

Course title: Arts and the Neurosciences: Painting and Music as Reverse Engineering the Brain.

Language of instruction: English

Professor: Fernando Giraldez, MELIS-UPF at the Parc de Recerca Biomèdica de Barcelona (PRBB)

Professor's contact and office hours: MELIS, UPF Barcelona Biomedical Research Park, PRBB, Dr. Aiguader 88, 08003, Barcelona

Email: fernando.giraldez@upf.edu

Office hours on demand

Course contact hours: 45

Recommended credit: 6 ECTS credits

Course prerequisites: None

Language requirements:

Recommended level in the European Framework B2 (or equivalent : Cambridge Certificate if the teaching language is English, DELE or 3 semesters in the case of Spanish).

Course focus and approach:

This class explores how artists behave as intuitive neuroscientists and how they have explored our brain to create sensory illusions.

Course description:

If “Beauty is in the eye of the beholder”, then what is in the eye of the beholder? Every work of art presents a perceptual challenge, and the masters of painting and music have deftly assumed the role of intuitive neuroscientists. They revealed how we perceive the world to enthrall us with their masterpieces. This course illustrates examples of artworks where artists have skillfully used their techniques to create stunning sensory illusions. Alongside an exploration of the history of painting and music, we will address some fundamental principles in the neuroscience of sensation and perception. The class may be an introduction to brain sciences and provide an engaging contact with the landscape of European culture.

Learning objectives:

By the end of the course, the student will be able to:

1. Describe the general principles of organization of the sensory systems and perception.

2. Describe the neural basis of visual perception and identify the mechanisms underlying visual illusions used in painting.
3. Describe the neural basis of hearing and identify the mechanisms underlying hearing illusions and music.
4. Apply neuroscientific knowledge to understand art perception and the rules of art.

Course workload:

Class workload: Teaching is based on discussion sessions, class exercises, demos and lectures. Students will read short articles, excerpts or book chapters (about 10-15 printed pages per week). There will be mandatory readings that will be assessed in the class through regular quizzes. MT and Final exams will require some study and skills in solving problems and questions as discussed in the sessions. Every student will do a ten-minute presentation -the “chalk-talk”, followed by a five-minute Q&A. There will be a mid-term and a final exam.

Teaching methodology:

The class will combine a set of lectures and seminars with activities based on the principles of active learning. Short lectures are intercalated with discussion sessions. Materials, class presentations, handouts, and readings will be available through *Aula Global*, the Moodle platform of the university. Demonstrations include animations and interactive materials.

Students may be invited to search information using their phones or computers, but also, they will be asked to close all electronics and write on paper during specific moments of the class. Students will be invited to contribute with their own background to discussions and works. There is a programmed visit to the *Museu Nacional d'Art de Catalunya* (MNAC).

Assessment criteria:

Grading is based on academic performance in the following assessments, on a scale from 0 to 10:

- 50%: Written tests. There will be two written tests (short questions and problems), one for the first three blocks, lessons 1-9 (Mid Term Exam, MT), and a second one for the remaining two blocks, lessons 10-15. Those students who score 7.5 or above in the MT may decide not to take these topics in the Final Test. Those who fail to reach the score of 7.5 or want to improve their mark, they can take the MT exam again at the Final Exam.

Exams will be handwritten and *partially open-book* – students will have five minutes to look at books and notes before starting to write their exam. This is aimed at focusing on analytic and synthetic skills and to avoid getting stuck on a specific term or data.

- 20%: Class participation and work in seminars. This will be assessed during the activities, seminars and discussion groups. The mere attendance to the class does not cover this part.
- 30%: Term paper presentation, “chalk-talk”

Requirements: To overcome the class, the student must participate in scheduled activities and add up to 5 points (50%) or higher among the different activities mentioned above. However, note that the mark obtained in each of the written tests must be above 5 over 10 for allowing further consideration.

BaPIS absence policy:

Attending class is mandatory and will be monitored daily by professors. Missing classes will impact on the student's final grade as follows:

Absences	Penalization
Up to two (2) absences	No penalization
Three (3) absences	1 point subtracted from final grade (on a 10-point scale)
Four (4) absences	2 points subtracted from final grade (on a 10-point scale)
Five (5) absences or more	The student receives an INCOMPLETE ("NO PRESENTADO") for the course

The BaPIS attendance policy does not make a distinction between justified and unjustified absences. All absences—whether due to common short-term illnesses or personal reasons—are counted toward the total amount and cannot be excused. Therefore, students are responsible for managing all their absences.

Only in cases of longer absences—such as hospitalization, prolonged illness, traumatic events, or other exceptional situations—will absences be considered for exceptions with appropriate documentation. The Academic Director will review these cases on an individual basis.

Students must inform the Instructor and the International Programs Office promptly via email if serious circumstances arise.

Classroom norms:

- No food or drink is permitted in class.
- Students will have a ten-minute break after one one- hour session.

Weekly schedule:

Week 1

Session 01. Introduction to the class.

Session 02 The Allegory of the Cave and the Neurosciences. The representation of the world and the sensory systems. Basic terms. The organization of sensory systems.

Week 2

Session 03. The visual world: from the retina to the brain. Why we like line drawings? Rods and cones. Retinal processing. The elusive smile of the *Mona Lisa*. Titian's *manchas* and the discovery of the *painter's brushstroke*.

Session 04. The visual brain. How do we identify objects? From neurons to ideas: feature extraction. The brain is Kantian: brain categorization, shape and objects.

Week 3

Session 05. The conquest of space. Binocular and monocular cues for spatial reconstruction. Perspective: From Fra Angelico to impressionism: looking at the history of representing 3-D.

Session 06. Colour in the brain. Colour is more than the mixture, colour is context. Colour illusions in painting. From medieval miniatures to Monet's blinking sun.

Week 4

Session 07. Visit to MNAC.

Session 08. Bring your own artwork

Week 5

Session 09. Art and neuroscience. The rules of art. Artists as intuitive neurologists. Is cubism a *neurological fiasco*?

Session 10. MT exam

Week 6

Session 11. Hearing. The biology of hearing, from hair cells to ecstasy. The mystery of pitch. The triumph of the sopranos and the Doppler effect. Looming sounds. The what and where of sounds.

Session 12. Music in the brain. The origins of musical scales. The limitations of melody and harmony. Music and language. The rules of music. What have we learnt from owls and bats?.

Week 7

Session 13. "*I don't like classical music*". The game of music. Knowing the music you listen.

Session 14 Nature and nurture (I). What is to be an artistic genius?

Week 8

Session 15 Nature and nurture (II). The false dilemma of genes and culture.

Session 16 Term paper and student's presentations, "*chalk-talks*"

Week 9

Session 17 Term paper and student's presentations, "*chalk-talks*"

Session 18. Term paper and student's presentations, "*chalk-talks*"

Week 10

Session 19 Term paper and student's presentations, "*chalk-talks*"

Session 20 General Discussion and Final Review

Week 11

Session 21 Final exam.

Last revision: March 2026

Required readings:

Mandatory class readings will be uploaded in *Aula Global* and will consist of articles and book chapters.

Recommended bibliography:

GIRALDEZ, F. (2020) Teaching Neuroscience as a Liberal Art, *Front. Educ.* 4:158
LIVINGSTONE, M. (2008) *Vision and Art: The Biology of Seeing* Abrams Press
PURVES, D. (2017) *Music as Biology: The Tones We Like and Why*. Harvard University Press
VILLIS, T (2025) <https://www.tutis.ca/Senses/index.htm>
WOLFE, J. et al. (2020) *Sensation & Perception*, Sinauer Associates Inc.