Course Title

Perception

Course Number
PSYCH-UA 9022 D01

Instruction Mode: In-Person

Fall 2022

Lecturer Contact Information
Dr. Sven Ohl (he/him/his)

Your instructor will inform you about learner hours (one-on-one meetings).

Prerequisites
PSYCH-UA 1 / Introduction to Psychology or equivalent

Units Earned
4

Course Details
Monday, 5:15pm to 8:00pm.

Location: Rooms will be posted in Albert before your first class.

In the interest of protecting the NYU Berlin community, we are closely following guidance around COVID-19 from the Robert Koch Institute (Germany’s institute for disease control and prevention), the Centers for Disease Control and Prevention (CDC), the World Health Organization, and the New York City Department of Health and Mental Hygiene and adjusting our recommendations and policies accordingly. Your health and well-being is our top priority. You are required to adhere to the most recent policies. Please note that you are expected to attend every class meeting in-person; however, this may change at any point during the semester if local COVID-19 regulations so require. You will be assigned a seat on the first day and are expected to use that seat for the entire semester due to NYU COVID-19 safety protocol.

Course Description
How do we construct a conception of physical reality based on sensory experience? In this course, we will survey basic facts, theories, biological mechanisms in the brain, and methods
in the study of sensation and perception. The major emphasis is on vision and audition, but other modalities will also be covered to some detail. Representative topics include receptor function and physiology; color; motion; depth; psychophysics of detection, discrimination and appearance; perceptual constancies; adaptation; pattern recognition, and the interaction of knowledge and perception. The discussed mechanisms of perception and the methods to explore them interface with a variety of applied fields, including the development of seeing and moving robots, the classification of image content by artificial intelligence, the engineering of immersive environments for virtual/augmented reality, or the implementation of visual phenomena in art installations or photography.

Course Learning Outcomes (CLOs)
Students analyze how minds and brains transform incoming sensory signals with the final result of a rich perception. You will learn which challenges exist for creating perception in the different sensory domains, and how to describe and apply mechanisms that overcome these challenges. By the end of the course, you will be able to contrast and evaluate major theories in perception. To do so, you will be equipped with a number of methods (e.g., psychophysics, signal detection theory) that can be applied to develop behavioral/neurophysiological experiments and to evaluate systems that aim to separate signal and noise.

Course Approach to Teaching & Learning (CATL)
My goal in teaching is to create a classroom environment in which students feel free to engage and to share their individual perception of different phenomena (e.g., using visual illusions) and discuss their implications. In order to maximize sustainable learning, I provide clear learning objectives, highlight the relevance of what is learned, provide optional learning materials/tools, and encourage evaluation of my own teaching performance (in written and anonymous form).

Assessment Components
The final grade will be composed of a weighted average, with the following weights assigned to individual assessment components:

15% Class Participation
20% Two Response Papers
30% Midterm Exam
35% Final Exam

Class Participation
Students are expected to prepare for each meeting by reading the specified material, to be present at all sessions of the course, to engage in and complete exercises and quizzes, and to actively contribute to discussions.

Response Papers
Response papers will summarize and discuss a scientific article (provided by the lecturer) on the general subject of perception. I will give you a short list of prompts from which you can choose one article ten days prior to the submission deadline, at the latest. Response papers should be 2 pages long (A4, 2 cm margin on each side, double-spaced, Times New Roman, Font Size 12). They should briefly introduce the topic, summarize the method and the findings of the research paper, give at least one interpretation of the result, and discuss a potential follow-up study. Papers must be submitted by midnight on the respective due date.
Midterm and Final Exam
The midterm exam counts 30% of your total grade. It will take place in-person on 24 Oct 2022. The final exam counts 35% of your total grade, will be assigned to you on the 8 Dec 2022 and is due on 15 Dec 2022. The final exam will be in the form of an open book exam, in which you will be asked to explain concepts, compare and contrast predictions of mechanisms, make drawings of signaling pathways, and apply different materials (e.g., scientific articles, visual illusions) in written form.

Failure to submit or fulfill any required component may result in failure of the class, regardless of grades achieved in other assignments.

Required Text(s)
Electronic Resources (via Brightspace / NYU Library Course Reserves)


Copies of the book are available at NYU Berlin's Academic Center and can be loaned to students.

Please follow this link for the [NYU Berlin Library Catalogue](#) or the link on NYU Berlin's website (Academics/Facilities & Services).

Session 1 – 05 Sep 2022: Introduction to sensation and perception
In the first session, we introduce ourselves and discuss our expectations of what we will learn in this Perception course. We review the syllabus, and clarify open questions about the course. I will then introduce why perception is such an astonishing ability of the brain, and we will identify key characteristics of perception. In a joint activity, we gather what visual information is needed for a robot to perform an everyday task like buying milk in a supermarket.

Learning outcomes:
- Familiarize yourself with the goals of studying perception and reflect on other domains where understanding perception is helpful or important.
- Explain Moravec's paradox and provide examples for it.
- Name what information has to be extracted from the visual system.
- Identify the challenges that the brain faces when processing sensory signals.
- Explain what is meant by the poverty of the stimulus.
- Describe principles the brain uses to overcome these challenges in order to produce perception.

Required reading for this session [provided online]:
- *Why your brain is not a computer*, Matthew Cobb (2020).
- *Making vaccines is straightforward; getting people to take them isn’t*, Naomi Oreskes (2021).
Session 2 – 12 Sep 2021: The physiology of perception and psychophysics
How do our senses collect signals from the environment and how are these signals transmitted in the brain? How can we quantify perception? In this session, we will examine some basic principles of brain organization that are relevant for perception and how the brain codes incoming sensory information. Moreover, we will take a look at methods for measuring thresholds and for studying perception in general that were introduced by psychophysics.

Required reading for this session: Goldstein Chapter 1 and the Appendix

**Learning outcomes:**
- Describe why we should care about physiology when studying perception.
- Reflect on the localization of brain functions.
- Name maps in the brain and what information they convey.
- Get to know the most relevant methods of neuroscience.
- Distinguish between absolute and difference thresholds.
- Describe the psychophysical laws by Weber, Fechner and Stevens.

Session 3 – 19 Sep 2021: Light and the optics of the eye
In this session, we will refresh our knowledge about the physics of light — the stimulus of visual perception. What are the advantages of having a sense for light? We will look closely at the anatomy of different eye types and how the optics of the eye form an image.

Required reading for this session: Goldstein Chapter 2

**Learning outcomes:**
- Name the visible electromagnetic spectrum.
- Describe examples of light being absorbed, diffracted, reflected, transmitted, and refracted.
- Identify the most important structures of the eye and discuss their main functions.
- Reflect on the advantages of pinholes in cameras/eyes.
- Describe how lenses overcome a major problem of pinhole systems.
- Distinguish between different conditions that do result in a blurry image.

Session 4 – 26 Sep 2021: The retina
The optics of the eye form an image on the retina. Different types of photoreceptors in the retina absorb the light and respond with an electrochemical signal. In this session, we study the photoreceptors in the retina and determine their preferred visual input. Moreover, we explore the different regions of the retina and demonstrate their impact on our visual perception.

Required reading for this session [provided online]: *Eye smarter than scientists believed: Neural computations in circuits of the retina*, Göllisch and Meister (2010).

**Learning outcomes:**
- Recall important components of the retina.
Summarize the neural circuitry and basic processing in the retina.
Summarize lateral inhibition and its consequences for vision.
Evaluate the most important functions of retinal processing.
Differentiate the rod and cone photoreceptors.
Design a visual system that can see during dim and bright light conditions.

03 Oct 2021: Public Holiday – No Class

Session 5 – 10 Oct 2022: Processing in the LGN and visual cortex
This session is dedicated to the physiology of early visual processing. How is the visual output from the retina relayed to the primary visual cortex? We will differentiate two visual processing streams. Finally, we will dive into the anatomy and the functioning of a heavily studied brain area that is crucial for visual perception: primary visual cortex.

Required reading for this session: Goldstein Chapter 3 and Chapter 4

Learning outcomes:
- Identify the important structures in the retino-geniculate pathway.
- Discuss the lateralization of processing and its influence on visual field deficits.
- Explain the concept of receptive fields.
- Evaluate the parallel pathways in (and the organization of) the LGN.
- Explain what is meant by a retinotopic map.
- Discuss the role of spatial frequency channels.
- Explain how neurons can selectively respond to a particular orientation.

First response paper due.

Session 6 – 17 Oct 2022: Depth and motion perception
After we learned about the first steps of visual processing in the retina and the brain, we can now turn to crucial elements of our visual perception — the perception of motion and depth. Why do we have a sense for motion and how can we determine the depth of objects? In this session, we will identify the main challenges for the visual system and its solutions for computing motion and depth.

Required reading for this session: Goldstein Chapter 8 and Chapter 10

Learning outcomes:
- Clarify why depth is inferred from a 2D input.
- Describe how depth and size perception are intertwined.
- Summarize how disparity can help seeing in 3D.
- Recall cues that help infer depth and provide examples for each cue.
- Find the main arguments for why motion is the outcome of vision, and not cognitively inferred.
- Create a basic motion detector.
Session 7 – 24 Oct 2022: Midterm & Color perception 1
In the first part of this session, we will write the midterm exam. In the second part of this session, we turn to the perception of color. In addition to fascinating illusions and demonstrations, we will devote our attention to the mechanisms of color perception and encounter one of the major disputes between scientifically competing ideas.

Required reading for this session: Goldstein Chapter 9

Learning outcomes:
- Summarize the main functions of color vision.
- Differentiate subtractive and additive color mixing. Reflect on what type of mixing is used by (and where in) the visual system.
- Reflect on why color vision can matter for building a TV screen/ computer monitor.
- Recall what information is conveyed in spectral power distribution.
- Explain the meaning of color metamers and why this is important to understand color perception.
- Reflect on how the different cones contribute to color perception.
- Summarize the different forms of color blindness.

Session 8 – 31 Oct 2022: Color perception 2 & Understanding perception
In this session, we ask what it even means to understand perception – and, in the bigger picture, the brain. What might an understanding even look like and what should be investigated to gain a better understanding? Finally, we will consider illusions and how they shape our understanding of perception.

Required reading for this session [provided online]: Visual illusions as a tool for dissociating seeing from thinking: A reply to Braddick, van Buren & Scholl (2018)

Learning outcomes:
- Reflect on the appropriate level of analysis for understanding the brain.
- Discuss the arguments for and against modular perception.
- Reflect on why visual illusions can be important for studying perception.
- Discuss how visual illusions can be a good test for artificial intelligence.

Session 9 – 07 Nov 2022: Perceptual organization
So far, we have focused on how early visual processes extract basic visual features from the visual input. But when we tell something about our environment, we typically report the presence of objects and how they relate to each other. In this session, we will look at principles of perceptual organization. What role do objects play in perception? Moreover, we consider the implications that arise when studying perception in a natural environment.

Required reading for this session: Goldstein Chapter 5

Learning outcomes:
- Discuss the role of objects as the unit (and therefore the level of analysis) of perception.
- Explain and apply Gestalt principles of perceptual organization.
- Explain basic factors that drive perceptual segregation.
Session 10 – 14 Nov 2022: Visual selection
Contrary to our subjective judgment, we often perceive only a small fraction of our visual environment. Using powerful in-class demonstrations, we will illustrate the limited capacity of visual processing. We will look at different forms of selection, and present the main experimental paradigms to assess the allocation of attention.

Required reading for this session: Goldstein Chapter 6

Learning outcomes:
- Distinguish between overt vs. covert attention, and endogenous vs. exogenous attention.
- Recall different experimental paradigms to study attention, draw typical outcomes of such experiments and interpret the results.
- Recall neural correlates of attention.
- Summarize different types of eye movements.
- Summarize different deficits of attention.

Session 11 – 21 Nov 2022: Perceptual awareness and metacognition
[Guest lecture by Polina Arbuzova]
A large part of sensory information coming into our brain is processed without our awareness. How do we know that? What are the limits of our conscious perception? What are the differences on the neural level? In the first part of this session, we will discuss the dissociation between the conscious and unconscious processing of sensory information. We will discuss the methods that allow us to study our perceptual awareness and try one of them out in the class. We will then look at the underlying neural correlates of conscious and unconscious processing. In the second part, we will talk about the concept of perceptual metacognition, or how we explicitly evaluate our perceptual processes. We will then discuss the ways to assess metacognitive ability experimentally, and how to quantify it. Finally, we will look at the neural basis of perceptual metacognition.

Required reading [provided online]:
Conscious and unconscious perception, Kouider and Faivre (2017)
The Power of Reflection, Stephen Fleming (2014)

Learning outcomes:
- Discuss the differences between the ecological approach to perception and snapshot vision.
- Explain how observers use information created by their own movements.
- Provide examples for affordances.
- Discuss the links between action and perception.
- Discuss how insights into the action-perception cycle can inform applications in current technological developments (e.g., robotics or foveal rendering in VR).
- Evaluate why there is no perception without action.

Second response paper due.
Session 12 – 28 Nov 2022: Hearing basics
In this session, we explore sound waves—the stimulus of hearing. We will analyze pure tones, and complex sounds, and illustrate how their characteristics relate to hearing. Finally, we analyze the extraordinary fine-tuning resulting from the ear’s anatomy and its functioning.

Required reading for this session: Goldstein Chapter 11

Learning outcomes:
- Explain the physics of sound and the characteristics of pure tones.
- Recall how loudness is expressed in dB.
- Reflect on what is visualized in the audibility curve.
- Explain the underlying spectra of complex sounds
- Discuss the role of the inner, middle and outer ear for hearing.

Session 13 – 05 Dec 2022: Time perception
[Guest lecture by Dr. Richard Schweitzer]
We devote this session to a topic that is rarely covered in a perceptual lecture, but which has attracted interest far beyond the study of perception and psychology: the perception of time. Can we even talk about a sense of time? Why does time sometimes pass slowly while at other moments the time flies by? In this guest lecture we discuss experimental methods to answer these questions and discuss the evidence for different models suggesting how the perception of time is constructed.

Learning outcomes:
- Describe the difference between physical and psychological time.
- Reflect on the different levels of timing.
- Evaluate the pros and cons of the following methods for studying time perception: verbal estimation, production, reproduction, and comparison.
- Explain the difference between prospective and retrospective timing.
- Evaluate the internal clock idea of time perception.

8 Dec 2022: The Final Exam will be assigned to you.

Session 14 – 12 Dec 2022: Sound localization
This session is dedicated to the astonishing processing of sound waves up to the point that these signals are used to locate a sound in the environment. During this journey, we will take a closer look at the anatomy and neurophysiology of the inner ear, the stimulus transduction, early coding in the auditory system, and finally the localization of sound.

Required reading for this session: Goldstein Chapter 12 and Chapter 13

Learning outcomes:
- Describe the anatomy and neurophysiology of the inner ear.
- Explain how a place code is implemented in the basilar membrane.
- Discuss how inner hair cells do transduction.
- Reflect on the different causes of hearing loss.
• Evaluate the importance of the different cues used for sound localization.

15 Dec 2022: Final Exam is due at 11:59pm CET (Berlin Time).

Recommendations for a Positive Teaching and Learning Environment
• Please do not eat during class and minimize any other distracting noises (e.g. rustling of papers and leaving the classroom before the break, unless absolutely necessary).
• Students should be respectful and courteous at all times to all participants in class.

Suggested Learning Opportunities that Relate to our Course
We will provide additional (optional) material for online studying using quizlet.com

Your Lecturer
Sven Ohl studied Psychology at Potsdam University (Germany) and as an international exchange student at the University of California, Berkeley. As a graduate student at the Berlin School of Mind and Brain, he completed his PhD in 2013 at Potsdam University. He joined the Active Perception and Cognition group at Humboldt University of Berlin and has been working as a temporary principal investigator since 2016. In his research he investigates the bidirectional links between action and perception—for instance how eye movements determine what information is maintained in visual memory. Sven Ohl is fascinated by the complex problems that perception continuously overcomes with ease without us even being aware of this visual intelligence.

Academic Policies

Grade Conversion
Your lecturer may use one of the following scales of numerical equivalents to letter grades:

A = 94-100 or 4.0
A- = 90-93 or 3.7
B+ = 87-89 or 3.3
B = 84-86 or 3.0
B- = 80-83 or 2.7
C+ = 77-79 or 2.3
C = 74-76 or 2.0
C- = 70-73 or 1.7
D+ = 67-69 or 1.3
D = 65-66 or 1.0
F = below 65 or 0

Attendance Policy
Studying at Global Academic Centers is an academically intensive and immersive experience, in which students from a wide range of backgrounds exchange ideas in discussion-based seminars. Learning in such an environment depends on the active participation of all students.
Since classes typically meet once or twice a week, even a single absence can cause a student to miss a significant portion of a course. To ensure the integrity of this academic experience, class attendance at the centers is expected promptly when class begins. Attendance will be checked at each class meeting.

As soon as it becomes clear that you cannot attend a class, you must inform your professor and/or the Academics team (berlin.academics@nyu.edu) by e-mail immediately (i.e. before the start of your class). Absences are only excused if they are due to illness, Moses Center accommodations, religious observance or emergencies. Your professor or site staff may ask you to present a doctor's note or an exceptional permission from an NYU Staff member as proof. Emergencies or other exceptional circumstances that you wish to be treated confidentially must be presented to NYU Berlin’s director or Wellness Counselor. Doctor's notes must be submitted in person or by e-mail to the Academics team, who will inform your professors.

Unexcused absences may be penalized with a two percent deduction from the student’s final course grade for every week's worth of classes missed, and may negatively affect your class participation grade. Four unexcused absences in one course may lead to a Fail in that course. Being more than 15 minutes late counts as an unexcused absence. Furthermore, your professor is entitled to deduct points for frequently joining the class late.

Exams, tests and quizzes, deadlines, and oral presentations that are missed due to illness always require a doctor's note as documentation. It is the student's responsibility to produce this doctor's note and submit it to site staff; until this doctor's note is produced the missed assessment is graded with an F and no make-up assessment is scheduled. In content classes, an F in one assignment may lead to failure of the entire class.

Regardless of whether an absence is excused or not, it is the student's responsibility to catch up with the work that was missed.

Final exams
Final exams must be taken at their designated times. Should there be a conflict between your final exams, please bring this to the attention of the Academics team. Students should not plan to leave the site before the end of the finals period.

Late Submission of Work
(1) Work submitted late receives a penalty of 2 points on the 100 point scale for each day it is late (including weekends and public holidays), unless an extension has been approved (with a doctor's note or by approval of NYU Berlin's administration), in which case the 2 points per day deductions start counting from the day the extended deadline has passed.

(2) Without an approved extension, written work submitted more than 5 days (including weekends and public holidays) following the submission date receives an F.

(3) Assignments due during finals week that are submitted more than 3 days late (including weekends and public holidays) without previously arranged extensions will not be accepted and will receive a zero. Any exceptions or extensions for work during finals week must be discussed with the Site Director, Dr. Gabriella Etmektsooglou.

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(4) Students who are late for a written exam have no automatic right to take extra time or to write the exam on another day.

(5) Please remember that university computers do not keep your essays - you must save them elsewhere. Having lost parts of your essay on a university computer is no excuse for a late submission.

**Academic Honesty/Plagiarism**

As the University's policy on "Academic Integrity for Students at NYU" states: "At NYU, a commitment to excellence, fairness, honesty, and respect within and outside the classroom is essential to maintaining the integrity of our community. By accepting membership in this community, students take responsibility for demonstrating these values in their own conduct and for recognizing and supporting these values in others." Students at Global Academic Centers must follow the University and school policies.

NYU takes plagiarism very seriously; penalties follow and may exceed those set out by your home school. Your lecturer may ask you to sign a declaration of authorship form, and may check your assignments by using TurnItIn or another software designed to detect offenses against academic integrity.

The presentation of another person’s words, ideas, judgment, images, or data as though they were your own, whether intentionally or unintentionally, constitutes an act of plagiarism. It is also an offense to submit work for assignments from two different courses that is substantially the same (be it oral presentations or written work). If there is an overlap of the subject of your assignment with one that you produced for another course (either in the current or any previous semester), you MUST inform your professor.

For guidelines on academic honesty, clarification of the definition of plagiarism, examples of procedures and sanctions, and resources to support proper citation, please see:

- NYU Academic Integrity Policies and Guidelines
- NYU Citations Style Guide

**Inclusivity Policies and Priorities**

NYU’s Office of Global Programs and NYU’s global sites are committed to equity, diversity, and inclusion. In order to nurture a more inclusive global university, NYU affirms the value of sharing differing perspectives and encourages open dialogue through a variety of pedagogical approaches. Our goal is to make all students feel included and welcome in all aspects of academic life, including our syllabi, classrooms, and educational activities/spaces.

**Attendance Rules on Religious Holidays**

Members of any religious group may, without penalty, excuse themselves from classes when required in compliance with their religious obligations. Students who anticipate being absent due to religious observance should notify their lecturer AND NYU Berlin’s Academics team in writing via e-mail one week in advance. If examinations or assignment deadlines are scheduled on the day the student will be absent, the Academics team will schedule a make-up examination or extend the deadline for assignments. Please note that an absence is only
excused for the holiday but not for any days of travel that may come before and/or after the holiday. See also University Calendar Policy on Religious Holidays.

**Pronouns and Name Pronunciation (Albert and Zoom)**

Students, staff, and faculty have the opportunity to add their pronouns, as well as the pronunciation of their names, into Albert. Students can have this information displayed to faculty, advisors, and administrators in Albert, Brightspace, the NYU Home internal directory, as well as other NYU systems. Students can also opt out of having their pronouns viewed by their instructors, in case they feel more comfortable sharing their pronouns outside of the classroom. For more information on how to change this information for your Albert account, please see the Pronouns and Name Pronunciation website.

Students, staff, and faculty are also encouraged, though not required, to list their pronouns, and update their names in the name display for Zoom. For more information on how to make this change, please see the Personalizing Zoom Display Names website.

**Moses Accommodations Statement**

Academic accommodations are available for students with documented and registered disabilities. Please contact the Moses Center for Student Accessibility (+1 212-998-4980 or mosescsd@nyu.edu) for further information. Students who are requesting academic accommodations are advised to reach out to the Moses Center as early as possible in the semester for assistance. Accommodations for this course are managed through NYU Berlin.

**Bias Response**

The New York University Bias Response Line provides a mechanism through which members of our community can share or report experiences and concerns of bias, discrimination, or harassing behavior that may occur within our community.

Experienced administrators in the Office of Equal Opportunity (OEO) receive and assess reports, and then help facilitate responses, which may include referral to another University school or unit, or investigation if warranted according to the University's existing Non-Discrimination and Anti-Harassment Policy.

The Bias Response Line is designed to enable the University to provide an open forum that helps to ensure that our community is equitable and inclusive.

To report an incident, you may do so in one of three ways:

- Online using the Web Form
- Email: bias.response@nyu.edu
- US Phone Number: +1 212-998-2277
- Local Number in Berlin: +49 (0) 30 2902 91277
Please consider the environment before printing this syllabus. If printing is necessary, please select only the essential page range.