role of of cortical feedback in neural computation
- Feedback and visual awareness: a possible link?

Topic 7: Neural plasticity and recovery from brain damage

- Some history: William James and Ramon y Cajal on plasticity
- Neural correlates of behavioral plasticity: brain imaging studies
- case study: functional recovery from hemispherectomy
- occipital cortex function in the congenitally blind

Topic 8: Memory

- Memory taxonomy by type in content
- long-term memory and the medial temporal lobes
- Anterograde amnesia: patient HM
- Declarative versus implicit memory
- Consolidation and reconsolidation
- Working memory and the frontal lobes

Topic 9: Language

- Speech comprehension and speech production
- The nature of the acoustic signal
- The computational challenges of speech perception

- "What" and "how": two brain routes in speech perception
- Brain lateralization in language processing

Topic 10: Executive function

- Automatic versus controlled behavior
- Situations requiring executive control
- The role of prefrontal cortex: neuropsychology
- Brain imaging studies: functional specialization within PFC