Universitat de Barcelona

**Facultat de Psicologia Departament de Psicologia Bàsica**

P. de la Vall d'Hebron 171
08035 Barcelona
Tel. +34 93 312 51 60
Fax. +34 93 402 13 63

# Perception, Action and Consciousness

## Master in Behaviour and Cognition

Joan López-Moliner, j.lopezmoliner@ub.edu

## OBJECTIVES

The main objective of the course is to provide students with solid knowledge on the principles of motor action control and the basic relations between perceptual and motor processes. By the end of the course students are expected to understand the underlying mechanisms that elicit basic sensorio-motor behavior and the neural substrates subserving sensorio-motor transformations. In this course students will learn an integrated approach to Perception and Action grounded on the framework of statistical decision theory. This framework allows to characterize models and mechanisms that account for the ability of humans to perceive and make decision coping with uncertainty.

## METHODOLOGY

Lectures will be combined with solving assigned problems in the statistical decision theory in interleaved practical sessions or hours. What is critical is to understand the basic concepts correctly. In order to achieve this, students will experience some of the motor and perceptual phenomena (e.g. adaptation). Students are encourage to bring a laptop to optimise learning in practical sessions. At the end, students will make short presentation of relevant papers.

## MANDATORY TEXTS

Ernst, M. O. and Bu lthoff, H. H. (2004). Merging the senses into a robust percept. Trends in Cognitive Sciences, 8:162–169.
Maloney, L. T. and Zhang, H. (2010). Decision-theoretic models of visual perception and action. Vision Res, 50(23):2362–74.
Wolpert, D. M. (2007). Probabilistic models in human sensorimotor control. Hum Mov Sci, 26(4):511–524.
Wise, S. P. and Shadmehr, R. (2001). Encyclopedia of the human brain, volume 3, chapter Motor Control, pages 1–21. Elsevier.
Wolpert, D. M. and Flanagan, J. R. (2010). Motor learning. Curr Biol, 20(11):R467–72.

## RECOMMENDED TEXTS

Haswell, C. C., Izawa, J., R Dowell, L., H Mostofsky, S., and Shadmehr, R. (2009). Representation of internal models of action in the autistic brain. Nat Neurosci, 12(8):970–2.
Shadmehr, R., Smith, M. A., and Krakauer, J. W. (2010). Error correction, sensory prediction, and adap- tation in motor control. Annu Rev Neurosci, 33:89–108.

**PROGRAM**

1. The Statistical Decision Theory (SDT) as a Framework for Perception, Action and Decision Making. (Weeks 1 & 2)
    -Perception as an inference process: the likelihood function & priors
    -Action as a general decision function
    -Consequences of action as a gain function
2. Problem solving with (SDT): coping with uncertainty (Weeks 3 and 4)
    -Measuring sensitivity
    -Measuring response bias
3. The limits of our senses (Week 5)
    -Spatial and temporal resolution in perception and action
    -Solutions to overcome the resolution: combining senses.
4. The control of our actions (Week 6 & 7)
    -The concept of adaptation, recalibration and motor learning
    -The role of the sensory consequences of our actions in control
    -Internal models: inverse and forwards models in motor control
    -Automatic and voluntary corrections
    -Conscious access to our actions in the normal and pathological brain
5. Potential applicability of Perception and Action concepts (Week 8)
6. Paper exposition (Week 8 & 9)
7. Exam (Week 10)

**EVALUATION CRITERIA**

Grades will be assigned as follows:

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|---|---|
| Assigned exercises paper presentation | 50% |
| Exam | 50% |