JACOBS UNIVERSITY

Cognitive Psychology and Neuroscience

Bachelor's Degree Program (BSc)

Contents

As of September 1, 2014 the School of Engineering and Science and the School of Humanities and Social Sciences have been replaced by the Focus Areas Health, Mobility and Diversity. Handbooks and policies might still refer to the old structure of Schools.
If this is the case, references to the School of Engineering and Science include courses offered within the following disciplines:

- Electrical Engineering and Computer Science
- Life Sciences
- Logistics
- Mathematical Sciences
- Natural and Environmental Sciences

References to the School of Humanities and Social Sciences include courses offered within the following disciplines:

- Economics and Management
- History
- Humanities
- Law
- Psychology
- Social Sciences
- Statistics and Methods

1 Cognitive Psychology and Neuroscience at Jacobs University

1.1 Concept

How can the dynamic interaction of about 100 billion nerve cells, each sending electrochemical impulses to each other in the millisecond-range, create what we experience every second of our lives as our feelings, thoughts and actions? Neuroscientists and psychologists with diverse backgrounds have been working on these questions for many decades, so far unraveling many mysteries but also discovering many more questions; questions that can be successively tackled with the rapid advance of new technologies such as neuroimaging or optogenetics. Still, neuroscience with its inherently transdisciplinary character has been suffering for a long time from the inflexibility of many university undergraduate programs that tend to focus on one single discipline. It is commonly agreed in the scientific community that advances in the neurosciences will most likely stem from the bridging of different disciplines and approaches. This is the starting point for Cognitive Psychology and Neuroscience and its global uniqueness. It is thus indispensable that students become proficient in both areas from the very beginning of their studies. With the university's inherently transdisciplinary approach, featuring strong ties among faculty and students to bridge disciplines on a small interconnected campus, a firm standing of research in both the life sciences and psychology, and a vast range of possibilities for flexible teaching focused on current research, permitted by a student-professor ratio of only 10:1, Cognitive Psychology and Neuroscience is the most innovative answer to the needs of creative and high-quality neuroscience research.

Cognitive Psychology and Neuroscience aims at educating a highly select and small student body from the very start of their undergraduate studies in understanding concepts in biology, neuroscience, and psychology and applying these concepts from their first year on in research laboratory settings and thereby enabling them to join research groups from early on. While the scope of knowledge and skills is broad and challenging, the focus is clearly set on developing a transdisciplinary understanding how the brain works and how one can investigate research questions on a practical level.

Students in their first year will take general biology, and biochemistry / cell biology (BCCB) courses covering animal behavior, anatomy, physiology, and cellular and molecular biology. These courses serve to enable students to understand the basic mechanisms that govern biological organisms from molecules to behavior. Additionally, complementary laboratory courses allow students to gain an in-depth practical understanding of this and the tools that are being used to find out by introducing them to, amongst others, microscopy, dissection, laboratory safety, spectrophotometry, molecular biology, cell biology, and scientific writing. On the other hand, students will also be introduced to the different fields of cognitive psychology, ranging from perception and attention to learning and memory and decision-making. This is also complemented by hands-on classes in experimental psychology and statistical methods that allow students to investigate their own research ideas and hand them the tools to analyze their own data. In addition, several courses such as the Introduction to Neuroscience or Sensation and Perception are inherently interdisciplinary and enable the students to connect the dots between the different disciplines they are learning.

The second year of studies allows for some specialization into either biology or psychology, while the majority of courses still ensures a strong transdisciplinary character. All students will further their knowledge in cognitive psychology disciplines like learning and memory, and emotion and motivation, both of whose neurobiological substrates will also be illuminated. At the same time, a focus on perceptual processing and behavior in animals and humans will be regarded from a biological perspective, complemented by neurobiological lab courses that allow students to investigate the neurophysiological substrates in animals and humans on their own. Furthermore, all students receive a thorough education of the various methods employed in the neurosciences from genetics to neuroimaging by various professors. Those who wish to put more emphasis on the biology part of their major will take in-depth courses in cell biology and lab courses in which to employ brain slicing, genetic transfection, laser microscopy and more advanced life science methods. Those who wish to focus more strongly on psychology will be offered advanced statistics courses and the cognitive psychology course Attention. While a specialization seems unavoidable due to the demanding workload, students are encouraged to also take courses from their respective other specialization.

The third and last year focuses on the employment of the concepts and methods that have been learned by conducting two semesters of guided research, each semester working within a different research group on campus and ultimately leading to the Bachelor Thesis. It is possible and encouraged for students to do each of their guided research projects in a different discipline. Additionally, more courses will focus on the intersection between neuroscience and psychology, such as Social Neuroscience or Behavioral Neurobiology. Students specializing in biology will receive advanced methodological training, and students specializing in psychology will learn about the impact of culture on human cognition and decision-making.

After these three years, students will have a broad but focused education in the neurosciences enabling them to understand and investigate questions about the human brain from many different perspectives, thus making them ideal future scientists with great advantages over common unidisciplinary undergraduate programs.

1.2 Career Options

Studying Cognitive Psychology and Neuroscience at Jacobs University enables students to understand biological systems from both the structural, functional as well as from the physiological side. Cognitive Psychology and Neuroscience is a steadily growing area in the field of life sciences, and both basic research and clinical institutions are looking for applicants with solid education in natural sciences and psychology. State-of-the-art methods are used for education and research. In addition, the transdisciplinary education offered at Jacobs University increases the number of possibilities for a later career in various academic and non-academic fields, as for example in life sciences, psychology, neuroeconomics or market research.

2 Requirements for a B.Sc. in Cognitive Psychology and Neuroscience

University Requirements

To obtain a B.Sc. degree at Jacobs University a minimum of 180 ECTS credit points must be earned over a period of 6 semesters.

Specialization in Psychology:

- 147,5 ECTS credits must be earned through mandatory courses in the School of Engineering and Science and the School of Humanities and Social Sciences.
- 15 ECTS credits must be earned through University Studies Courses (**USC**)
- 17,5 ECTS credits are accredited either for elective courses from both schools or for language courses.

Specialization in Biology/Neuroscience:

- 145 ECTS credits must be earned through mandatory courses in the School of Engineering and Science and the School of Humanities and Social Sciences.
- 15 ECTS credits must be earned through University Studies Courses (**USC**)
- 20 ECTS credits are accredited either for elective courses from both schools or for language courses.

Requirements of the Major

- **Year 1 level courses:**
  - Academic and Professional Skills (990100, 2,5 ECTS credits),
  - ESM2A - Linear Algebra, Probability, Statistics (120102, 5 ECTS credits),
  - Statistical Methods I (990102) 5 ECTS credits),
  - General Biology / Neuroscience I (500101, 5 ECTS credits) plus
  - Natural Science Lab Units (NatSciLabs) Biology / Neuroscience I/II (500111, 500112, 5 ECTS credits),
  - Introduction to Neuroscience (500122, 5 credits),
  - General BCCB I and II (520101,520102) 10 ECTS credits) plus
  - Natural Science Lab Units (NatSciLabs) BCCB I/II (520111, 520112, 5 ECTS credits),
  - Sensation and Perception (710101, 5 ECTS credits),
  - Introduction to Cognitive Psychology 710111, 5 ECTS credits),
  - Lab Course in Experimental Psychology I (740101, 5 ECTS credits).

- **Year 2 level courses:**
  - Systems Neuroscience (500201, 5 ECTS credits),
  - Animal Senses and Behavior (500202, 5 ECTS credits),
  - Methods in Neurobiology and Cognitive Psychology (500232, 5 credits),
  - Advanced Cell Biology I (520211,5 ECTS credits),
  - Emotion and Motivation (720201, 5 ECTS credits),
  - Learning and Memory (710102, 5 ECTS credits),

- Lab Course in Experimental Psychology II (740102, 5 ECTS credits).

Bio/Neuro Specialization:
- Advanced Biology/Neuroscience Lab I/II (500221, 500222, 7,5 ECTS credits),
- Biological Physics (560122) 5 ECTS credits),

Psychology Specialization:
- Statistical Methods II (990201) 5 ECTS credits),
- Attention (710211, 5 ECTS credits),

- **Year 3 level courses:**
  - Neuroendocrinology/Biorythms (500321, 5 ECTS credits),
  - Theoretical Neuroscience (500332, 5 ECTS credits),
  - Behavioral Neurobiology (500341, 5 ECTS credits),
  - Social Neuroscience (720302, 5 ECTS credits),
  - Guided Research and BSc Thesis in Cognitive Psychology and Neuroscience I/II including four research lab rotations (500361, 500362, 15 ECTS credits).

Bio/Neuro Specialization:
- Biophysical Chemistry (560351, 5 ECTS credits),

Psychology Specialization:
- Decision Making (710302, 5 ECTS credits),
- Culture and Cognition (720311, 5 ECTS credits),

Jacobs University Bremen reserves the right to substitute courses by replacements and/or reduce the number of mandatory/mandatory elective courses offered

3 Recommended Course Plan

Year 1 Courses	**Fall**	**C**	**T**	**Spring**	**C**	**T**
Academic and Professional Skills	990100	*2.5*	m			
ESM2A - Linear Algebra, Probability, Statistics				120102	*5*	m
Statistical Methods I: Exploring Relationships and Comparing Groups				990102	*5*	m
General Biology/Neuroscience	500101	*5*	m			
NatSciLab Biology/Neuroscience I/II	500111	*2.5*	m	500112	*2.5*	m
Introduction to Neuroscience				500122	*5*	m
General BCCB I/II	520101	*5*	m	520102	*5*	m
NatSciLab BCCB I/II	520111	*2.5*	m	520112	*2.5*	m
Sensation and Perception				710101	*5*	m
Introduction to Cognitive Psychology	710111	*5*	m			
Lab Course in Experimental Psychology I	740101	*5*	m			
Electives in SHSS and SES, Language Courses and University Studies Courses		*2,5*	e			
Running Total / *Semester Total*	30	*30*		60	*30*	

Year 2 Courses	**Fall**	**C**	**T**	**Spring**	**C**	**T**
Animal Senses and Behavior	500202	*5*	m			
Systems Neuroscience				500201	*5*	m
Advanced Cell Biology I	520211	*5*	m			
Methods in Neurobiology and Cognitive Psychology				500232	*5*	m
Emotion and Motivation				720201	*5*	m
Learning and Memory	710102	*5*	m			
Lab Course Experimental Psychology II	740102	*5*	m			
plus Biology/Neuroscience Specialization						
Adv. Lab Course Bio/Neuroscience I/II	500221	*3,75*	m	500222	*3,75*	m
Biological Physics				560122	*5*	m
Electives in SHSS and SES, Language Courses and University Studies Courses		*5*	e		*7,5*	e
Running Total / *Semester Total*	90	*28,75*		120	*31,25*	
or						
plus Psychology Specialization						
Statistical Methods II: Classification, Modeling and Prediction	990201	*5*	m			
Attention				710211	*5*	m
Electives in SHSS and SES, Language Courses and University Studies Courses		*5*	e		*10*	e
Running Total / *Semester Total*	90	*30*		120	*30*	

C = ECTS credit points, T=type (m=mandatory, e=elective)

Year 3 Courses	**Fall**	**C**	**T**	**Spring**	**C**	**T**
Neuroendocrinology/Biorhythms	500321	*5*	m			
Theoretical Neuroscience				500332	*5*	m
Behavioral Neurobiology	500341	*5*	m			
Social Neuroscience				720302	*5*	m
Guided Research and BSc Thesis in Cognitive Psychology and Neuroscience I/II	500361	*7.5*	m	500362	*7.5*	m
plus Biology/Neuroscience Specialization						
Biophysical Chemistry	560351	*5*	m			
Electives in SHSS and SES, Language Courses and University Studies Courses		*7.5*	e		*12.5*	e
Running Total / *Semester Total*	150	*30*		180.0	*30*	
or						
plus Psychology Specialization						
Decision Making				710302	*5*	m
Culture and Cognition	720311	*5*	m			
Electives in SHSS and SES, Language Courses and University Studies Courses		*7.5*	e		*7.5*	e
Running Total / *Semester Total*	150	*30*		180.0	*30*	

C = ECTS credit points, T=type (m=mandatory, e=elective)

3.1 Recommended Elective Courses

The following courses are only to be seen as recommendations. As Elective Courses students are absolutely free to choose from any of the courses offered by the School of Humanities and Social Sciences or by the School of Engineering and Sciences.

Recommended Elective Courses for both specialization areas:

- USC - The Neuroscience of Arts and Politics (020060, 5 ECTS)
- ESM1C - Introduction to Calculus (120121, 5 ECTS)
  Note: Students with "unsure" math preparation are strongly recommended to take ESM1C as an elective or at least as a serious audit course.
- Introduction to Scientific Presentations (500322, 5 ECTS)
- Current Topics in the Life Sciences (500322, 5 ECTS)

Recommended Elective Courses for the specialization in Cognitive Psychology:

- Introduction to Social Psychology (730101, 5 ECTS)
- Attitudes and Social Cognition (730102, 5 ECTS)
- The Logic of Comparative Research (990211, 5 ECTS)
- Stereotypes, Prejudices and Discrimination (730201, 5 ECTS)

Recommended Elective Courses for the specialization in Biology/Neuroscience:

- Microbiology (520251, 5 ECTS)
- Molecular Biology and Genomics (520342, 5 ECTS)
- Biomedicine and Infectious Biology (520311, 5 ECTS)
- Immunology (520322, 5 ECTS)

3.2 Recommendation Professional Skills

The SES highly recommends attending the Professional Skills seminars offered by the Career Services Center. Those seminars include soft skills development seminars and application training which will help you cope with your studies and master your internship and job search.

All undergraduate students are required to complete an internship, normally to be accomplished between the second and third year of study. Information about the internship will be listed on the transcript.
The internship must last at least two consecutive months. No credits are connected to the internship requirement.
For more information on internships see http://www.jacobs-university.de/career-services/internship.

4 Courses: Cognitive Psychology and Neuroscience

4.1 First Year of Study

120102 – ESM2A - Linear Algebra, Probability, Statistics

Short Name: ESM2A
Type: Lecture
Semester: 2
Credit Points: 5 ECTS
Prerequisites: None
Corequisites: None
Tutorial: No

Course contents The course covers the following topics: Linear Algebra (equations of lines and planes, matrix algebra, system of linear equations, matrix inverse, vector spaces, linear independence, basis, dimension, linear transformations, change of basis, eigenvalues and eigenvectors, diagonalization). Probability (basic notions of set theory, outcomes, events, sample space, probability, conditional probability, Bayes' rule, permutations and combinations, random variables, expected value, variance, binomial, Poisson, and normal distributions, central limit theorem). Statistics (one-sample hypothesis testing, two sample hypothesis testing, chi-square hypothesis testing, analysis of variance, bivariate association, simple linear regression, multiple regression and correlation).

990100 – Academic and Professional Skills

Short Name: APS
Type: Modules
Semester: 1
Credit Points: 2,5 ECTS
Prerequisites: None
Corequisites: None
Tutorial: No

Course contents The Academic and Professional Skills (APS) module aims at broadening students' key qualifications to increase academic success, foster career planning, and enhance employability. APS consists of one obligatory course "Academic skills in a nutshell: an introduction to writing an academic paper" (1.6 credits), which must be completed in the first year of studies, and a series of elective workshops (0.9 credits), which can be completed during the three years at Jacobs University. Students pass the APS module when they successfully obtain a total of 2.5 credits, including the obligatory course. "Academic skills in a nutshell: an introduction to writing an academic paper" introduces students to the basic principles and procedures of scientific inquiry. Students will learn the essentials of writing an academic paper, which will prepare them for academic life at the university level and enable them to be more successful throughout their studies. On successful completion of the course students will be awarded 1.6 credits toward the overall APS module credit. The elective credits in the APS module cover a

wide range of professional, academic, coping, and interpersonal skills. Workshops are offered by SHSS, Career Services, the Information Resource Center, the Counseling Center, Financial Services, and more. SHSS publishes a schedule and description of upcoming elective credits at the start of every semester. Students are able to choose workshops tailored to their needs and wishes (to a total of at least 0.9 credits).

990102 – Statistical Methods I: Exploring Relationships and Comparing Groups

Short Name: Stat.Meth.l
Type: Lecture/Lab
Semester: 2
Credit Points: 5 ECTS
Prerequisites: None
Corequisites: None
Tutorial: No

Course contents This course extends the discussion of quantitative methods beyond the introductory level. It reviews some exemplary pieces of quantitative research in the social sciences in order to explain basic statistical concepts and examine their potential and limitations. The topics covered include descriptive statistics, hypothesis testing, regression and correlation, and analysis of variance. The course is equally divided between lecture and lab sessions. During the lab sessions, the tools and concepts discussed during the lecture sessions are applied to real life data sets. The course also serves as a basic training in the statistics software SPSS.

500101 – General Biology/Neuroscience

Short Name: GenBioNsc
Type: Lecture
Semester: 1
Credit Points: 5 ECTS
Prerequisites: None
Corequisites: None
Tutorial: Yes

Course contents The course presents an integrated view of biology and aims to provide an understanding of the major environmental challenges common to all organisms. Largely based on organisms and organ systems, the course will confront the students with biodiversity and tackle questions related to respiration, internal transport, osmoregulation, reproduction, etc. The course has a clear focus on fundamental Neuroscience. The course is expected to generate in the students an on-going interest in the biology of organisms.

500111 – Natural Science Lab Unit Biology/Neuroscience I

Short Name: NatSciLab Bio I
Type: Lab
Semester: 1
Credit Points: 2.5 ECTS
Prerequisites: None
Corequisites: 500101
Tutorial: No

Course contents The vast array of plant and animal species reflects the ways by which adaptations to environmental factors took place. Especially with respect to morphology, physiology, and in case of animals, also sensory systems and behavior, a tremendous variety of specializations is present. This course will describe the principles of biological systems, focusing on the relationship between structure and function, from single cells to brain anatomy. Different plant and animal species are discussed in detail to illustrate these close connections. The lab course will complement the lecture by practical work on selected specimens/organs. The course instructors will provide detailed descriptions of the experiments.

500112 – Natural Science Lab Unit Biology/Neuroscience II

Short Name: NatSciLab BioNsc II
Type: Lab
Semester: 2
Credit Points: 2.5 ECTS
Prerequisites: 500111
Corequisites: IntroNeuro
Tutorial: No

Course contents This course is a continuation of the first semester's course. The focus of this course is more on the physiological level, i.e., how organisms function in relation to environmental challenges. The main goal is therefore to understand the basic physiological principles of animals and humans. During the course, experiments will be performed in the following fields: neurophysiology, behavior, salt balance, circulation, endocrine function.

500122 – Introduction to Neuroscience

Short Name: IntroNeuro
Type: Lecture
Semester: 2
Credit Points: 5 ECTS
Prerequisites: 500101
Corequisites: None
Tutorial: No

Course contents The lecture is a continuation of the lecture ”General Biology / Neuroscience” with a strong emphasis on neuroscience. The topics covered are, amongst others, functional properties of ion channels, synaptic transmission and neurotransmitters, synaptic plasticity, sensory systems (vision, auditory system, and chemical sense), movement control, brain development, neural circuits, regeneration of nerve cells, and memory. In all areas, clinical aspects are included where relevant. This lecture lays the ground for courses (lectures and laboratory courses) in the second and third year of the program ”Cognitive Psychology and Neuroscience” and is accompanied by a laboratory course.

520101 – General Biochemistry and Cell Biology I

Short Name: GenBCCB I
Type: Lecture
Semester: 1
Credit Points: 5 ECTS
Prerequisites: None
Corequisites: None
Tutorial: No

Course contents This is a unique course that gives, over the first year of studies at Jacobs University, a comprehensive introduction to biochemistry and cell biology. At the end of the course, students will have gained knowledge of the foundations and the scope of the subject and of the specific scientific reasoning that underlies research in this field. Topics covered will be the biochemistry and biophysics of DNA, proteins (especially enzymes), carbohydrates, and lipids; the buildup and the breakdown of these substances; the (animal, plant, and bacterial) cell, its substructure, and its organelles; an introduction to the most common chemical reactions in living cells and the underlying thermodynamic, chemical, and kinetic principles, including metabolism and its regulation; and introductory overviews of specialized fields such as biophysics, structural biology, molecular machines, molecular neurobiology, immunology, molecular genetics, developmental biology, and cancer. Information about the techniques and strategies to obtain knowledge and to ask questions in molecular life science, as well as historical outlines, will accompany each topic. This course requires solid High School knowledge of both biology and chemistry, or the willingness to acquire it at Jacobs University.

520111 – Natural Science Lab Unit Biochemistry and Cell Biology I

Short Name: NatSciLabBCCB I
Type: Lab
Semester: 1
Credit Points: 2.5 ECTS
Prerequisites: None
Corequisites: 520101
Tutorial: No

Course contents This course trains basic laboratory skills and gives an introduction to biochemical and cell biological work in the laboratory. The course parallels the general biochemistry and cell biology lecture. An introduction is given to substance classes on one hand and methods on the other. Course days include e.g., the handling of glass and micropipettes, balances, spectrophotometers and light microscopes. Experiments include gel filtration, thin layer chromatography of plant pigments, titration, pH-dependence of enzymes, identification of carbohydrates, microscopy of sperms and muscle etc. For each course day, a lab report is handed in.

520102 – General Biochemistry and Cell Biology II

Short Name: GenBCCB II
Type: Lecture
Semester: 2
Credit Points: 5 ECTS
Prerequisites: 520101
Corequisites: None
Tutorial: No

Course contents This is the second part of the comprehensive introduction to biochemistry and cell biology with special emphasis on the connections to the related fields chemistry and biology. In the spring semester, the emphasis of the course will be on more complex cell biological topics, such as the synthesis, topogenesis and breakdown of cellular components in the context of the cellular environment, and introductory overviews of specialized fields such as biophysics, structural biology, cell cycle, molecular neurobiology, immunology, DNA technology, developmental biology, and cancer. Information about the techniques and strategies to obtain knowledge and to ask questions in molecular life science, as well as historical outlines, will accompany each topic. Good High School knowledge of both biology and chemistry, or the willingness to acquire it in self-study, is assumed.

520112 – Natural Science Lab Unit Biochemistry and Cell Biology II

Short Name: NatSciLabBCCB II
Type: Lab
Semester: 2
Credit Points: 2.5 ECTS
Prerequisites: None
Corequisites: 520102
Tutorial: No

Course contents This course trains basic laboratory skills and gives an introduction to biochemical and cell biological work in the laboratory. The course parallels the general biochemistry and cell biology lecture. An introduction is given to substance classes on one hand and methods on the other.
As a continuation of the fall course, this time the focus lies on DNA and RNA. Course days include e.g., the handling of glass and micropipettes, balances, spectrophotometers and light

microscopes. Experiments include isolation of DNA and RNA from pea seedlings, isolation of DNA from stressed C6 glioma cells and detection of an apoptotic DNA ladder by means of agarose gel electrophoresis, sterile cultivation of yeast cells, determination of cytotoxicity, fixation, staining and microscopic investigation of M phase cells.

710101 – Sensation and Perception

Short Name: SensPercept
Type: Lecture
Semester: 2
Credit Points: 5 ECTS
Prerequisites: None
Corequisites: None
Tutorial: No

Course contents Pioneering work on sensation and perception started in the 19th century and through the years, perception has remained a major focus of Psychology. Sensation refers to the process of detecting a stimulus or a stimulus property in the environment. It is the necessary collection of information about the world from which perceptions will be made. Perception refers to the way in which we interpret the information that is gathered by the senses. The process of perception can not be understood while ignoring the known physiology of the sensory systems that underlies the perceptual process. The course covers both physiological explanations for phenomena of perception and more cognitive aspects of the perceptional process, for which a physiological explanation might be available in the future. This lecture covers the following topics:

- Methods of investigation: Phenomenological method; psychophysical methods such as methods of limits, method of constant stimuli, magnitude estimation, and basic ideas of signal detection; psychophysical measures such as absolute threshold, difference threshold, adaptation; Fechner's law, Weber's law, Stevens' power law.
- Visual perception: The visual stimulus, the structure of the eye, neural processing including basic neural circuitry, and information flow and organization in the brain; perception of objects and models of object perception such as the Gestalt approach, feature integration theory (Treisman), recognition-by-component model (Biederman), Marr's computational approach; perception of depth, monocular depth cues, binocular depth cues; perception of color and models of color perception such as trichromatic theory, opponent-process theory; perception of movement, motion sensing systems such as image-retina system, eye-head system, corollary discharge theory; perceptual constancies such as color constancy, size constancy, lightness constancy, shape constancy; and phenomenon such as visual illusions.
- Auditory perception: The sound stimulus, the structure of the ear, neural processing in the cochlea and auditory nerve; the experience of sound (loudness, pitch, timbre); perception of simple tones and complex sound; models such as Bekesy's Place Theory; localization of sound.
- Touch and pain: The cutaneous stimulus; the skin and its different receptor systems; active versus passive touch; pain and pain relief, such as analgesia and endogenous opiates, placebo.

- Smell and taste: The olfactory stimulus, the olfactory system, the taste stimulus, the taste system; pheromones; taste quality; flavor.

710111 – Introduction to Cognitive Psychology

Short Name: Int.Cog.Psych.
Type: Lecture
Semester: 1
Credit Points: 5 ECTS
Prerequisites: None
Corequisites: None
Tutorial: No

Course contents This course provides an introduction to cognitive psychology. The goal of cognitive psychology is to understand how the human mind works, in particular how we perceive, attend to, learn and memorize information as well as how we solve problems and make decisions. The course will focus on the historical foundations of cognitive psychology, influential and current theories and models as well as empirical research methods. As an introductory course, this lecture will review important aspects of cognitive psychological research, which then will be discussed in more detail in 1st, 2nd and 3rd year lectures and seminars. The lecture includes the following topics:

- History of Cognitive Psychology
- Basic concepts and research methods of Cognitive Psychology
- Perception
- Attention
- Learning and Memory
- Thinking and Problem Solving
- Intelligence, Language and Knowledge
- Decision Making
- Cognitive Development
- Cognitive Neuroscience and Neuropsychology

740101 – Lab Course in Experimental Psychology I

Short Name: Lab.Exp.Psych.I
Type: Lab
Semester: 1
Credit Points: 5 ECTS
Prerequisites: None
Corequisites: None
Tutorial: No

Course contents Introduction to experimental methods used in Cognitive and Social Psychology. This course complements the methods training that is shared with all students in the School of Humanities and Social Sciences. It provides both, theoretical and first hands-on experience with techniques and methods that are typical for psychological research. The course

will include an introduction into the logic of basic experimental research designs accompanied by practical hands-on experience with classic research methods and paradigms. How can human judgment and behaviour be assigned to numbers, and how can we deal with these numbers? Specific topics of this course will cover for example unidimensional scaling (incl. Likert, Thurstone, Guttman, Rasch, Mokken), the theory of measurement, the logic of basic research designs, descriptive statistics, signal detection theory, etc.

4.2 Second Year of Study

4.2.1 General Courses

500201 – Systems Neuroscience

Short Name: SysNeuro
Type: Lecture
Semester: 4
Credit Points: 5 ECTS
Prerequisites: 500101 or 500102
Corequisites: None
Tutorial: No

Course contents The course provides an outline of structure - function relationships in the mammalian nervous system, in particular at the large-scale systems level. It covers the anatomical organization and physiological mechanisms underlying sensory perception and motor behavior, as well attention, emotion and memory.

500202 – Animal Senses and Behavior

Short Name: AnimSens
Type: Lecture
Semester: 3
Credit Points: 5 ECTS
Prerequisites: None
Corequisites: None
Tutorial: No

Course contents The aim of the course is to present an integrated view of animal (and human) sensory physiology and behavior. The course commences with a comparative study of the structure and function of sense organs, emphasizing that an understanding of an animal's behavior is impossible without a detailed knowledge of the sense organs. Various aspects of intra- and interspecific behaviors, e.g., orientation, feeding, territoriality, courtship, etc. are then explained, before predominantly ecological aspects (e.g., competition, parasitism, pest control, etc.) wrap up the course.

500232 – Methods in Neurobiology and Cognitive Psychology

Short Name: MethBio
Type: Lecture
Semester: 4
Credit Points: 5 ECTS
Prerequisites: None
Corequisites: None
Tutorial: No

Course contents In the area of Neurobiology and Cognitive Psychology, respectively, a vast array of research methods exist for investigating neuropsychological processes from single cells to complex human behavior. In recent years, fundamentally new techniques have been introduced which enable researchers to gain new insights into processes (e.g. structural and functional neuroimaging, magnetoencephalography), or to specifically manipulate them (e.g. optogenetical methods), respectively. Apart from basic research, these new techniques and the well-established other methods (e.g. EEG, various behavioral and cognitive psychological tests) are very important in clinical investigations. In this respect, the understanding of neurodegenerative processes is of particular importance since early signs may be discovered well before first clinical signs of the disease occur, thus leading to better diagnosis and treatment options. The lecture, given by several experts in their fields, provides an overview of the different methods used in the area of neurobiology and cognitive psychology.

520211 – Advanced Cell Biology I

Short Name: AdvCB I
Type: Lecture
Semester: 3
Credit Points: 5 ECTS
Prerequisites: 520101, 520102
Corequisites: None
Tutorial: No

Course contents This course intends to give a detailed understanding on the biology of pro- and eukaryotic cells on the basis of the biochemical features of cellular macromolecules. Cells are limited by a plasma membrane bearing important functions like communication of cells with their surroundings. Within eukaryotic cells, biological membranes form cellular compartments to optimize biochemical reactions necessary for all cells to perform their biological functions. The biogenesis of cellular compartments will be a central part on the way of understanding the evolution of multicellular organisms. The complexity of cellular systems and of their macromolecular constituents becomes most obvious in certain disorders that have been characterized on the molecular level. Therefore, biomedical implications will be included whereever possible.

- Definition and evolution of cells
- Cell proliferation, cell differentiation, and cell death
- Nucleus
- From RNA to protein

- Protein folding
- Protein sorting
- ER and Golgi
- Secretory pathway
- Quality control
- Plasma membrane & glycocalyx
- Molecular mechanisms of vesicular traffic

710102 – Learning and Memory

Short Name: LearnMem
Type: Lecture
Semester: 3
Credit Points: 5 ECTS
Prerequisites: None
Corequisites: None
Tutorial: No

Course contents The study of memory seeks to understand how information is stored and retrieved, how new information is integrated to existing information, why we forget, and whether or not we can improve memory. The concept of model testing, i.e., stating assumptions and deriving predictions, empirical testing, and possible modification of the model, is introduced. This lecture covers the following topics:

- Sensory memory: Link between perception and memory; iconic memory; echoic memory; experimental paradigms such as partial report.
- Immediate memory: Information to be retained only briefly; experimental procedures for investigating immediate memory such as free and serial recall, Brown-Peterson paradigm; models of immediate memory such as Broadbent's model of primary memory; Atkinson & Shiffrin's Dual Store model; serial position curves and its meaning for testing immediate memory; Sternberg paradigm for memory retrieval from short-term store; Baddeley's working memory model; levels of processing.
- Generic memory: Information to be retained indefinitely; propositions and concepts; knowledge; models of semantic memory such as Collins & Quillian's hierarchical model; the feature overlap model; Collins & Loftus's spreading activation model including priming.
- Forgetting: The failure to retrieve a memory of a previous experienced event; models of forgetting such as consolidation theory, interference theory; decay versus interference in immediate memory; retroactive interference; proactive interference.
- Implicit memory: Memory without reference to a specific learning episode; Implicit versus explicit memory; indirect versus direct test; implicit learning; experimental dissociations; association priming; models of implicit memory such as activation, multiple memory systems, transfer appropriate processing, bias approach.
- Memory and brain: The neural base of learning and memory; Information processing in and between neurons; synaptic plasticity; postsynaptic potential; classical conditioning; instrumental conditioning; Hebb rule; anatomy; cerebral cortex, methods of investigation such as EEG, ERP, CT, MRI, PET, fMRI.

- Memory deficits: Amnesia and Alzheimer's disease; retrograde and anterograde amnesia; Korsakoff syndrome; methods to assess amnesia; case study; Alzheimer's disease and diagnosis.
- Recognition: Identifying material that has been presented previously; signal detection theory; face recognition.
- Reconstructive processes in memory: Eyewitness memory; flashbulb memory; hypnoses; emotion and memory; context and memory; cognitive interview; implanting memories (false memory).
- Mnemonics: Strategies used to improve memory; levels of processing; PQ4R; method of loci; method of associations; method of key words; number-consonant alphabet.

720201 – Emotion and Motivation

Short Name: Emot-Motiv
Type: Seminar
Semester: 4
Credit Points: 5 ECTS
Prerequisites: None
Corequisites: None
Tutorial: No

Course contents Emotion and motivation are central to our own experience of the world and strongly influence the role we play in it. Emotion and motivation interface with almost all areas of psychology and are also highly relevant in connected domains. Terms such as emotion, mood, temperament, but also motivation are often used in ways that reflect our layman's understanding of these phenomena, but that does not take into account the extensive history of scientific research into these concepts. This course explores the history and tradition of scientific research on emotion and motivation. The course is to provide students with a solid understanding of the competing theoretical approaches at different levels, ranging from biological and neuroscience approaches to social and cultural concepts. In consequence the successful participants shall have the foundations required to analyze the strengths and weaknesses of applying such concepts various contexts, including in empirical research as well as in various applications. Lastly, they shall be informed of current debates and trends in emotion and motivation research Major theoretical approaches will be presented for emotion and for motivation. In each case there will be an emphasis on critical analysis and discussion of the premises and inconsistencies of the theories in the light of empirical data. The work of specific researchers or specific methods (e.g., measurement of facial activity) will be pursued in more depth. Major theoretical approaches to emotions:

- Darwinian perspective on emotions.
- Evolutionary basis of emotions and their expressions: Jamesian Perspective of emotion.
- Function of physiological changes associated with emotion: Cannon critique of specificity of physiological patterning; mixed models, specifically the Schachter-Singer theory of emotion and associated concepts, such as excitation transfer.
- Cognitive perspective of emotion: Origin of the modern appraisal construct in the approaches by Arnold and Lazarus, as well as modern multidimensional concepts of appraisal (e.g., Frijda, Smith, Scherer, Roseman); the relationship of cognition and emotion

will be discussed particularly in the light of the Lazarus-Zajonc debate; multiple levels of processing.
- Social-Constructivist Perspective: Different levels of social influence on the definition, experience, and expression of emotions will be discussed (e.g. Averill's theory); display rules, feeling rules, and social schemata of physiological responses.

Major theoretical approaches to motivation:
- History of the motivation concept
- Biological approaches: Drive concept; examples such as hunger, thirst; physiological underpinnings.
- Behavioural approaches: Learning theory in relation to motivation (Pavlov, Thorndike, Garcia); innate vs. learned behaviour; species-characteristic stereotyped behaviour.
- Cognition and emotion: Goals as knowledge structures
- Motivation and social behaviour: Sociobiology, evolutionary psychology. Cultural perspectives
- Interaction between emotion and motivation

740102 – Lab Course in Experimental Psychology II

Short Name: Lab.Exp.Psych.II
Type: Lab
Semester: 3
Credit Points: 5 ECTS
Prerequisites: None
Corequisites: None
Tutorial: No

Course contents Design and conduct of experiments in small groups Small groups of students develop, conduct, and analyze empirical projects. The choice of the question to be studied, the hypothesis, the operationalization of the variables, and the conduct of the study are to be performed by the students. This includes a much greater focus on and participation in the theoretical derivation of the research question than the Lab Course in Experimental Psychology I. The course will be divided into group sessions in which common issues relating to the stages of the projects are discussed. In addition, there will be individual meetings with the groups linked to their specific projects. An emphasis is put on the translation of prescientific observations to clear hypotheses and their link to existing theoretical frameworks. Critical analysis and discussion of these elements are of particular importance. The results of the studies are to be presented in the form of simulated conference presentations or posters.

4.2.2 Biology/Neuroscience Specialization

500221 and 500222 – Advanced Lab Course Biology/Neuroscience I and II

Short Name: AdvLabBioNsc I+II
Type: Lab
Semester: 3 and 4
Credit Points: 7,5 ECTS
Prerequisites: None
Corequisites: None
Tutorial: No

Course contents This is a major-specific mandatory lab course for Cognitive Psychology and Neuroscience majors in their second year. Lab course units include selected experiments from basic and clinical Neuroscience. From 4 units to be selected, 2 are prescribed.

- Microbiology Unit (elective)

In the Microbiology unit, participants will learn how and where microbes live, how they utilize nutrients, and how we can identify them based on their phenotypes and genotypes. Students will isolate bacteria from different natural and man-made sources, respectively, and will use pure cultures of these micro-organisms to conduct physiological experiments and to classify them phylogenetically.

- Neurobiology and Sensory Physiology lab unit 1 and 2 (mandatory)

How does the human brain use environmental as well as internal (somatic) sensory information to guide perception, cognition and behavior? We explore this question through experiments that demonstrate principles of sensory (auditory, visual) transduction as well as fundamental mechanisms of perception in the human brain. Tutorial components during the unit offer an opportunity to discuss in more detail material from corresponding lectures and to become acquainted with the latest research trends in sensory neuroscience.

560122 – Biological Physics

Short Name: BioPhys
Type: Lecture
Semester: 2
Credit Points: 5 ECTS
Prerequisites: None
Corequisites: None
Tutorial: None

Course contents To understand and design biotechnological processes quantification is necessary. This course introduces general physical principles needed to quantify biological phenomena. To facilitate the understanding we provide also some basic mathematical procedures. We introduce the concept of forces, potentials, electric fields but also fluidic dynamics, heat, flow. The relevance is demonstrated using the example of the bacterium Escherichia coli for which we characterize the underlying principle of motion, diffusion, elasticity and energetics.

4.2.3 Psychology Specialization

990201 – Statistical Methods II: Classification, Modeling and Prediction

Short Name: Stat.Meth.II
Type: Lecture/Lab
Semester: 3
Credit Points: 5 ECTS
Prerequisites: None
Corequisites: None
Tutorial: No

Course contents This course builds on discussion of quantitative methods in Statistical Methods I. It focuses on multivariate statistical methods, in particular regression analysis, factor analysis, principal component analysis, and cluster analysis. The general objective is to make students intelligent users of the various multivariate statistical methods and enable them to make sensible decisions about when to use which procedure. This course, like the previous one, is divided into lecture and lab sessions. The lectures discuss the theoretical aspects of the different methods. The lab classes teach students how to run the relevant procedures in SPSS, how to interpret the computer output and how to effectively communicate the results of statistical analyses.

710211 – Attention

Short Name: Attention
Type: Seminar
Semester: 4
Credit Points: 5 ECTS
Prerequisites: None
Corequisites: None
Tutorial: No

Course contents Attention research seeks to understand how attention allows and affects detection, perception and encoding of information, which algorithms underlie attentional functions and how those are implemented in the human brain. The course focuses on classic and current issues within the field of attention research. The course includes the following topics:

- Seminal past and current theories and models of attention
- Research methods and paradigms to study attention; attention tests
- Alerting, sustained attention, divided attention, selective attention, joint attention
- Involuntary versus voluntary attention, attentional control
- Overt attention: exploring the world with saccadic eye movements
- Attention across modalities
- Development of attentional functions
- Disorders of attention; impact of brain injuries on attention
- Neuronal networks of attention in the brain
- Practical applications of attention research

4.3 Third Year of Study

4.3.1 General Courses

500321 – Neuroendocrinology/Biorhythms

Short Name: NeuroendoRhyth
Type: Lecture
Semester: 5
Credit Points: 5 ECTS
Prerequisites: None
Corequisites: None
Tutorial: No

Course contents The course will cover the fascinating properties of neurons which produce hormones (neurosecretory neurons), e.g., oxytocin, vasopressin, releasing hormones, etc. By neuroendocrine processes, such important processes like reproduction are regulated. Biorhythms are the basis for adaptation to varying environmental factors. Virtually all organisms including single cells express such rhythms. During the lecture, students will learn the basic principles of rhythm generating systems and their importance for the life sciences.

500332 – Theoretical Neuroscience

Short Name: TheoNeuro
Type: Lecture
Semester: 6
Credit Points: 5 ECTS
Prerequisites: None
Corequisites: None
Tutorial: No

Course contents The course will cover methods and knowledge for addressing structure - function relationships at different scales of the nervous system through mathematical analyses and computational modeling. Lectures will review neurobiological concepts and currently available data as well as mathematical approaches for representing neural systems. Complementary lab session will provide an opportunity to become familiar with widely used neural modeling packages and to carry out individual course projects.

500341 – Behavioral Neurobiology: A lifespan developmental perspective

Short Name: BehNeuroBio
Type: Lecture
Semester: 5
Credit Points: 5 ECTS
Prerequisites: None
Corequisites: None
Tutorial: No

Course contents This advanced course will add a lifespan developmental neuroscience perspective to topics previously covered in cognitive psychology and neuroscience. Biological (e.g., genetic) and contextual (e.g., experience) influences on brain development over the lifespan are addressed. Plasticity of the brain across the lifespan is emphasized. Plasticity is the ability of the nervous system to respond to changed demands and, thus, underlies learning and adaptive behavior. Development of the cerebral cortex and behavioral outcomes are explored in the context of environmental effects that can amplify or inhibit adaptive capacity. Neural malleability is maximal in early development, but the capacity for change in the nervous system is maintained throughout life including old age. Normal age development of the brain is contrasted to pathological changes that appear in some diseases of old age. Consequences of normal and non-normal development and aging and the influence of lifestyle factors (e.g., a physically active lifestyle, continued education) are discussed. Students will leave the course with an understanding of brain-behavior-environment interactions in lifespan developmental outcomes. Students will train their research, presentation and writing skills by critically evaluating scientific evidence.

720302 – Social Neuroscience

Short Name: Soc-Neuro
Type: Seminar
Semester: 6
Credit Points: 5 ECTS
Prerequisites: None
Corequisites: None
Tutorial: No

Course contents Social Neuroscience assumes that the mechanisms underlying mind and behaviour will not be fully explicable by a biological or a social approach alone. Hence, the interactions of different levels of organization, ranging from hormonal and biochemical factors, to the central and peripheral nervous systems, the endocrine and the immune systems, individual differences in behaviour, interpersonal interactions, and social and cultural moderators are the main focus of study. None of these levels is considered the best level of analysis for the understanding of human or animal behaviour. The students shall understand the rationale of and challenges for multi-level analyses and become familiar with examples of such approaches relating to different psychological concepts. This course provides arguments that social and biological approaches are complementary rather than antagonistic. Specifically it will address:

- Philosophical issues regarding the mind-body relationship.
- Basic concepts of the psychophysiological approach.
- Social Neuroscience as an extension of the psychophysiological approach.
- Multilevel integrative analyses of social behaviour.
- Introduction to the relative functions and structure of autonomic and somatic nervous systems in relationship to the central nervous system.
- Social cognition and the brain: Basic processes, specific processes, such as the self, perceiving others, social information processing; description of a module in human extrastriate cortex specialized for face perception; voice-selective areas in human auditory

cortex; the human amygdala in social judgment.
- Social Neuroscience of motivation and emotion.
- Social Neuroscience of attitudes and preferences: For example event-related potentials as indicators of negativity bias; face elicited event-related potentials and tomography analyses of affective attitude.
- Biology of social relationships and interpersonal processes: Basic processes, specific processes such as attachment, personal ties, affiliation and sexuality, aggression and social order, individual differences in social behaviour.
- Social influences on biology and health (. e.g., psychoneuroimmunology)
- Problems of the Social Neuroscience concept.
- The difficult relationship of social and biological approaches in psychology.

500361, 500362 – Guided Research and BSc Thesis in Cognitive Psychology and Neuroscience I and II

Short Name: GRCPN I, GRCPN II
Type: Research
Semester: 5 - 6
Credit Points: 15
Prerequisites: None
Corequisites: None
Tutorial: No

Course contents This lab course intends to intensely train students in laboratory practice on a given research project of the Instructor's group. It is an integrated part of the lab rotations each student has to attend during the 3^{rd} year education. Two lab rotations per each semester of the 3^{rd} year will give the students the opportunity to visit four different research laboratories of the various life sciences disciplines participating in this course structure. All individual lab rotations will finally be written up in a thesis to prove the student's ability of performing independent research. Scheduling has to be decided between the students and the individual Instructors of the particular lab rotations. The Instructors of Record of the BCCB, CPN, and Biotechnology 3^{rd} year lab courses I and II will have to organize for accommodation of each student within the research laboratories preferably of their first choices. However, this needs to be done in a way to allow equal and appropriate distribution of all students between the various research groups. Students will indicate their preferences, and the Instructors of Record will decide on the order of lab rotations during the 3rd year. To enable the students with the necessary information on which lab to choose, an information evening will be organized at the end of the 4th semester. Students are urged to attend.

4.3.2 Biology/Neuroscience Specialization

560351 – Biophysical Chemistry

Short Name: Biophys
Type: Lecture
Semester: 5
Credit Points: 5 ECTS
Prerequisites: None
Corequisites: None
Tutorial: None

Course contents Interactions between molecules, such as antibody-antigen, enzyme-substrates, receptor-membrane are the base of biological processes. This course introduces current theoretical and experimental tools to quantify such interaction between biomolecules. We begin with a molecular view to introduce the relevant forces and interaction necessary to understand and perform molecular modeling. In a second part we follow a more macroscopic thermodynamic view: substrate binding or partitioning, cooperative effects, transport across membranes to name a few keywords. The third part is devoted to kinetic phenomena and the necessary experimental techniques as relaxation theory, correlation spectroscopy, stopped flow.

4.3.3 Psychology Specialization

710302 – Decision Making

Short Name: Dec-Mak
Type: Lecture
Semester: 6
Credit Points: 5 ECTS
Prerequisites: None
Corequisites: None
Tutorial: No

Course contents Decision making may be defined as intentional and reflective choice in response of perceived needs. Decision making and decision theory are broad and complex areas of great theoretical interest and practical impact in almost all today's disciplines ranging from biology and neuroscience to computer science, economics, marketing, mathematics, political sciences, psychology to sociology or statistics. In some of these disciplines decision making has been studied for more than two centuries. The focus in this lecture lies on individual decision making. The students learn about basic concepts of decision making, theories of decision making, methods to elicits values/utilities, importance weights/probabilities and shall be able to conduct a decision analysis. New directions in decision making research complement the course. Specifically, the following topics are addressed:

- Elements of decision problems: Values, objectives, sequential decisions, uncertain events, consequences
- Models of problem structure: Fundamental and means objectives, influence diagrams, decision trees

- Models of uncertainty: probability and its assessment, judgments, heuristics and biases, accuracy , calibration
- Models of preference: expected utility theory, prospect theory, models for decision making under certainty, heuristics
- Decision analysis: Value/utility measurement, probability/ weight measurement, Multi-attribute Utility Theory (MAUT), conjoint analysis, sensitivity analysis
- Specific topics such as neuroeconomics, decision making in medicine and new approaches in the field of decision making

720311 – Culture and Cognition

Short Name: Cult-Cog
Type: Seminar
Semester: 5
Credit Points: 5 ECTS
Prerequisites: None
Corequisites: None
Tutorial: No

Course contents Cognitive scientists and cultural theorists traditionally have thought about the culture's influences on cognition quite differently. From a Cognitive Science perspective, the study of cognition typically is construed as the search for those aspects of mental experience that are uniformly true for all. In fact for much of the 20th century most psychologists assumed that all normal human beings were equipped with the same set of attentional, perceptual, memorial, learning, and inferential procedures. From a Cultural Studies perspective, there is no avoiding the cultural framework within which individuals think and act. The idea of universal mental experiences is often rejected outright by many cultural theorists; every human thought and perception is uniquely situated within a very specific framework informed by history, tradition, language, social context, etc. The goal of this seminar is to explore the dynamic of both perspectives by asking which aspects of human thinking and judgment are universally the same or culturally shaped. In particular the following issues and questions will be addressed:

- Definitions of culture and dimensions of cultural comparisons
- Methodological challenges of studying culture's influences
- Culture and systems of thought: Analytic versus holistic thinking
- Causal attribution across cultures: How fundamental is the fundamental attribution error?
- Cultural differences in reasoning: Western logic versus Eastern dialectics
- The self-concept in a cross-cultural perspective: Independent versus interdependent self-construals
- Culture and context: How flexible are cross-cultural variations in self-construals?
- Does thinking about the self influence thinking in general?
- Direct versus indirect communication in different cultures
- Characteristics of cross-cultural interaction: Working in multi-cultural teams
- Intercultural trainings

This seminar provides an introduction to important theoretical approaches from both Cognitive and Social Psychology as well as from adjacent other disciplines, like Anthropology or Ethnology. The discussed research findings may, however, help to improve cross-cultural interaction in many applied fields.