PhD Education

Overview of available courses at our partner schools
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INTRODUCTION

This guide is meant for all PhDs within the Language in Interaction (LiI) project and provides an overview of available courses at our LiI partner schools.

LiI aims at teaching and training the next generation of leading scientists in its field of research. To provide an optimal educational environment for all junior scientists, Language in Interaction exploits, coordinates, and integrates the already existing excellent graduate programmes in its field. These are:
- Donders Graduate School (DGS)
- International Max Planck Research School for Language Sciences (IMPRS)
- Institute for Logic, Language and Computation PhD Programme (ILLC)
- Netherlands Graduate School of Linguistics (LOT)
- Netherlands Research School for Information and Knowledge Systems (SIKS)

Each LiI PhD student is allowed to participate in courses of the above-mentioned graduate schools against rates applicable for internal students; thus without additional costs. In addition, on their own initiative LiI PhDs can opt for lab rotations at all PI groups participating in LiI, enabling optimal, individualized curricula.

Next to all available courses from our LiI partner schools, additional courses are listed that are NOT offered by our LiI partner schools but directly by a university or affiliated institute. These courses are NOT freely accessible for all LiI PhDs. We still chose to list these courses as they are of great value for a large part of the LiI PhDs.

All courses in this document are subdivided into the categories "disciplinary-", "technical-" and "soft skill courses". You may use the table of contents to find an interesting course. By clicking the accompanying page number, you will automatically be redirected to summary information on this course. If more elaborate information on a course is available on an external webpage a link is provided below the course title.
DISCIPLINARY COURSES

Donders Graduate School

Advanced Computational Neuroscience (6 EC)
(link)

Prerequisites
Neurophysics 1 and Neurophysics 2

Objectives
After successful completion of the course, you will be able to understand the computational neuroscience literature, in terms of being able to implement and critically evaluate these models in terms of whether they address the underlying neuroscience problem, and write computer programs to implement a number of common computational models.

Contents
The course consists of two parts. One part is given by Kappen and consists of the following topics: stochastic neuron models and networks, deep networks and sparse coding, learning rules for classification, Boltzmann Machines and reinforcement learning. This part contains many computer exercises that are also the final examination.

The other part is taught by Tiesinga uses the tools of nonlinear dynamics, neural networks and information theory (covered in Computational Neuroscience) to study models for cognitive processes, such as attention, decision making, memory and learning. Each year there will be a variety of topics covered in the lectures choosen from amongst modern literature on reinforcement learning, neuromorphic computing (?), neural oscillations in cognitive processes and information transfer, plasticity, reduction of large-scale models to low-dimensional dynamics, and single neuron models at various levels of complexity. The students will do small problem sets in a weekly practice hour during the course (30%) and a final project (70%) for the end grade.

Lecturers
prof. dr. P.H.E. Tiesinga, and prof. dr. H.J. Kappen

Animal Models for Brain function and Disorders (6 EC)
(link)

Objectives
Experiments in animals and in animal models for normal and pathological behaviour form an indispensable link between neuroimaging studies in humans and molecular and cellular work in neuronal tissue from various species. Animal experiments allow also invasive neurotechnologies to delineate the neurobiological mechanisms of different aspects of behaviour and cognition.

The students will get a critical state-of-the-art overview of different animal species (zebrafish, mouse, rat) used for neuroscience research, their pro’s and con’s and translational value, transgenic animal models and their breeding, behavioural models for endophenotypes of brain disorders and their validity, in vivo neurotechnologies like neuroimaging, opto- and chemogenetics, electrophysiology, EEG, tracing and intracerebral pharmacological manipulations, surgery methods, experimental design, data analysis, and ex vivo approaches like immunohistochemistry and electrophysiology.

Lectures will be complemented with several animal facility tours and demonstrations. The students themselves will get the possibility to work out and present a detailed plan for an animal experiment based on research questions formulated by the teachers (student presentations). The students can use the practicalities addressed during the lectures, the literature proposed to read for each lecture, and any additional literature needed to fulfil this assignment.
The course is indispensable for students who are considering to do in vivo animal experiments. It gives also an excellent opportunity to meet scientists from different neuroscience fields offering internship positions.

After completion of the course, students are able to:
1. Define technologies to generate and method to breed transgenic animals
2. Define which behavioural models for rodents measure what type of behaviour and how they work
3. Define animal models for disease and aware of their advantages and disadvantages
4. Explain how neurotechnologies and ex vivo technologies work
5. Design experiments dedicated to test a hypothesis and evaluate experiments as presented in papers

Contents
Brain function and the neurobiology of their disturbances are far from elucidated. Recent advances in tools to manipulate the genome of animals and (related) neurotechnologies to manipulate specific neural projections or to measure neuronal firing and neurotransmitter release have greatly contributed to unravelling mechanisms. Furthermore, neuroimaging, the technique to measure brain structure and function in humans, is now also applied to small animals to gather data with high translational value. The course is given by experts in the field. Some have been developing psychoactive drugs for many years in various drug companies, all have long records as neurobiologists with a deep interest in behaviour, cognition and their disturbances. Lectures will be given on various aspects of animal models for a selected number of brain functions and psychiatric and neurological disorders such as autism, anxiety and depression, drug addiction, Alzheimer’s disease, pain and epilepsy.

Lecturer
prof. dr. J.R. Homberg

Attention and Performance (6 EC)

Objectives
This course will provide students with a state-of-the-art introduction to sensorimotor task performance and the role of attention in this process. This is achieved by explaining how perception, action, and attention mechanisms characterized at a functional level are linked to brain activity, neural circuits, and genetic variation, and how these mechanisms are engaged in sensorimotor task performance. At the end of the course, students will be able to (1) describe key empirical findings in the cognitive neuroscience of attention and performance, (2) analyze and compare current theories of attention and performance, and (3) evaluate the theories in the light of the key findings or new predictions.

Contents
(1) Neurobiological aspects. The course will provide a detailed overview of the neurobiological basis of the hierarchically organized human sensorimotor and attentional systems, including ventral and dorsal streams for perception and action, the cortical and subcortical structures underlying alerting, orienting, and the executive control of perceptually guided action, corresponding neurotransmitter systems, and attention-related genes.
(2) Functional aspects. We will address key aspects of sensorimotor task performance and their relation to the attentional functions of alerting, orienting, and executive control; the executive functions of updating/monitoring, inhibiting/enhancing, and shifting; ventral and dorsal streams for perception and action; internal forward and inverse models; performing Stroop-like tasks, task switching, and dual-task performance; perception-action coupling, ideomotor theory and mirror neurons; attention and automaticity; errors and performance monitoring; attention and consciousness.
(3) Theoretical/quantitative aspects. Part of the course will address the computational and mathematical modeling of sensorimotor task performance and the role of attention. We will emphasize analysis of performance distributions rather than mean performance measures.
(4) Additional aspects. We will discuss evidence from response times and their distributions,
performance errors, eye-tracking, lesion-deficit analysis, animal neurophysiology, and human imaging (EEG, MEG, fMRI, TMS, and genetic imaging). Where relevant, implications of theories, models, and empirical findings for applied and clinical research issues will be discussed.

Lecturers
prof. dr. A.P.A. Roelofs, and dr. M.V. Peelen

Cognition and Complexity (6 EC)
(link)

Prerequisites
A completed (academic) BSc degree in Artificial Intelligence or related field (such as Cognitive Science, Computing Science, Cognitive Psychology, Cognitive Neuroscience, Philosophy, or Linguistics). Furthermore, the course assumes that students have some affinity with cognitive psychological research and some proficiency in algorithm design and analysis.

Objectives
In this course, students learn to use methods derived from computational complexity theory for analyzing the (in)tractability of cognitive models, and for identifying sources of complexity in a model. Students also learn how this knowledge can be used to make model revisions that yield tractability. As two competing models may differ in the nature of their sources of complexity, the analyses can also yield novel empirical predictions that can be used to test the models.

Contents
The functioning of the human brain can be studied and modeled at different levels of abstraction ranging from the neural implementation level to a cognitive computational level. Ideally, models postulated at the computational level are consistent with the brain resources available at the neural level. Building computational models that fit with human brain resources can be quite challenging. This is illustrated by the fact that many computational models in Cognitive (Neuro)science postulate brain computations that are—on closer inspection—computationally intractable. Here ‘computational intractability’ means that the postulated computations require more resources (such as time, space, memory, hardware) than a human mind/brain or any computational mechanism has realistically available.

Examples of intractable computational models can be found in almost all cognitive domains, including perception, learning, language, planning, decision-making, communication, and reasoning. Intractability makes these models psychologically and neurally implausible as cognitive computational level models of brain functioning. However, there are ways to deal with this problem by identifying sources of complexity in these models and investigating if they can be removed from the model without the loss of explanatory power. This course covers several concepts and techniques that can be used to this end.

Lecturer
dr. I.J.E.I. van Rooij

Cognitive Control and Decision Making (6 EC)
(link)

Objectives
This course will provide students with a thorough background in the neurobiological and functional properties of human cognitive and behavioural control, motivation, top-down attention, reinforcement learning and impulsive decision making. This will be achieved by providing a multi-disciplinary and convergent-methods approach, integrating essential theoretical and experimental frameworks from experimental psychology, neuroimaging and electrophysiology, psychopharmacology and computational modeling in humans as well as nonhumans animals.
By the end of the course, students will have obtained knowledge about the various theoretical frameworks that exist for guiding and interpreting empirical evidence on important constructs in this quickly developing field. In addition, the course will engage them in several activities to get them thinking like scientists. For example, they will be taught to judge and combine existing knowledge and ideas to create new ideas by developing and presenting a research proposal to address an unanswered question in the field.

Contents
(1) Neurobiological aspects. The course will give a detailed and comprehensive overview of the neurobiological basis of human cognitive control, goal-directed and habitual behavior, and decision making, while taking into account research in humans and animal models. The role of the major ascending neuromodulatory systems, such as those of dopamine and serotonin, will be discussed. Fields ranging from functional neuroanatomy via neurophysiology, psychopharmacology, genetics, computational modeling to cognitive and experimental psychology will be covered.
(2) Functional aspects. We will focus on basic constituents of cognitive control, such as value-based and perceptual decision making, top-down control of perception and attention, and reinforcement learning. Furthermore, we will discuss failures of control in neurological and psychiatric disorders and across development.
(3) Theoretical aspects. Current theories and mathematically formalized computational models applied at various levels of abstraction will be presented and discussed in the light of experimental data.
(4) Additional aspects. Where relevant, implications of theories, models and empirical findings for applied and clinical purposes will be discussed. Where necessary, experimental methods and analysis tools for studying cognitive control will be presented.

Lecturer
prof. dr. R. Cools

Cognitive Neuroscience of Memory (6 EC)
(link)

Objectives
This course gives an in-depth overview on how we encode, store and retrieve information in terms of memory systems, which are anatomically defined structures supporting specific and diverse operations all characterized as memory.

Contents
This course covers the underlying mechanisms and cognitive concepts of memory, our ability to use past experiences. It has five major sections:
(1) The introduction sets the basic framework in which we are working with in present day memory research: Memory systems and cellular and molecular underpinnings of neural plasticity.
(2) In a second section, we will discuss the basic processes of memory - how is new information encoded, how is this information later retrieved from memory and how has it been consolidated in the meantime?
(3) In the third section, you will learn how spatial information is represented and stored in memory.
(4) A more methods based section will introduce animal models of memory and novel techniques in cognitive neuroscience of memory like decoding memories from fMRI data or oscillatory brain activity.
(5) The final section will explain situations when memory is too good and not good enough. While stressful life events can lead to traumatic memories that cannot be forgotten, neuropsychiatric disorders can impair memory so that nothing can be remembered.

Lecturer
prof. dr. G. Fernandez
Computational Neuroscience (3 EC)
(link)

Prerequisites
Neurophysics 1 and Neurophysics 2

Objectives
After successful completion of the course
(1) The student is able to calculate the response of a neuron or of a network of neurons to various inputs, both analytically and by computer simulations
(2) The student should be able to apply basic principles from Information Theory and Non-linear Systems analysis to quantify information processing by networks of neurons and to determine the attraction domain and stable states of a network of neurons.
(3) The student should be able to discuss the functional role (if any) of oscillations, neuronal correlations and neuronal variability based the homework problems and assigned literature

Contents
The aim of this course is to give a theoretical description of the neuronal dynamics at the level of a single neuron and at the population level. The theoretical model will be used to explain the information processing and the storage and retrieval of information by populations of neurons. We will cover the following topics: nonlinear dynamics of neurons and systems of neurons, population coding in combination with Fisher information, information theory, neural-mass models and models and function of oscillations.

Lecturers
prof. dr. P.H.E. Tiesinga, and prof. dr. H.J. Kappen

Developmental Cognitive Neuroscience (6 EC)
(link)

Objectives
During the course, a number of general topics from the field of Developmental Cognitive Neuroscience will be addressed. This sub-discipline at the interface between cognitive neuroscience and developmental psychology is a young and promising field within the area of neurosciences. After following the course, the student will have a broad overview over the field of study and its methods. The student will also have an in-depth understanding of a number of key issues, theories, and current research topics and will be able to critically evaluate a number of debates in the field of Developmental Cognitive Neuroscience.

Contents
After a general overview on the discipline, the different methods of studying neuro-cognitive development in young children will be addressed (such as measures of brain activity, looking measures, the use of marker tasks etc). The main focus of the course will be on the early development of perception and action. From these areas, a number of current research topics, such as the development of vision, orienting and attention, face perception, and the development of action perception and action production, will be chosen and discussed intensively. Other topics include the early development of memory and executive functioning,

(1) Neurobiological aspects: The course will provide an overview on the early development of the brain with several aspects of the pre- and postnatal brain development being treated in more detail. Special attention will be paid to the recent attempts to link changes in performance in cognitive tasks to brain development.
(2) Functional aspects: Basic experimental paradigms that investigate the cognitive development of perception and action will be discussed. Research on deviant functioning and atypical development also plays an important role within the field of developmental cognitive neuroscience as it can shed light on the neural basis of normal cognition. In this course, attention will be paid especially to autism, dyslexia, and Williams syndrome.
(3) Theoretical aspects: Different models of neurological and psychological development will be
discussed. Furthermore, an important part of the course will be discussing contrasting theoretical explanations of findings on early neuropsychological and perceptual, social and cognitive development and their implications for the field of developmental cognitive neuroscience.

(4) **Additional aspects:** The students will be given the opportunity to gain some hands-on experience with baby research. During the course, there will be a visit to the Baby & Child Research Center and a series of practical sessions on working with video, eye-tracking, and EEG data from infants.

**Lecturer**
prof. dr. S. Hunnius

**Early Onset Neurodevelopmental Disorders (6 EC)**

**Objectives**
This course will focus on early onset neurdevelopmental disorders, the underlying brain mechanisms, early environmental and genetic risk factors, and later patterns of normal and deviant behavior (i.e. psychopathology). After this course, the student will be able to:

1. Describe the clinical features of neurodevelopmental disorders such as ADHD, ASD, and childhood psychopathy/ aggression.
2. Understand the association between brain development and early onset neurodevelopmental disorders.
3. Understand the contribution of genetic and environmental factors to early brain development and neurodevelopmental disorders (at levels of quantitative genetics, molecular genetics, imaging genetics, early environmental risk factors).
4. Understand concepts and research literature on animal models on neurodevelopmental disorders.

**Learning goals**
(1) You will learn to understand the principles of early brain development in the context of early onset neurodevelopmental disorders such as ADHD, ASD, conduct disorder/aggression and intellectual disability.
(2) After the course, you can explain the association between brain development, genetic plus environmental factors and neurodevelopmental disorders. You will grasp brain imaging and cognitive techniques, applied to the study of these disorders. You will also learn about the effect of early environmental risk factors (maternal stress, fetal exposure to alcohol and nicotine, exposure to SSRIs) on brain development, and about animal models (mice, rats) of neurodevelopmental disorders.
(3) You will present a research paper on one of the topics together with another student. Throughout the course, you give feedback on presentations of other students and reflect critically on scientific papers.

**Contents**
(1) Introduction: brain development and psychopathology
(2) Autism, 3 lectures
(3) ADHD, 2 lectures
(4) Childhood psychopathy and aggression, 2 lectures
(5) Molecular principles of early brain development
(6) Animal models of neuropsychiatric disorders, 2 lectures
(7) Exposure to SSRIs, serotonin and brain development
(8) Twin studies of neurodevelopmental disorders
(9) Mindfulness-based interventions for ADHD
(10) Molecular-genetics of neurodevelopmental disorders
(11) Imaging genetics in neurodevelopmental disorders
(12) Integration and wrap-up

**Lecturer**
dr. C. Greven
First Language Acquisition (6 EC)

Objectives
Mastering a first language is one of the most striking achievements of human development. This course provides an introduction to theory, empirical findings, and research methods in the study of language acquisition. This course comprises two parts. After a general introduction into the field, we will focus on the acquisition of word level structure: sound structure, morphology and the acquisition of the lexicon and the acquisition of higher-level structure: information structure, syntax, and the syntax-semantics interface. In both parts there will be substantial attention to children’s online processing.

Contents
(1) Acquisition of sound structure, morphology and the lexicon. During the first year of life infants become increasingly sensitive to language-specific features of the sound system of their native language. We review segmental, phonotactic, and prosodic aspects of phonological acquisition, and examine the research paradigms used to investigate infant and child speech perception. The results from perception studies are compared to those from production studies. Production studies show that there is a continuum between babbling and early words in terms of motor skills, but cognitive factors and the acquisition of a lexicon come into play too as children build their phonological systems.

(2) The acquisition of information structure, syntax and the syntax-semantic interface: The second part focuses on first language acquisition and the development of grammatical processing mechanisms. We will examine research on first language acquisition and children’s sentence processing, and ask what the relationship is between the development of grammatical competence and the development of processing mechanisms/strategies; how L1 parsing procedures develop; and how children process sentences in comparison to adults.

Studies investigating children’s real-time language processing have until recently been rare in comparison to studies of children’s production and ultimate interpretation of language. This is surprising given the arguably crucial role that processing mechanisms may play in language development. In this course, the aim is to provide an overview on the topic of developmental psycholinguistics.

Lecturer
prof. dr. J.P.M. Fikkert

Molecular and Cellular Neurobiology (6 EC)

Objectives
The aim of this course is to give students an appreciation of current issues in Neurobiology, in particular molecular and cellular aspects, and more specifically regarding chemical and electrical communication in the brain, and how these can impact on behaviour; the (epi)genetic, molecular and cellular background of neurodegenerative and neurodevelopmental disorders; experimental design and interpretation of results of neurobiological studies, including handling of big data.

Contents
This course considers advanced topics in Molecular and Cellular Neurobiology. Topics include chemical communication in the brain, electrical communication in the brain, neurogenomics, molecular and cellular mechanisms involved in neurodegenerative diseases, in particular Alzheimer’s disease, and (epi)genetic and molecular mechanisms underlying neurodevelopmental disorders, in particular autism and schizophrenia. Aspects of these topics are presented, with emphasis on recent developments. Furthermore, the students will analyse, review and present scientific articles, and experimentally design and interpret results of neurobiological studies, including handling of big data, in computer-assisted, simulated research projects. The lectures are in English (exam questions are in English; exam answers can
Motor Control (6 EC)
(link)

Objectives
This course will provide students with a thorough background in the neurobiological and functional properties of the human motor system. The content is aimed at providing students with an understanding of many of the important principles and modern theories in motor planning, control, estimation, prediction, learning and coordination necessary to conduct, critically evaluate, and disseminate research of the motor system. This will be achieved by providing a multi-disciplinary overview of motor control, covering theoretical and experimental work from the fields of biomechanics, computational neuroscience, experimental psychology and robotics, and focusing on the hierarchical organization of the motor system considered from a neuroanatomical, neurophysiological and cognitive point of view.

Contents
(1) Neurobiological aspects. This course will provide a detailed overview of the neurobiological basis of the hierarchically organized human motor control system, including the (sub)cortical structures involved in the planning and execution of movements, the peripheral neuromuscular system and its specific biophysical make-up, and the various reflex mechanisms involved in motion. Fields that will be covered are neuroanatomy, neurophysiology, biomechanics, and psychonometrics.
(2) Functional aspects. We will focus on eye, head, and arm movements, as well as on walking, drawing and handwriting. Research paradigms that are promising for future neurocognitive research, stemming from experimental psychology and human movement science, will be discussed.
(3) Theoretical/quantitative aspects. An overview will be presented of the theoretical models of the planning and execution of movements that address problems related to solving inverse kinematics and inverse dynamics of kinematically redundant limbs, feedforward and feedback mechanisms in motor systems, learning and self-organization and cognitive constraints which affect human motor performance. All models will be discussed in the context of available experimental data.
(4) Additional aspects. Where relevant, implications of theories, models and research findings for applied and clinical research purposes will be discussed. Part of the course will focus on experimental methods for studying human motor control, including analysis tools like computational modelling and rigid-body analysis, EMG, EEG, MEG, and fMRI.

Neurobiology of Language (6 EC)
(link)

Objectives
This course will provide up-to-date insights into the neurobiological basis of language. The course will be given by internationally leading researchers in the field. Students will learn how state-of-the-art methods and approaches are currently being applied, and what are the next big questions for the field.

Contents
Students will get a thorough overview of the neural processes involved in language comprehension and production. We will see how insights from cognitive neuroscience can inform psycholinguistic models and vice versa. Topics covered include (among others): Neural basis of semantics; Pragmatics and the brain; Cognitive neuroscience models of language;
Neural insights into prediction in language. Part of the course consists of discussion sessions.

Lecturer
dr. R.M. Willems

Neurobiology of (mal)Adaptation (6 EC)
(link)

Objectives
This course teaches how the brain and its physiology changes when individuals are challenged by environmental adversity. At the end of the course the student understands the neural mechanisms of adaptive and maladaptive plasticity; and will be able to implement the latter in the analysis of the pathophysiology of numerous psychiatric disorders.

You will understand and be able to explain the various domains (functional, special and temporal) of the stress adaptation response. You will gain in-depth knowledge about the molecules and neuronal pathways governing the physiological, endocrine and behavioral stress response.

You will be able to interpret critically and design yourself experiments with animals as well as human subjects probing the neural basis of the acute stress response and the long-term consequences of stressful experiences.

Contents
This course integrates animal models and human data disclosing adaptive and maladaptive responses to stressful events. Our course has five sections ranging from an introduction into (i) the molecular and anatomical pathways underlying the stress response, (ii) the basic behavioural response repertoire like fear conditioning, freezing, and fight/flight, over (iii) gene, gene-by-environment interactions and transgenerational inheritance of stress effects relevant for (interindividual differences)of the stress response, to human data into (iv) fundamentally adaptive responses to threat and (v) maladaptive consequences of stress leading to the most important psychiatric disorders like major depression and anxiety disorders.

Lecturer
prof. dr. G. Fernandez

Neurogenetics (6 EC)
(link)

Objectives
The aim of this course is to provide a comprehensive overview of exciting developments in neurogenetics research and the molecular and cellular mechanisms that are disrupted in disorders that affect the nervous system.

After this course you will be able to:

(1) Describe the complete range of monogenetic defects that result in neurodevelopmental disorders.
(2) Chose the right research strategy to locate genetic factors and pathways that are involved in monogenetic and multifactorial neurodevelopmental disorders.
(3) Describe the epigenetic modifications that affect learning, memory, and behavior and discuss transgenerational epigenetic inheritance.
(4) Chose an animal to model neurodevelopmental disorders and specify the optimal test to deduce the effect of dysfunctioning of specific genes and pathways on human learning, memory, and behavior.
(5) Apply the principles of neurophysiology to study synaptic plasticity in rodent models for neurodevelopmental disorders.
(6) Write an argumentative, well-organized project proposal to study the genetic origins of a neurodevelopmental disorder including a description of its impact on society.
Contents
Neurological disorders will be discussed which represent a variety of inheritance patterns and types of molecular genetic investigations. Examples include, X-linked and autosomal forms of intellectual disability, psychiatric conditions with complex inheritance, genetics of speech, epigenetic defects in neurological disease. The course starts with a few introductory lectures to introduce some basic genetic principles and methodologies, and then takes the form of weekly "journal clubs" that address specific neurological disorders. Later sessions of the masterclass will focus on molecular and cellular neurobiological mechanisms that are affected by mutations and research strategies that are used to unravel these: generation and characterization of model organisms (rodents, Drosophila), cellular studies and neurophysiology.

Topics include:
(1) Basic Molecular Genetics: Genes and chromosomes, inheritance patterns, linkage studies, genome projects
(2) High Throughput genomics, chromosomal disorders, CNVs and the plastic genome
(3) Mendelian disorders and special forms of inheritance (van Bokhoven, de Brouwer)
(4) Multifactorial disorders of the brain, Quantitative Neurogenetics
(5) Genetics of intellectual disabilities, autism spectrum disorder, ADHD, and schizophrenia
(6) Genetics of speech
(7) Imaging genetics
(8) Epigenetic defects underlying neurological disorders
(9) The genetic toolbox to generate tailor-made rodent models. Behavioral phenotyping
(10) Synaptic plasticity in rodent models for neurogenetic disorders
(11) Generation and characterization of Drosophilamodels for neurodevelopmental and neurodegenerative disorders
(12) Development of novel therapeutic strategies

Lecturer
prof. dr. ir. J.H.L.M. van Bokhoven

Neuroimaging I (6 EC)
(link)

Objectives
After completing this course, students are able to describe the basic principles of human cognitive neuroimaging. For all major neuroimaging modalities, they will be able to explain the relationship between neural activity and the measured signal. They will be able to evaluate strengths and weaknesses of different modalities for answering specific questions. They will be able to explain the basics of experimental designs and statistical analysis of neuroimaging studies. Furthermore, students will be able to describe the physics underlying neuroimaging techniques.

Contents
(1) Neuroimaging methodological aspects: This course will provide an overview of the currently most widely used neuroimaging methods in cognitive neuroscience (EEG/ERP, MEG, TMS, fMRI, PET). For each of these methods, the basic measurement technique and the relationship between the measured signal and neural activity will be discussed. Special emphasis is placed on what can and cannot be inferred in terms of underlying brain activity.
(2) Experimental design aspects: The course will discuss in detail how these methods are combined with experimental paradigms that isolate functional aspects of human cognition. It aims at making students aware of the relevant design issues in imaging experiments. It will also discuss the assumptions in mapping functional onto neural architecture.
(3) Data analysis aspects: The course will provide an overview of the methods of processing the data, obtained with the different research methods commonly used in modern cognitive neuroscience. The underlying data analysis models will be discussed, e.g., the General Linear Model for fMRI.

Lecturer
dr. N. Kohn
**Perception (6 EC)**

**Objectives**
The course aims at providing a comprehensive, multi-disciplinary, overview of visual information processing. This includes the neuroanatomical structure of the visual system, in depth coverage of neural coding at different levels, psychophysical characterization of processes, and cognitive aspects of visual pattern representations. After this course, you will be able to (1) describe and compare contemporary theories of visual information processing, (2) analyze and evaluate key findings in the domain of visual information processing, and (3) apply contemporary theories of visual information processing to existing as well as new visual phenomena.

**Contents**
(1) **Neurobiological aspects.** Topics covered will be the neurophysiological and neuroanatomical properties of the retino-cortical pathway. In addition, processing in the ventral/dorsal streams as well as neural correlates of top-down processes, the neural basis of movement detection and colour vision.
(2) **Functional aspects.** Psychophysical and empirical paradigms that are employed to investigate mental representations of visual patterns will be covered, as well as integrative theoretical paradigms, starting from structural descriptions of these mental representations.
(3) **Theoretical/quantitative aspects.** Recent models of self-organization in the visual pathway will be dealt with, starting with the development of neuronal connectivity in the retina, up to models for the emergence of feature-selectivity in the visual cortex.

**Lecturer**
dr. A.R. Koning

**Psychology of Learning (6 EC)**

**Objectives**
This course will focus on behavioural and psychological processes underlying the acquisition of new knowledge in human and non-human animals. Although the focus is on a psychological level of description, where possible attempts will be made to integrate this level in a multidisciplinary framework, searching for neurobiological and neuropsychological evidence supporting psychological theories. Additionally, the application of learning paradigms in clinical and cognitive research will be discussed. After this course, the student is able to (1) explain and relate key experimental paradigms, empirical phenomena, neurocognitive mechanisms, concepts, and theories concerning the acquisition of new knowledge, (2) apply experimental paradigms, neurocognitive mechanisms, concepts, and theories from the psychology of learning to anecdotal, experimental, developmental, and clinical data, cases, and studies, (3) combine the knowledge implicated in (1) and (2) for the purpose of explicating a novel research question and associated experimental research design to address this question.

**Contents**
The course starts with an overview of behavioural phenomena, basic principles, and current psychological theories and (computational) models in the research fields of classical and operant conditioning. Thereafter, a number of topical lectures will be presented, largely building on concepts and basic principles discussed in the initial lectures. The topical lectures address a discussion of the distinction between implicit and explicit learning (also in a clinical context), the neuropharmacology of behavioural flexibility in learning contexts, the learning capacity across the lifespan, second-language learning, and the learning capacity of psychopathic individuals.

**Lecturer**
dr. J.H.R. Maes
Quantitative Brain Networks (6 EC)
(link)

Prerequisites
(Physics master): Neurophysics 1 and Neurophysics 2
(Research master CNS) Advanced mathematics or equivalent.

Objectives
The goal is to provide the neurobiological background and the mathematical/computational skills necessary to understand current technical publications in the field of Brain networks and neuronal communication.

Contents
This course covers the experimental methods to assess connectivity; data analysis methods to extract connectivity from dynamics; statistical models for connectivity and dynamical models that reproduce the observed coherent brain states.

The brain is all about communication, between individual neurons as well as between brain areas comprised of billions of neurons. To study brain communication advanced new experimental and mathematical techniques have been developed, which require mathematical sophistication and a neurobiological background to fully comprehend.

Topics
(1) Local circuit structure: experimental methods to extract connectivity, results of rodent and primate experiments, and theoretical methods for describing connectivity
(2) Local circuit dynamics: interpreting the local field potential, dynamical measures for the connectivity, results from primate experiments
(3) Large-scale brain structure: neuroimaging methods to determine anatomical and functional connectivity
(4) Large-scale brain dynamics: brain oscillations, mean field models.

Lecturers

Sentence Production and Comprehension (6 EC)
(link)

Objectives
Language use requires more than just recognizing or producing words. Rather, words form the building blocks of phrases, sentences, texts, and conversations. The course will give an in depth introduction to phrase, sentence and text comprehension and sentence production in mono- and bilinguals, as well as to the cognitive neuroscience paradigms developed in these domains. After the course, you should (a) have a firm grasp of major (theoretical, empirical and methodological) research developments in the field, (b) be in a better position to understand and critically evaluate extant research, and (c) be able to begin to contribute to the field (in case a Master Thesis is conducted in this area).

Contents
The course will cover four broad areas of research:
(1) Sentence and text comprehension. In real life, words never come alone -- they are in the company of other words, of other linguistic signals (e.g., intonation), and of a wide range of other relevant factors (such as the current scene, what has been said before and by whom). As we comprehend language, we need to somehow combine all these sources of information to make sense of what is said. How do people do this? Amongst other things, we'll have a look at the methodology used to keep track of sentence comprehension as it unfolds, we'll review a wide range of recent research on sentence-level syntactic, semantic and referential processing, and we'll examine theoretical and computational perspectives on how the system might incrementally deal with words as they come in.
(2) **Sentence production.** Sentence production requires the transformation of a preverbal communicative intention into articulation. This transformation is achieved by a series of processing stages. Modern psycholinguistic models of language production assume at least the following levels: conceptualization, i.e. the preparation of a representation of the communicative intention; lexicalization and grammatical encoding, i.e. the selection of the appropriate words from the mental lexicon and the generation of a syntactic structure; phonological encoding, i.e. the generation of a phonological representation of the to-be-produced sentence; and articulation. Central questions in the area of sentence production are: (a) How are the different processing stages coordinated in time? (b) Which properties of the communicative intention affect the choice of appropriate words and of the syntactic structure for the to-be-produced sentence? (c) How much of a sentence is planned before a speaker initiates articulation? Is there something as an advance planning unit of a fixed structurally defined size? Do the planning units at the different processing stages differ in size?

(3) **Language in action.** Primarily later in the course, we take a step back from the established domains of comprehension and production, and have a look at how the systems involved interact with other systems that make our species the flexible species that we are. After all, language is there for a purpose, which is to help people deal (and live) with others and the world around them. Amongst other things, we'll have a look at how the processing systems involved in comprehension and production systems interlock in conversation, how they relate to attention, action, our goals, values and emotions, how language processing interacts with processing of the sensory environment (e.g., how linguistic processing and the properties of the visual environment jointly determine visual orienting), how they relate to our body (embodied sentence comprehension), and in what ways our language processing machinery might scaffold our thinking.

(4) **Second language processing.** The findings, models and theories discussed so far in the course predominantly apply to first language (L1) speakers. However, most of us speak other languages as well, though mostly not as proficiently as our mother tongue. The last part of the course will look at sentence processing from a second language (L2) perspective as well as at how L2 speakers learn from correct input in 'everyday life'.

**Lecturer**
prof. dr. H.J. Schriefers

**Social Neurocognition (6 EC)**
(link)

**Objectives**
This course will provide students with a thorough background in the newly emergent field of social cognitive neuroscience. A broad range of social phenomena will be examined at multiple levels (1) the social level including experience and behaviors (2) the cognitive level which deals with information processing systems and (3) the neural level which deals with brain/neuronal bases of the first two levels.

**Contents**
A wide variety of social psychological phenomenon which have been examined using neuroscience techniques will be discussed. Topics will include emotion, joint action, animal and human communication, and disturbed social functioning in psychiatric disorders. These topics will be discussed at both general and specific (article) levels. Guest speakers at the forefront of specific research topics in social neurocognition will contribute to the course.

**Lecturer**
prof. dr. I. Toni
Structural Aspects of Language (6 EC)

(link)

Objectives
This course is meant to provide you with an in depth study of the structure of (spoken) language in three different modules: Phonology & Phonetics (period 1), Morphology & Syntax (period 2), and Semantics & Pragmatics (period 3). You will recognize how structural aspects of language in these domains are currently studied, and you will understand how they can be analyzed in psycholinguistics and neurolinguistics. You will be able to evaluate theories, and to judge the value of experimental findings in the light of these theories.

Contents
The emphasis will be on how structural aspects of language in the different domains influence language production, language perception and comprehension, and language learning. We will read and discuss recent scientific articles. Different theoretical perspectives will be discussed to describe and analyze morphological, syntactic, semantic, pragmatic, phonological, and phonetic aspects of language. The relevance of linguistic approaches and generalizations for current psycholinguistic and neurolinguistic research will be addressed explicitly during the course. Topics to be covered in the three modules include the nature of phonological rules and representations, phonetic and phonological variation, and prosodic structure (Phonology & Phonetics), case, agreement, and word order (Morphology & Syntax), quantification, definiteness, and discourse particles (Semantics & Pragmatics).

Lecturer
dr. M.E. Broersma

The Auditory System (3 EC)

(link)

Prerequisites
(1) Basic mathematics, including Fourier series, and elementary differential equations, basic use of Matlab (or equivalent).
(2) Bachelor physics, mathematics, informatics, medical biology, science, functional psychology, artificial intelligence.

Objectives
(1) Students can describe
   the neural pathways of the auditory system
   the traveling wave, inner- and outer hair cell function of the cochlea
   the neural responses in different stages of the ascending auditory pathway
   the concept of spectrotemporal receptive fields
(2) students can design and implement basic psychoacoustic tests
(3) students can describe and interpret different monaural and binaural hearing impairments
(4) students can describe the methodology and function of different hearing aids

Contents
The course on Auditory Perception and Technology consists of two parts. The first part presents a thorough background of the basic neurobiological, functional and psychoacoustic properties of the auditory system. This will be achieved by integrating essential experimental and theoretical frameworks from biophysics (e.g. cochlear mechanics, auditory filters), human psychophysics (e.g. signal detection theory), and computational neuroscience and neurophysiology (e.g. spectro-temporal analysis in the CNS, and the neural encoding of sounds). These tools are applied to several psychoacoustic phenomena, and will also be applied in some simple psycho-acoustic (dichotic) experiments to be carried out as assignements on the computer.

The second part of the course focuses on the technology of restoring hearing function in the hearing impaired. First, different types of hearing impairments are described. The following
hearing technologies will be discussed: (acoustic) hearing aids, bone-anchored hearing devices, middle-ear implant, the cochlear implant.

Lecturers
prof. dr. A.J. van Opstal, and dr. M.M. van Wanrooij

Using and Acquiring Multiple Languages (6 EC)
(link)

Objectives
After completion of the course, students should be able to discuss recent psychological, neuroscientific, and linguistic developments in the domain of multilingualism. They should also understand the rationale underlying recent studies in terms of their methodological, theoretical, and modelling aspects. Finally, the course will train skills of critical reflection on the literature by requiring an oral and written in-depth presentation with respect to one specific research theme.

Contents
In the first part of the course, neuroscientific and (psycho)linguistic approaches to multilingualism are considered to characterize how multilinguals read, listen, speak, and learn foreign languages. Processes and representations are described at sublexical (phonemic and syllabic), lexical, syntactic, semantic, and dialogue levels. The focus of the course lies on a still-unresolved but central question: Since languages sometimes help each other and sometimes fight each other during processing, what determines the balancing act between the various languages in the multilingual mind? An in-depth understanding of this issue requires a consideration of the types of stimulus materials and research techniques in use, the effects of age of acquisition, and the available bilingual models of language (non)selective access and executive control. Complex issues like simultaneous translation and foreign-accented speech are informative here as well.

The second part of the course deepens the student’s knowledge of multilingualism and second language acquisition with respect to a chosen theme or application by means of one or more relevant articles. The gist of what the student has read and understood is presented to fellow students and incorporated in a written report that is made available to others (and limited in size).

Lecturer
prof. A.F.J. Dijkstra

Word Recognition and Production (6 EC)
(link)

Objectives
Words are the building blocks that make it possible for us to produce and comprehend language. Students will receive an introduction to the main issues in auditory and visual word recognition and on word processing in speech production. Empirical evidence (behavioural, neuroimaging and neuropsychological data), computational models, and lexical statistics will be discussed. At the end of the course the student will be able to (1) describe key findings in the cognitive neuroscience of lexical processing, (2) evaluate the strengths and weaknesses of these data, (3) evaluate current theories of lexical processing, and (4) generate ideas for new experiments to address what is not yet known about these issues.

Contents
(1) Auditory word recognition.
The mental processes which operate during the recognition of spoken words will be examined. Topics in the auditory word recognition will include: the multiple activation of lexical hypotheses and the competition between them; modulation of lexical activation by phonetic information; segmentation of continuous speech into words; and whether lexical form and meaning representations are distinct. We will also ask questions about the mapping of the
speech signal onto the lexicon. Do prelexical representations mediate between the signal and the lexicon? How do listeners deal with the variability in speech? What is the nature of the information flow in the recognition system (e.g., is there feedback and/or cascade)?

(2) Spoken word production.
Spoken word production involves the cognitive processes underlying the generation of spoken words, ranging from intention to articulation. Models of spoken word production often divide the word generation process into conceptualizing, lemma retrieval, word-form encoding, and articulation, with word-form encoding further divided into morphological encoding, phonological encoding, and phonetic encoding. Moreover, models assume a process of self-monitoring, which serves to ensure that word planning and articulation are consistent with intent. In the production lectures we will discuss evidence on these processes from response time, error, eyetracking, electrophysiological, neuropsychological, functional neuroimaging, tractographic, and computational modeling studies.

(3) Visual word recognition.
How do we recognise words during reading? In student-led seminars we will first discuss prelexical issues (e.g., early stages of visual processing, the role of eye movements in reading, the nature of access representations). We will then discuss lexical issues (e.g., how word recognition is influenced by word frequency and the lexical neighborhood of words, the segmentation of morphologically complex words). We will ask whether current computational models of reading can capture the complexity of the data.

(4) The mental lexicon.
During the course we will also explore the relationships among spoken word production, auditory word recognition and visual word recognition. We will consider (a) the issues that recur whenever lexical processing is examined (e.g., the time course of processing, the role of frequency, the balance between storage and computation, and the role of context); and (b) the ways in which differences in the nature of the tasks involved in speaking words, listening to them, and reading them impose different constraints on the mental processes underlying those three abilities. One seminar in the first week of the course with both lecturers will introduce these questions and hence the course as a whole. We will return to these questions as the course progresses, in particular during the student-led seminars on visual word recognition and in a final student-led discussion at the end of the course.

Lecturer
prof. dr. J.M. McQueen
ILLC - Master of Logic

Advanced Topics in Computational Semantics (6 EC)
(link)

Objectives
1) describe computational models for learning meaning representations for words and sentences
2) discuss the strengths and limitations of these methods
3) construct and implement models to learn meaning representations for words and sentences
4) evaluate these models experimentally and analyse their performance
5) use the above models in NLP applications

Contents
The field of computational semantics is concerned with automatic interpretation of natural language. This course will provide an overview of state-of-the-art statistical approaches to semantics. Specifically, we will look at learning sparse and dense representations of word meaning, modelling predicate-argument structure, compositional semantics and neural models of phrase and sentence meaning. The course will also cover semantic models that lie at the intersection with other fields: multimodal semantic models that draw knowledge from linguistic and visual data, and cognitively-motivated semantic models and their evaluation against brain imaging data. Finally, we will look at the real world applications of these models in areas such as opinion mining and automated fact checking.

This is an advanced research seminar aiming to introduce students to recent developments in the field of NLP. The course will consist of a set of lectures and seminar sessions, where the students will present and discuss recent research papers. This year we will focus on representation learning for NLP, considering different levels of language analysis: words, sentences and longer discourse fragments. We will also look at the recently proposed contextualised word representation models (such as ELMo and BERT) and joint learning methods (including multilingual joint learning and multitask learning).

An important component of the course is a research project, in which the students will have the opportunity to implement a number of semantic models, perform experiments addressing a new research question and write a research paper.

Lecturer
dr. E. Shutova

Cognition and Language Development (6 EC)
(link)

Prerequisites
No previous background in linguistics is required.

Objectives
(1) understand and explain the aims, methods and recent results in the field of (psycho-)linguistics.
(2) describe the position of (psycho-)linguistics in the field of cognitive science.
(3) critically evaluate current research in (psycho)linguistics

Contents
Starting point for this course are a number of questions that are central in (psycho-)linguistic debates. These include discussions about language as a cognitive function, discussions concerning the effect of multilingualism on cognitive development, and the domain specificity/generality of language. We will focus on how these issues are translated into empirical questions in language acquisition and language pathology. Students will learn with what kind of experimental methods these questions can be investigated and how experimental studies contribute to such debates.
The philosophy behind this course is that by studying these discussions in detail, the student will not only achieve more insight in some current notions in the study of (psycho-)linguistics, cognitive science and experimental methods, but also achieve some basic knowledge of the basics of linguistic theory in general and the way it has been shaped.

Central questions which will keep coming back in our classes are:
- What constitutes linguistic knowledge?
- How is this knowledge acquired?
- How is this knowledge physiologically encoded?
- How is this knowledge related to other cognitive functions/behavior?

Lecturer
dr. N. Vasic

**Computational Dialogue Modelling (6 EC)**
(link)

**Prerequisites**
MSc Logic students should have some knowledge of semantics and pragmatics and, ideally, some programming skills. MSc AI students should have successfully completed NLP-1. Students from other programmes are also welcome and should contact the course coordinator if they are unsure about their technical background.

**Objectives**
(1) To become familiar with fundamental concepts in the study of dialogue
(2) To gain insight into current research directions in computational dialogue modelling
(3) To acquire the ability to evaluate and contribute to research in computational dialogue modelling

**Contents**
Research on dialogue modelling is concerned with developing computational models of how we use language in interaction, that is, to communicate with each other in conversation. This is a fascinating enterprise where the concerns of linguistics interface with those of other fields such as artificial intelligence and cognitive science. The results of this research have an important role to play in language technology, as they provide the basis for developing dialogue agents for human–computer interaction. The course will cover seminal and contemporary work on language interaction and dialogue, including models of dialogue agents in visually-grounded settings.

Lecturer
dr. R. Fernandez Rovira

**Foundations of Neural and Cognitive Modelling (6 EC)**
(link)

**Prerequisites**
Bachelor-level linear algebra and some programming experience are recommended.

**Objectives**
(1) students are able to explain the conceptual and technical foundations of the major modelling paradigms in brain and cognitive science.
(2) students can demonstrate their technical skills by solving representative exercises from these fields.
(3) students can demonstrate their conceptual understanding by critically assessing published models in various subfields, distinguishing between appropriate abstractions and inappropriate simplifications, and by describing relations to models formulated in other paradigms.

**Contents**
How do brains implement high-level cognitive functions? How can modelling contribute to
answering that question? In this course we consider the conceptual and technical foundations of the major modelling approaches in the brain and cognitive sciences, and explicitly investigate the commonalities and differences. As case studies, we look at models of single neurons (Hodgkin-Huxley, Fitzhugh-Nagumo, McCulloch-Pitts, Rosenblatt), models of networks of neurons (Hopfield, Kohonen, Rumelhart & McClelland, Elman, Hebbian learning, backpropagation), and some basic symbolic and probabilistic models of categorization, reasoning, planning and language (k-means clustering, mixtures of Gaussians, HMM, PCFG). We end with a brief look at how these techniques come together in modern deep learning models.

The lectures combine refreshers on the used mathematical techniques (e.g., ordinary differential equations, vector- and matrix-algebra, probability theory and grammars) with conceptual discussion of the various models, the acceptability of the simplifications they make, and their relations to each other. In the computerlabs we study the properties of the various models (using existing implementations). Towards the end of the course all students present an evaluation of a modelling paper from their own favorite field, discuss its relation to other modelling paradigms and to the modelling methodology discussed in the course.

Lecturer
dr. W.H. Zuidema

Logic and Conversation (6 EC)
(link)

Prerequisites
Good working knowledge of first-order logic is required, and some background in formal semantics is convenient, though not really necessary. For students of the Master of Logic, it is usually best to take this course in your second year (although there may be exceptions of course, depending on your specific background).

Objectives
At the end of the course, the student has a good working knowledge of contemporary logical approaches to natural language semantics, in particular those that go beyond truth-conditional aspects of meaning.

Contents
The theme of the course is the interplay between semantics and pragmatics in the interpretation of natural language discourse, and the role of logic in formulating semantic and pragmatic theories. Traditionally, logic is concerned with the characterization of valid reasoning and argumentation, and therefore focusses on informative content, defined in terms of truth conditions. When analyzing conversation, however, other notions become of interest as well. In particular, besides static truth-conditional content, inquisitive and dynamic aspects of meaning come to play a crucial role.

The first part of the course focuses on inquisitive semantics, a logical framework developed in recent years at the ILLC. The second part of the course varies from year to year. A detailed program will be made available on: https://projects.illc.uva.nl/inquisitivesemantics

Lecturer
dr. F. Roelofsen

Meaning, Reference and Modality (6 EC)
(link)

Objectives
Upon successful completion of this course student have acquired working knowledge of the history, background, and current issues in semantic and pragmatic debates concerning Meaning, Reference and Modality.
Contents
In this course classical intensional semantics and dynamic semantics are approached from a philosophical-logical perspective. The philosophical backgrounds of the two paradigms are studied as well as their logical formulation. We will study classical texts on intensionality from Frege, Lewis, Stalnaker and Kripke, and zoom in on long-standing issues such as sense and reference; naming, identity and necessity; context and context change; modality and discourse.

Lecturer
dr. P.J.E. Dekker

Philosophy of Cognition (6 EC)
(link)

Prerequisites
Some prior knowledge through a BA in Philosophy, or else introductory level of knowledge in analytical philosophy, in the fields of philosophy of language, epistemology and phenomenology. When in doubt about whether your background knowledge and skills are sufficient, contact the instructor of the course.

Objectives
Upon successful completion of this course students will have:
(1) acquired an overview of the main positions within contemporary philosophical discussions in the field of philosophy of mind and cognition, in particular with respect to mind-body and mind-world relations;
(2) gained an understanding of the relationship between the philosophical study of mind and the empirical research within cognitive sciences;
(3) developed skills in assessing and presenting philosophical arguments during discussions;
(4) developed skills in reading and writing philosophical texts.

Contents
What is the mind? How are mind and body related? And how should we investigate such questions?
In this course we will look into the contemporary philosophy of mind and cognition. The course starts with a general overview of main topics in philosophy of mind and cognition, and their roots in metaphysics, phenomenology and epistemology. We will consider a number of different contemporary positions on what the mind is and how we are to investigate it. We will discuss how each of these perspectives can deal with specific topics, such as the possibility of social cognition; meaning and intentionality; the distinction between first- and third person experience; and the relation to empirical research of cognitive processing (i.e. in neuroscience, computational science and psychology). Towards the end of the course we will zoom in on the recent debate on externalist conceptions of cognition, in particular externalist accounts of perceptual processing and of the role of language, which emphasize the embodied and embedded nature of mind. Although the course is primarily concerned with philosophical texts and positions, problems and arguments from other disciplines will frequently be considered, such as for instance understanding gained from psychological and neurological pathologies, as well as problems from the context of computational modelling of mind.

Lecturer
dr. E.C. Brouwer

Rationality, Cognition and Reasoning (6 EC)
(link)

Objectives
Upon successful completion of this course the student
(1) is aware of the intimate connection between logical form and cognitive processing;
(2) is familiar with different facets of reasoning.
This course is concerned with the (supposed) tension between logical norms of reasoning and actual human reasoning. We present a large quantity of data from the psychological literature, pertaining to children, literate adults, illiterate adults, patients suffering from various psychiatric disorders, and brain imaging of reasoning processes. We also discuss the various theories that psychologists have proposed to account for these findings, such as ‘mental models’, evolutionary psychology and Bayesian probabilistic approaches. We then discuss these same data from a logical point of view -- with the outcome that the proposed psychological explanations are all based on a philosophically untenable view of rationality. Alternatives will be proposed. The course has two main goals: (i) making students aware of the intimate connection between logical form and cognitive processing, and (ii) acquainting students with experimental technique to get hands-on experience of ‘reasoning in the wild’. This year we will focus on the philosophical and experimental issues raised by ‘theory of mind’ phenomena.

Master of Logic students will be given the opportunity to earn another 6ec by means of a group project in which students design and perform an experiment (based on game technology) probing some facets of human reasoning (e.g. analogical reasoning).

Lecturer
prof.dr. M. van Lambalgen

Semantics and Cognition (6 EC)
(link)

Prerequisites
There are no formal prerequisites as such, although some basic background in formal semantics, cognitive science, linguistics, or computer science would be useful.

Objectives
(1) To gain knowledge of the practices and methodologies of state-of-the-art research at the intersection of semantics/pragmatics and cognitive science. Which new issues can be raised and answered by collaboration between semanticists and cognitive scientists?
(2) To acquire methodological expertise and the theoretical know-how in order to be able to take part in collaborative projects involving logicians, semanticists, linguists, computer scientists, and cognitive scientists.
(3) To learn how to critically read interdisciplinary papers and pursue interdisciplinary research projects (from linguistic analysis/formalization, through (cognitive) computational modeling to experimental work, and back).
(4) To study recent literature combining semantic methods with cognitive science research.

Contents
Cognitive science research—driven by two forces: psychological (experimental) involvement and explicit theoretical modeling (often computational)—has become extremely influential in recent years. Today, we finally observe an increase in the collaborative effort between linguists and cognitive scientists. This is an exciting new challenge and an opportunity both for semantics and cognitive science.

The course aims at giving an overview of the trends and methods in this emerging research area. We will explore the applicability of modern cognitive science methods to study the meaning in natural language. This year we will specifically focus on the research in formal semantics, especially concerning quantifiers, and its interaction with psycholinguistics and cognitive science, building a potential bridge with research of Cognitive Semantics and Quantities project (http://www.jakubszymanik.com/CoSaQ/).

Lecturer
dr. J.K. Szymanik
**Centre for Language Studies**  
**Research Master Language and Communication**

**Child Bilingualism (6 EC)**  
(.link)

**Objectives**  
The learning outcomes are that students (i) are capable of understanding state-of-the-art child bilingualism literature in considerable detail, (ii) can identify questions, open ends and predictions of the various proposals, (iii) are familiar with the most frequently used data collection methods and are able to explain the pros and cons of each, and (iv) are able to translate research findings into practical advice for parents.

**Contents**  
How do children acquire two languages at the same time? To what extent do their two languages influence each other? Is there a difference between children who start learning their two languages before age four versus those who start after this age? How do bilingual children compare with their monolingual peers? These are just some of the questions addressed in this course. The course will deal with a number of current issues in the field of bilingual language development, including age effects, cross-linguistic influence, language dominance and the role of variation in input quantity and quality. The aim of the class is to discuss and evaluate the different perspectives on these issues and to detect the theoretical and empirical gaps that will steer new research. The focus will be on the acquisition of morphosyntax and vocabulary and both offline and online linguistic knowledge and processing will be considered. In addition, the course offers hands-on experience with various data collection methods typically used in (bilingual) language development research, and we will consider the practical import of research findings for parents and teachers of bilingual children.

**Lecturers**  
dr. S. Unsworth

**Communication and Persuasion (6 EC)**  
(.link)

**Objectives**  
At the end of the course  
(1) The student has a thorough understanding of theories within the field of communication and persuasion  
(2) The student can critically evaluate current (empirical and theoretical) research within this field  
(3) The student can relate different contributions in the field to each other and synthesize these contributions in a clear and coherent review of the literature

**Contents**  
Communication is often designed to influence people’s beliefs, attitudes, and behaviour. It is employed in marketing and health contexts, but also by politicians, organizations, and governments. In this course, we will focus on the different means that can be employed to fuel the persuasion process. More specifically, we will focus on how individuals’ beliefs and attitudes can be influenced by narratives, but also through the artful use of language and images. We will focus on the cognitive and affective processes that are evoked by strategic choices in message design and how these thoughts and feelings may determine the outcome of the persuasion process. In other words: we will focus on the mechanisms of persuasion and how verbal and visual aspects of persuasive messages evoke and guide the persuasion process’ outcome. During the course, we will be reading the relevant literature on the issue. For each of the main themes above, students will write a short essay in which they discuss and integrate the literature and apply the insights onto a concrete persuasive message. During the meetings, the literature will be discussed and the essays will be presented. The final assignment is a literature review on
one of the topics of the student's choosing.

Lecturers
prof. dr. H.H.J. Das, and dr. W.G. Reijnierse

Computational Psycholinguistics (6 EC)
(link)

Objectives
In this course you will learn:
(1) what the basic concepts, results and debates are in the field of computational psycholinguistics
(2) to identify the core properties, strengths and weaknesses of different modelling approaches
(3) to critically assess computational models and the claims arising from them
(4) how to develop and/or evaluate a computational psycholinguistic model

Contents
Computational psycholinguists develop computational models that simulate aspects of the human language system, for example: learning word meaning from large amounts of language input, assigning syntactic structures to sentences, or generating sentences given the intended meaning. A successful model can explain findings from human experiments and thereby increases our understanding of the human cognitive system. In this course, we will discuss the properties of different model types, look into the details of some of the most important models proposed in the literature, and gain hands-on experience with the development and/or evaluation of a computational psycholinguistic model.

Lecturer
dr. S.L. Frank

Foundations of Language and Communication (6 EC)
(link)

Objectives
Students are brought up to date on the range of theories in linguistics and communication studies, their points of overlap and differences among them, and current debates. The course is the entry class for the Research Master's programme Language and Communication; it aims to provide students with an explanation for why these two fields are best combined.

At the end of the course, the student can

understand the relationship between language and communication;
describe recent theorizing on the origin of language as a means of human communication;
describe the contribution of linguistics and communication sciences to the description and explanation of language and language use;
evaluate contributions to the academic debate and defend positions.

Contents
In this course, we focus on language as a uniquely human instrument and introduce various perspectives on how it is studied. We start with the state of the art on what has made human communication possible and why and how it has probably come about. Next, we survey the various different traditions in linguistics and the communication sciences, concentrating on how they could be seen as natural and complementary counterparts. However, we also look at explanations of the language faculty in the domain of linguistics in which the communicative function of language plays no role, and approaches to communication that do not privilege language as the primary vehicle for conveying meaning.

Lecturer
dr. R.M. Willems
**Introduction to Language and Speech Technology (6 EC)**

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**Prerequisites**

Some experience with programming (not any specific programming language, but programming in general) and statistics.

**Objectives**

You understand the degree to which text (either written or spoken) can be processed automatically and the purposes for which this processing can be used. You are able to select the proper resources or algorithms for given tasks and situations, and can follow up on this selection by finding and obtaining relevant resources and software, and judging their appropriateness. In case the available resources or software are not fully suited for the task/situation at hand, you can describe how they should be adjusted or extended (note that this does not imply your ability to implement such adjustments/extensions yourself).

**Contents**

In this course, we examine the various linguistic levels that are being processed automatically (e.g. speech and syntax), the information that can be derived from that processing (e.g. for purposes of information extraction and man-machine dialogue), and the techniques that are used for the actual processing (e.g. Hidden Markov Models and word embeddings).

As for literature, we are currently in a transition phase, with the seminal handbook Speech and Language Processing (2nd edition) by Jurafsky and Martin starting to show its age, the 3rd edition more up-to-date but not quite finished, and a similar handbook (Natural Language Processing by Jacob Eisenstein) also not quite finished. As a result, we will work through selected chapters from the publicly available drafts of all three of these handbooks, and do some of the exercises. In selected cases, you will obtain hands-on experience with available systems and/or techniques.

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**Lecturer**

Dr. B.J.M. van Halteren

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**Multimodal Context of Language: Gesture and Sign (6 EC)**

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**Objectives**

Most research on language takes speech as the main domain of investigation. However, in face to face communication we use language in a visual world. Speakers use not only speech but also meaningful hand movements called 'gestures' when they speak (pointing, iconic gestures etc). Furthermore, deaf communities use sign languages that are produced and perceived only in the visual-spatial modality. This course aims to give an interdisciplinary and state of the art overview of the role of the body and visual expression in the structuring, functioning and the development of the human language faculty. As such it offers a new window into our assumptions of language and its workings. The course will be presented in relation to discussions on embodied cognition and semantics, situated use of language, the links between language, action, space, memory, social cognition/interaction and their neural correlates.

**Contents**

The course consists of several modules as described below.

*Gestures in spoken language:*

(1) Introduction to gesture basics - definitions; structure; theories
(2) The role of gestures in processing of language - production and comprehension
(3) The role of gestures in cognition (social, memory, imagery)
(3) The role of gestures in language acquisition and development (first, second, bilingual)
(4) The role of gestures in interaction (dialogue, common ground)
(5) Gestures and the brain
Sign Language
(1) Introduction to sign language grammar
(2) Sign language processing/comparison with speech processing
(3) Acquisition of sign language (first, second, bimodal bilingual)
(4) Sign language and the brain
(5) Emerging language systems (in the wild/laboratory)
(6) The role of gesture or sign in language evolution

Broader significance
(1) Situated language use
(2) Language development
(3) Embodied cognition
(4) Relations between action, space, cognition and language

Lecturers
prof. dr. H.A. Ozyurek, and dr. O.A. Crasborn

New ways of analyzing syntactic variation (6 EC)
(link)

Objectives
At the end of the course students are expected to
(1) understand the concept of syntactic variation and change and the problems associated with it;
(2) be acquainted with the major theories of (sociolinguistic) syntactic variation and diachronic syntax;
(3) be able to generate hypotheses on probable driving-forces for variation and change;
(4) be able to conduct a databased investigation into the internal and external determinants of syntactic variation, and to report the results in a journal article.

Contents
Variationist syntax (or sociosyntax) investigates the factors which determine why one of two (or more) constructional alternatives - such as He gave the boy the book and He gave the book to the boy - is preferred over the other(s). The last decade has been extremely exciting for variationist syntacticians: it has witnessed revolutionary theoretical innovation in combination with a rapidly growing quest for more, and more diverse quantitative data. In spite of this undeniable progress, a lot remains to be done. The problem of the theoretical basis for variationist syntax, for instance, has been on the agenda since Labov (1972), but it has remained basically unsolved. In addition, the focus has for the most part been on synchronic variation, whereas the other source of syntactic variability, diachronic change, is typically ignored or underrepresented in sociolinguistics. So, as well as modeling variation, we will also investigate where variation comes from. And although new methodologies are booming in psychology and language technology, there is almost no interdisciplinary cooperation between psychologists and language technologists on the one hand, and theoretical (socio)syntacticians and diachronic syntacticians on the other. This course is dedicated to convincing you of the need to cross the borders between linguistic syntax and its neighbouring disciplines if you want to become a good (socio)syntactician.
In this course, we review both the problems and the prospects of syntactic variation research. We will introduce the (new) theories (function-based sociosyntax, construction grammar, diachronic theories, ...), and the (new) methods (Magnitude Estimation, online experimentation, machine-based learning). But more importantly, we will also focus on the practical aspects of sociosyntactic and historical syntactic work, on the basis of hands-on analyses of (new) syntactic variables.

Lecturers
prof. dr. A.M.C. van Kemenade, and G.T. Schoenmakers
Non-nativeness in communication (6 EC)

(link)

Objectives
At the end of the course
(1) students are able to describe and apply linguistic theories on non-nativeness and to relate them to communicative effects;
(2) students have a thorough understanding of knowledge pertaining to non-nativeness and are critically aware of the limitations of this kind of research;
(3) students have a comprehensive understanding of approaches and techniques used in the domain of non-nativeness research;
(4) students are able to report on the state of the art in non-nativeness in the form of a research proposal presented in a form of an academic poster.

Contents
1. Introduction to Non-nativeness and Multilingualism
2. Cultural differences in Argumentation
3. The effect of Non-nativeness: Attention in advertising/job ads (eyetracking)
4. Receptive Multilingualism as a language mode in the Dutch-German border area
5. Visual metaphors
6. Accentedness and non-nativeness VILLA Varieties of Initial Learners in Language Acquisition
7. Gestures and non-nativeness

Successful communication is a key factor for social and cultural integration. At the same time, increasing numbers of people travel, live, or work in a non-native language environment, and thus speaking multiple languages that are not their mother tongue. However, the processing of these non-native languages is a complex cognitive task; speaking and listening to a non-native speaker asks for both socio-cultural as for language-specific strategies.

In this course we focus on the effects of multilingualism in the real world, ‘in the wild’; what effect does non-nativeness have to comprehensibility, status and image and media choice but also for example on safety in a multilingual working team in international organizations. Would it not be helpful if we all could learn to use new languages in a native way? Or, would it not be great if we all could speak our mother tongue and at the same time listen and comprehend all other languages from all over the world (Receptive Multilingualism) but especially from our neighbours (German, French)? And how can a new language best be learned; in a classroom with a grammar book or better in daily life in the country and the culture immersed in the language belongs to? Is there a difference between learning your mother tongue and learning a second language? Is it possible to reach the “perfect” native level in a second language? Does learning to speak and listen in a new language really mean that you have to learn to think or literally look at the world around you in a different way? Although we will discuss also articles in this more theoretical Language and Thought debate, we want to focus on empirical research carried out by the Nijmegen Centre for Language Studies (ranging from corpus analyses and surveys, acquisition input manipulations to eyetracking and technical speech perception analyses) mainly on Language Acquisition.

As part of the course there will be a miniconference in Münster (Westfälische Wilhelm Universität) with presentations via postersessions and a guest lecture.

Lecturer
dr. M.B.P. Starren

Psychology of Language and Cultural Cognition (6 EC)

(link)

Objectives
The learning outcomes are that students (i) are capable of understanding state-of-the-art psycholinguistic and cognitive research in considerable detail, (ii) can contrast psycholinguistic
and cognitive theories, identify open ends and predictions of various theoretical approaches, and (iii) understand on some general level the most frequently used research methods and are able to explain the pros and cons of each method.

Contents
This course will address current topics in psycholinguistics and cultural cognition. Topics to be covered include: the role of prediction in language processing; embodiment in language comprehension; how social structure affects the emergence of linguistic structure; conscious and subconscious language processing; neural entrainment in language and music; individual differences in linguistic knowledge and processing; language comprehension in noisy environments; language, thought, and culture: what can we learn from comparing languages, and what can we learn from modern experimental approaches; how literacy changes mind and brain.

Lecturers
prof. dr. F. Huettig, dr. F. Hintz, dr. M. Ostarek, dr. L. Raviv

Sign language and bilingualism (6 EC)
(link)

Objectives
After completing this course, students will be able to identify the unique characteristics of signed languages, to recognize bimodal bilingualism, and to identify and describe types of language contact between signed and spoken languages. In particular, after completing the course, students will be able to detect several challenging issues for families where sign language is part of their daily communication, to summarize and criticize a range of linguistic topics that are applicable to groups of bimodal bilinguals, such as code-blending and phonological cross-language activation, and to recognize and criticize a range of research methods in this field, such as corpus analysis and a range of experimental methods.

Contents
When we encounter the word 'bilingualism', most of us are inclined to think of two spoken languages. There are also people who master a spoken language and a signed language, also known as 'bimodal bilinguals'. Deaf and hearing children who have deaf parents often acquire sign language as a native language, while other people (like most sign language interpreters) acquire sign language as a second language. In this course, you will first get acquainted with sign linguistics: the lexicon, grammar and use of signed languages. We then zoom in on language contact between spoken and signed languages, look at first and second language acquisition of sign language, and at bilingual language processing. We will examine the first steps of native and non-native sign language acquisition as well as more proficient sign language use, and discuss whether there are particular (cognitive) advantages associated to bilingualism in general and bimodal bilingualism in particular.

Lecturers
dr. E.A. Ormell, and dr. O.A. Crasborn

Speech Production and Comprehension (6 EC)
(link)

Objectives
After completion of the course, students will have acquired a thorough understanding of representational and processing questions in the research domain of native and non-native spoken language production and comprehension. Students will also have gained experience in different aspects of experimental spoken language research (formulating a falsifiable research question, addressing that question experimentally, and writing a research proposal).

Contents
This course will address current topics in the study of speech production and comprehension,
which all concern general questions about how linguistic representations are stored and processed. Topics to be covered include how language users produce and cope with phonetic reduction, how background noise or cognitive load may affect their speech processing, and how “effortful listening” (due e.g., hearing loss, degraded speech quality) affects memory for spoken words and sentences. Secondly, a number of classes will be devoted to audiovisual spoken communication and to non-native speech processing. Thirdly, speech comprehension problems in non-typical populations will be discussed (e.g., speech perception in dyslexia). Apart from reading and discussing papers, students will propose a speech study of their own.

Students will read, discuss and present research papers. Furthermore, students will formulate a research question, design an experiment to address that question, and report on their proposed research project.

Lecturer
dr. E. Janse

(Automatic) Speech Recognition (6 EC)
(link)

Prerequisites
Knowledge of statistics and scripting/programming

Objectives
This course provides an overview of the theoretical and practical issues related to automatic continuous speech recognition, a rapidly advancing research field bridging AI, linguistics and computational modeling.

From a theoretical perspective, students will be able to understand and explain design considerations regarding the feature extraction, acoustic modeling (using Deep Neural Networks or Gaussian mixture models), training and decoding algorithms (Baum-Welch, Viterbi), the pronunciation vocabulary, language modeling, evaluation procedures, and scalability of the approach.

From a practical point of view, students will familiarize themselves with ASR via web interfaces and with speech decoding using e.g. Deep Neural Networks, so that they are able to perform mid-scale ASR experiments. A number of default experiments are pre-specified, but students are encouraged to explore their own research questions, e.g., the discovery of structure in speech, the use of prediction in speech decoding, accent detection, or the relation between speech and artificial intelligence.

In principle, each student writes his/her own scientific report, but cooperation may apply depending on group size.

Contents
In the first part of the course, relevant aspects of speech production, speech perception, and acoustics are addressed. Thereafter, we discuss the theoretical and practical aspects of Automatic Speech Recognition.

Speech production is a process in which some message (a sequence of one or more discrete symbols e.g. a sequence of words or phonemes) is transformed into a continuous speech signal (spoken utterance). Due to the anatomical differences in articulator organs as well as to individual behavioural differences in how these organs are used during speech production, speech signals that represent the same message may show a tremendous amount of variation.

Next, we address the question how the reverse process might take place, i.e., the decoding of a spoken utterance in terms of discrete elements (e.g. words, phonemes). In particular, we will explore various approaches for Automatic Speech Recognition (ASR), including the hidden Markov models (HMMs) based ASR, and the artificial net based approaches in ASR.

Lectures are given to provide students with background knowledge on ASR. Students will define their own research questions which can be answered by means of ASR technology. Students meet on a regular basis to present their progress to fellow students and to discuss any challenges encountered. A scientific report is written on the research carried out. Depending on the topics chosen, this report is individual or team-work.
Lecturers
dr. L.F.M. ten Bosch

The Syntax-Semantics Interface (6 EC)
(link)

Objectives
At the end of this course students are able to read, evaluate and discuss linguistic papers that deal with evidentiality. Students can compare various theoretic approaches and apply them to empirical data. Students have formulated their own research question on evidentiality and conducted a small research project at the syntax-semantics interface in order to address that question. Students have shown to be able to report on the results of their research both in an oral presentation and in academic writing.

Contents
The topic of this course on the syntax-semantics interface may vary per year, and this year's topic is Pronouns and Gender. The system of personal pronouns in the languages of the world is traditionally considered a small, closed class of forms, which can be distinguished and ordered semantically in terms of person, number, and gender. In most languages, only third person pronouns are distinguished for gender. Depending on the referent's gender, languages can use different pronouns (semantic gender), but also the grammatical features of the noun that the pronoun 'stands for' may play a role (syntactic gender). In case of possessive pronouns, not only the referent's (possessor's) gender but also the possessee's gender can influence the choice of pronoun (e.g. French sa mère 'his/her mother'). We will study pronouns and gender cross-linguistically and from different theoretical perspectives on the basis of recent scientific publications in syntax and semantics, or even unpublished manuscripts.

Lecturer
prof. dr. H. de Hoop
TECHNICAL COURSES

Donders Graduate School

Advanced Brain Computer Interfaces (6 EC)
(link)

Prerequisites
(1) Basic Python (or MATLAB) programming experience.
(2) Basic understanding of linear algebra and signal analysis, e.g. fourier decomposition of a signal -- as provided by taking "Mathematics for Artificial Intelligence" or equivalent.
(3) Basic background in Brain Computer Interfaces -- as provided by taking "Introduction to Brain Computer Interfaces" or equivalent.

Objectives
(1) Understand what is needed to build a Brain Computer Interface.
(2) Be able to implement a simple BCI experiment using the hardware/software tools available at the DCC.
(3) Be able to run a small BCI pilot experiment, analyze results, and report results in the scientific literature.

Contents
A Brain Computer Interface (BCI) is a device for translating user intentions, encoded by performing specific mental tasks, into control signals which can be used to control external devices. Whilst BCI builds on ideas and techniques from multiple disciplines including Neuroscience, Psychology, Cognitive Neuroscience, Signal Processing, Artificial Intelligence, it is fundamentally an experimental subject. All ideas/designs must be validated against real subjects generating real signals to prove their worth.

This course consists of three components:
(1) Lectures on Advanced Topics in Brain Computer Interfacing, focusing on advanced signal analysis and machine learning techniques.
(2) Tutorials on how to develop a modern advanced BCI and conduct EEG BCI experiments using our in-house developed BCI framework.
(3) Assignment where students work in small teams (3-4 people) to apply the knowledge gained in the Lecture and Tutorials to design, implement and evaluate their own EEG based BCI system. Consisting of stimulus type/mental task, signal detection & processing and feedback/output generation.

During the assignment phase, teams will have access to all the facilities available in the department, including EEG-equipment, stimulus-generation software, signal-analysis software, and output-devices (e.g. video, audio, Lego-robots, internet-BCI-games, virtual-reality environments). Finally, they will test their design by conducting a set of experiments and report the results.

After developing their BCI students give a demonstration to prove it works correctly, conduct a set of experiments to validate this further and report on these experiments in the form of a scientific article.

Note: this course includes a significant practical component using a mix of EEG hardware and Python based analysis software.

Lecturer
dr. Y. Güçlütürk
Advanced Math (3 EC)

Prerequisites
The course assumes knowledge at the level of the basic maths course.

Objectives
The data considered in cognitive neuroscience studies are typically of a considerable complexity: multiple time-series of haemodynamic responses recorded in numerous voxels (fMRI, PET) or electrophysiological activity recorded through many electrode channels (EEG) or sensors (MEG). Both the acquisition and analysis of such data rely on sophisticated quantitative techniques. Also, increasingly, models for the neurocognitive processes underlying these data are specified at a quantitative level. Consequently, for a basic understanding of data acquisition, analysis and modelling, some minimum amount of mathematical ‘literacy’ is required. The aim of this course is to provide (or refresh) such a minimal background. Both technical detail and mathematical rigor will be bypassed; instead, focus is on familiarizing the student with the basic mathematical concepts and tools to be encountered in the other courses of the master’s programme and possibly to be applied in the second-year research training. In particular, the aim of this course is to provide the mathematical background necessary to be able to take both Neuroimaging II courses.

Contents
The two topics covered will be linear algebra and Fourier analysis. Two thirds of the time will be spent doing formal lectures with accompanying exercises, in the other third of the time examples will be worked in MatLab.

Lecturer
prof. dr. D.G. Norris

Advanced Neuroscience Techniques (6 EC)

Prerequisites
Neuroimaging I

Objectives
New developments in neuroscience are to a large extent driven by technical advances. The aim of this course is to introduce these advances such that students by the end of the course will (1) Have gained a comprehensive overview of advanced neuroscience techniques (2) Understand the possibilities and limitations provided by the new techniques (3) Be able to read and critically evaluate research papers applying advanced neuroscience techniques (4) Be able to identify the technique most suited to answer a given research question

Contents
Neuroscience techniques are undergoing a rapid development. These developments open up new possibilities for investigating the brain as a network at various levels. We will introduce a range of advanced techniques which currently are being applied in neuroscience in particular to study brain networks. We aim at covering both the basics of the techniques and how they are applied to address specific research questions. The topics to be covered include:
(1) Advanced MR imaging
   o Mathematical models of the BOLD response
   o New acquisition techniques for BOLD
   o Imaging layers and columns
   o MR spectroscopy
   o Resting state fMRI
   o fMRI combined with EEG
(2) Stimulations approaches
Basic Mathematics (3 EC)
(link)

Objectives
The data considered in cognitive neuroscience studies are typically of a considerable complexity: multiple time-series of haemodynamic responses recorded in numerous voxels (fMRI, PET) or electrophysiological activity recorded through many electrode channels (EEG) or sensors (MEG). Both the acquisition and analysis of such data rely on sometimes pretty sophisticated quantitative techniques. Also, increasingly, models for the neurocognitive processes underlying these data are specified at a quantitative level. Consequently, for a basic understanding of data acquisition, analysis and modelling, some minimum amount of mathematical ‘literacy’ is required. The aim of this course is to provide (or refresh) such a minimal background. Both technical detail and mathematical rigor will be bypassed; instead, focus is on familiarizing the student with the basic mathematical concepts and tools to be encountered in the other courses of the master's programme and possibly to be applied in the second-year research training.

Contents
The course will start with general mathematics at –or at least not going far beyond-- a sound secondary school level. Topics here include: (review of) standard functions (algebraic, exponential, logarithmic, trigonometric), differentiation and function extrema, partial derivatives and multidimensional function extrema, integration. Later, more specific topics appear: introduction to complex numbers, to the ideas of Fourier analysis, and to the basics of vector and matrix algebra.

Lecturer
dr. M.G.M. Koppen

Cognition and Complexity (6 EC)
(link)

Prerequisites
A completed (academic) BSc degree in Artificial Intelligence or related field (such as Cognitive Science, Computing Science, Cognitive Psychology, Cognitive Neuroscience, Philosophy, or Linguistics). Furthermore, the course assumes that students have some affinity with cognitive psychological research and some proficiency in algorithm design and analysis.

Objectives
In this course, students learn to use methods derived from computational complexity theory for analyzing the (in)tractability of cognitive models, and for identifying sources of complexity in a model. Students also learn how this knowledge can be used to make model revisions that yield tractability. As two competing models may differ in the nature of their sources of complexity, the analyses can also yield novel empirical predictions that can be used to test the models.
The functioning of the human brain can be studied and modeled at different levels of abstraction ranging from the neural implementation level to a cognitive computational level. Ideally, models posited at the computational level are consistent with the brain resources available at the neural level. Building computational models that fit with human brain resources can be quite challenging. This is illustrated by the fact that many computational models in Cognitive (Neuro)science postulate brain computations that are, on closer inspection, computationally intractable. Here 'computational intractability' means that the postulated computations require more resources (such as time, space, memory, hardware) than a human mind/brain or any computational mechanism has realistically available. Examples of intractable computational models can be found in almost all cognitive domains, including perception, learning, language, planning, decision-making, communication, and reasoning. Intractability makes these models psychologically and neurally implausible as cognitive computational level models of brain functioning. However, there are ways to deal with this problem by identifying sources of complexity in these models and investigating if they can be removed from the model without the loss of explanatory power. This course covers several concepts and techniques that can be used to this end.

Lecturer
dr. I.J.E.I. van Rooij

**Machine Learning (3 EC)**
(link)

**Prerequisites**
The following courses are useful but not required: *Inleiding Machine Learning*

**Objectives**
The aim of the course is to familiarize the student with the modern concepts of machine learning at the international research level. In particular:
(1) The student understands the concepts of Bayesian inference and use it to derive a number of different machine learning methods, such as (multi-layered) perceptrons, graphical models, Markov models and clustering and derive learning methods for these models.
(2) The student is capable to write computer programs to implement the above methods

**Contents**
The course provides an advanced introduction to the modern view on machine learning with emphasis on the Bayesian perspective. The course is intended for Master's students in physics and mathematics as well as master's students in artificial intelligence/computer science with sufficient mathematical background.
For physics and math students, this course is the follow-up of the bachelor course Inleiding Machine Learning. The course provides a good preparation for a Masters' specialisation in Theoretical Neuroscience or Machine Learning and is part of the minor Computational Data Science. See [http://www.snn.ru.nl/~bertk/machinelearning/](http://www.snn.ru.nl/~bertk/machinelearning/) for detailed course description.

Lecturer
prof. dr. H.J. Kappen

**Neural Information Processing Systems (6 EC)**
(link)

**Prerequisites**
(1) SOW-BK1104 Calculus or equivalent
(2) SOW-BK1124 Linear Algebra or equivalent
(3) SOW-BK1203 Bayesian Statistics or equivalent
(4) SOW-BK1230A Neural Networks or equivalent
(5) Python experience (including automatic differentiation packages such as Chainer/PyTorch)
Objectives
After successful completion of the course, you will have learned:
(1) The recent advances in deep/reinforcement learning and neural coding
(2) How to implement state-of-the-art artificial neural networks in Python (with Chainer / PyTorch).

Contents
Perhaps the most ambitious goal of AI is to build artificial cognitive systems whose cognitive skills match and/or surpass those of humans, which is also known as artificial general intelligence or AGI. A promising way through which this goal can be achieved is modeling artificial cognitive systems after the human brain to mimic the cognitive computations thereof in silico. Evidently, the success of this approach relies on the continuous interplay between AI and neuroscience. In this course, we will embrace this philosophy, and tread the path from AI to neuroscience and back. On our journey, we will explore how to leverage our understanding of biological neural networks for their artificial counterparts and vice versa.

Lecturer

NeuroImaging II: Electrophysiological Methods (6 EC)
(link)

Prerequisites
Taking the exam for this course is only allowed after the course DGCN09 (Advanced math) has been passed successfully. If you have sufficient knowledge of mathematics you may request an exemption from this rule from the Examination Board.

Objectives
This course is about the analysis of EEG- and MEG-data. The objective is to introduce the student to the most important analysis methods for this type of data.

Contents
(1) EEG- and MEG-signals produced by neurophysiological processes. The signals that are measured using EEG-electrodes or MEG-sensors are produced by neurophysiological processes in the neuropil. In this part of the course, we describe these processes, the electrical currents they produce, and how these currents produce measurable EEG- and MEG-signals.
(2) Signal processing of electrophysiological data. Often, the relevant aspect in the electrophysiological data is a modulation of oscillatory components. To identify these components, we need a representation in the frequency domain. In this part of the course, we present the frequency domain methods that are most prominent in current research.
(3) Source reconstruction. The gold standard in cognitive neuroscience are measurements of electrophysiological signals at locations in the brain from where they originate physiologically. Unfortunately, in human cognitive neuroscience, we can only measure these signals at some distance from their physiological origin, via the EEG or the MEG. Source reconstruction techniques, are then used to infer a signal at the source level (the brain's grey matter) from an observed signal at the sensor level. In this part of the course, we give an introduction to these methods.
(4) Statistical testing of electrophysiological data. One of the challenges in the statistical analysis of electrophysiological data is the high dimensionality of this type of data (many channels, many time points, and many frequencies). For this type of data, nonparametric methods are much better suited than the classical parametric methods. In this part of the course, we give an introduction to these nonparametric methods.

Lecturers
dr. E.G.G. Maris
Neuroimaging II: Haemodynamic methods (6 EC)  
(link)

Prerequisites
Taking the exam for this course is only allowed after the course DGCN01 (Advanced math) has been passed successfully. If you have sufficient knowledge of mathematics you may request an exemption from this rule from the Examination Board.

Objectives
This course builds on the course Neuroimaging I (DGCN02). It aims to give students a deeper understanding of the imaging methods and analytical tools that are available to cognitive neuroscientists. At the conclusion of the course the student should be able to acquire and evaluate data acquired with fMRI. The course offers a systematic explanation of the acquisition experiment and hands on experience with the most commonly used data analysis techniques. It is mandatory for students wishing to perform an fMRI experiment in their master's project.

Contents
(1) Data acquisition: The student will be taught how data are acquired and what the fundamental limitations of the techniques are. The basic principles of MRI will be taught. MRI using the echo planar imaging technique will be explained and modern developments in accelerating data acquisition introduced. Generalised image reconstruction in terms of k-space will be introduced and image acquisition and reconstruction in MRI explained in these terms. The complex nature of the BOLD response used for f(MRI) will be examined. The measurement of connectivity using both resting state fMRI and fibre tracking based on diffusion tensor measures will be introduced.
(2) Data Analysis: The main areas covered in this part of the course are: analysing structural MRI data including segmentation and assessment of grey matter volume; analysis of fMRI data both at the single subject and the group level using the general linear model; exploratory data analysis including the use of independent components, and their application to measuring functional connectivity; the assessment of structural connectivity using diffusion-weighted imaging.
(3) Design aspects: An in-depth treatment will be given of the different experimental design types in imaging studies. The advantages and disadvantages of the different design types will be discussed, with emphasis on statistical efficiency. Students will be given the task to design an experiment and practice analyses.

Lecturers
prof. dr. D.G. Norris

Practical ERP training (3 EC)  
(link)

Objectives
To get hands-on research experience in human ERP experimental design, data acquisition, and data analyses. At the end of the course, the participant is able to set up, plan, and execute a basic human ERP experiment. In addition, the student is familiar with the ethical considerations related to human ERP research.

Contents
The students will get an introduction into the practical aspects of setting up human ERP experiments by means of lectures, practices, assignments, and tutorials. The practical work involves setting up an ERP experiment, how to obtain approval of the ethical committee, ERP data acquisition of 2 participants, ERP data analyses and a short presentation. After the course the students can plan, set-up and run independently a straightforward ERP experiment.

Lecturer
dr. M.L.A. Jongsma
**International Max Planck Research School for Language Sciences**

**Introduction to Python Programming (1.0 EC)**
This course is an introduction to using Python for cognitive science. Possible uses include experiment design, data analysis, computational modelling, and general productivity/utility. Rather than emphasizing one specific use case, the course will focus on general programming and problem solving competence and the ability to write code for any given use.

The course will teach students to:
- Install and use Python 3 on their own laptop
- Use Python’s built-in data types, functions, and modules to solve simple tasks like renaming files or generating random lists of experimental stimuli
- Use NumPy, SciPy, Pandas & Seaborn to import and analyse experimental data
- Install and use 3rd party modules for more specialised tasks
- Write clear, commented code that is suitable for publication alongside journal articles
- Use Jupyter Notebooks to document their work
- Use the Python documentation and StackOverflow to troubleshoot problems

**Mixed Effect Models in R (0.5 EC)**
This course serves as an introduction to linear mixed effects regression (lmer) in R, and a number of specific issues in lmer. In addition, time will be devoted to more specific questions from participants.

The course will be based on numerous examples of data sets and lmer models. At the end of the course, the participant is aware of the advantages and pitfalls of the various approaches, and has learned how to relate modelling issues with the literature. Students will know which models to run, how to implement them correctly, and how to report the results.
Deep Learning for Natural Language Processing (6 EC)

Objectives
In this course students will learn about deep learning models, methods, and best practices relevant to applying them to several concrete language technology problems.

Contents
Deep learning approaches achieve state-of-the-art performance for many language technology tasks, such as summarization, machine translation, and question answering. In this course we will cover several of those problems and the corresponding deep learning approaches.

The material is organized into the following four parts:
Part 1: Words (Tasks: Lexical representations and word similarities)
Part 2: Sequence classification (Tasks: sentiment analysis and question classification)
Part 3: Next word-prediction and sequence labeling (Tasks: language modeling, named entity recognition, part-of-speech tagging)
Part 4: Sequence-to-sequence modeling (Tasks: Summarization, Neural Machine Translation, dialog/QA systems)
Part 5: In parts 1-4, we concentrate on learning from labelled data, but sometimes in NLP it’s necessary to learn from unlabelled or partly labelled collections.

This course does not use a textbook and the relevant reading material, mostly consisting of research publication, will be distributed at the beginning of the course.

Lecturer
Dr. C. Monz, and Dr. W. Ferreira Aziz

Natural Language Processing 1 (6 EC)

Prerequisites
Recommended prior knowledge
(1) probability theory
(2) basics of machine learning
(3) programming experience
(4) prior exposure to natural language processing / computational linguistics may be helpful

Objectives
(1) describe computational modelling methods for several levels of language analysis (morphology, syntax, semantics and discourse)
(2) construct language processing models for several tasks, such as word representation learning, sentence representation learning, text classification etc.
(3) implement supervised (and some unsupervised) estimation procedures for these models
(4) evaluate these models experimentally and analyse their performance
(5) use the above techniques in NLP applications

Contents
This course introduces the fundamental techniques for a range of tasks in natural language processing (NLP), with a particular focus on statistical approaches. We will consider tasks that involve hierarchical structure (e.g., syntactic trees) and/or hidden structure (e.g., in semantic tasks), using supervised and some unsupervised statistical learning algorithms. The course aims to explain the potential and the main limitations of these techniques, as well as discussing them in the wider context of current research issues in NLP and its real-world applications.
The lectures will cover the following topics:
- Introduction to NLP and its applications
- Morphological processing
- Language models
- Part-of-speech tagging
- Context-free grammars and syntactic parsing
- Lexical and distributional semantics
- Neural language models and word embeddings
- Compositional semantics and sentence representations
- Discourse processing
- Entailment and paraphrasing
- Dialogue modelling
- Summarization and question answering
- Machine translation
- Some examples of recent NLP research

An important component of the course is a hands-on practical, in which the students will have the opportunity to implement a number of language processing methods and perform experiments on a real-world task: sentiment analysis of movie reviews.

**Lecturer**
dr. E. Shutova

**Natural Language Processing 2 (6 EC)**
(link)

**Prerequisites**
Recommended prior knowledge
Natural Language Processing and Machine Learning

**Objectives**
(1) Acquire knowledge of advanced NLP techniques, particularly in machine translation
(2) Acquire awareness of ongoing research and challenges in NLP in general
(3) Practice reading and presenting scientific articles in NLP
(4) Develop, program and report basic solutions to example problems within multiple small projects

**Contents**
The amount of language data that is available to us electronically is increasing with the day. With this eminent increase, a question arises as to the possibility of inducing latent structure in this data that can be useful for further tasks such as machine translation. The different kinds of latent structure that is possible depends on the data and the task, and will usually demand suitable statistical models and learners. The course will teach methods for inducing a variety of latent structure for tasks such as language modeling, machine translation and adaptation across domains. The course covers the following topics
(1) Machine Translation and Paraphrasing
(2) Domain adaptation
(3) Latent, hierarchical or linguistic structure in natural language data
The course will further dive into a selection of advanced and current NLP topics, such as contextualized embeddings, deep generative models, speech recognition, neural language modelling, interpretability.

**Lecturer**
dr. W.H. Zuidema
Structures for Semantics (6 EC)

Objectives
Upon successful completion of this course students have gained working knowledge of the logical/mathematical techniques employed in formal semantics.

Contents
We will study mathematical techniques that are used in formal semantics to model natural language meanings. We will discuss, among others, type theory, the lambda calculus, generalized quantifiers, intentional logic, partial orders and lattices. In all cases we will motivate the techniques from a semantic point of view and discuss linguistic applications of the tools.

Lecturer
dr. M.D. Aloni
School for Information and Knowledge Systems

Tutorial Program
More information about the [tutorial courses](#) offered by SIKS

Advances in Information Retrieval (1 EC)
Capita Selecta IR (formalisms, models), probabilistic models for IR, multi-media retrieval, empirical methods for IR, multi-media retrieval, XML retrieval, web mining en web retrieval, automatic query improvement.

**Course directors**
Dr. S. Verberne (UL), Prof. dr. D. Hiemstra (RUN), Prof. dr. A. de Vries (RUN)

Foundations of Data Science: Data Mining (1 EC)

**Course directors**
Dr. A. Feelders (UU), Prof.dr. A. Siebes (UU)

Kaleidoscope Data Science (1 EC)

**Course directors**
Prof.dr. U Kaymak (TU/e), Dr. H. Weigand (TiU)

Knowledge Representation and Reasoning: Foundations and Applications (1 EC)
Mix of symbolic and subsymbolic techniques from an AI perspective by consistent application of the “learning and reasoning” metaphor: Probabilistic reasoning / Introduction Bayesian networks, introduction machine learning, reinforcement learning, learning and reasoning for information access, qualitative reasoning, causal modelling, model based reasoning.

**Course directors**
Dr. A. Ten Teije (VUA), Dr. P. Groot (RUN)

Mathematical methods for IKS (1 EC)
Information theory, probability, Bayesian learning, statistical techniques for IKS.

**Course directors**
Prof.dr. E.O. Postma (TiU), Prof. dr. T. Heskes (RUN), Prof.dr. A. van den Bosch (RUN)

Research methods and methodology for IKS (2 EC)
This course is strongly recommended for all students and is organized each year. It fills in the gap left by the lack of attention to research methods for IKS in current Dutch (and foreign) Master curricula. It is not a general research methods course, but tackles methodological issues specifically in the context of computer science and information systems development and more in general the engineering of information and knowledge systems.

**Course directors**
Dr. H. Weigand (TiU), Prof.dr. R.J. Wieringa (UT), Prof.dr. J.-J.Ch. Meyer (UU), Dr. R. Starmans (UU), Prof.dr. J.M. Akkermans (VUA).

Trends and Topics in Multi Agent Systems (1 EC)
For the main part based on symbolic AI. Introduction multi-agent systems: agent logics, agent theories, agent architectures, agent programming, norms/ institutions/deontic logic, 6 planning, coordination, conflict resolution in MAS, negotiation, mechanism design and auctions.

**Course directors**
Prof.dr. C. Jonker (TUD), Prof.dr. M. Dastani (UU), Prof.dr. K.L. Hindriks (VUA)
Centre for Language Studies
Research Master Language and Communication

Linear Mixed Effects Modeling (3 EC)
(link)

Prerequisites
We will use R (R studio) as platform, but this course is not a course on R itself. Familiarity with R is assumed.

Objectives
This course will provide a practical guide and theoretical background of linear mixed effects modeling (LMER).

LMER is a statistical technique that has become more and more popular during the last couple of years. During the course, aspects related to exploratory versus confirmatory research, model selection, fixed and random effects, anova versus AIC/BIC, the optimization of statistical models, and model prediction will be discussed. The computational part of the course is based on numerous realistic data examples.

Contents
The course will consist of two (intertwined) parts.
In the theoretical part we will discuss the ins-and-outs of LMER models, including the concept of significance, the "p-value", the way how these models try to optimize model parameters so as to minimize some error criterion, the balance between fixed and random terms, contrast coding, and the significance of predictors as a function of the presence of other predictors. We will also discuss blame analysis: properties of LMER models that may help to understand which participants can be blamed for a certain effect, and touch on more advanced issues such as quantile regressions, and GAMS.

The practical part will be based on the application of various models on existing datasets or your own dataset. The course will start with simple examples. The platform we will use is R.

Lecturer
dr. L.F.M. ten Bosch

Text and Multimedia Mining (6 EC)
(link)

Objectives
After successful completion of this course, students have an understanding, both at the conceptual and the technical level, of the application of natural language processing (NLP) and multimedia processing techniques to the areas of text and multimedia mining. Students can design models for machine learning algorithms, and they can evaluate and report on the developed models. Also students understand, from a theoretical perspective, which tools are applicable in which situations, and which real-world challenges prevent the application of certain techniques (such as language variation and noise due to document processing errors or user interpretations). The course includes a set of assignments, which are designed to support student learning. Students are required to complete the assignments in order to pass the course.

Contents
Text mining, also known as 'knowledge discovery from text', is an ICT research and development field that has gained increasing focus in the last decade, attracting researchers from computational linguistics, machine learning (an AI subfield), and information retrieval. Recently, text mining techniques been expanded to tackle other types of content, such as images, audio, and video. Example key applications that have emerged from this melting pot are question answering, social media mining, and summarization. The emphasis of the course is on text data, but other multimedia data are also covered. This course gives an overview of the field in a practical, hands-on fashion. In addition to the lectures, the students work on a self-chosen
text or multimedia mining problem in the second half of the course, resulting in an individual research project paper.

Lecturer
prof. dr. M.A. Larson, and dr. I.H.E. Hendrickx
The Donders Institute organises several "Toolkits of Cognitive Neuroscience". This intensive several-day courses provide in-depth knowledge on (new developments in) different brain imaging techniques, involving series of lectures, discussions, live demos, hands-on training, and direct interactions with experts in the field.
Statistics for PhD candidates by using SPSS (2 EC; English and Dutch course)

What is the most suitable analysis technique for a set research goal?
Which requirements must the data meet in order for this technique to be successfully applied?
How can I confirm whether these requirements have been met and what does it mean if they do not?
How do I conduct the analysis with the aid of SPSS?
How do I interpret the results of the analysis?

Objectives
(1) A broad reintroduction to descriptive statistics
(2) A thorough reintroduction to hypothesis testing and explanatory statistics
(3) Controlling analyses in the SPSS computer package for Windows
(4) The ability to interpret the results of statistical analyses

Contents
In this statistics refresher course you will receive the answers to all these and other questions and be informed about topics in the field of methods and techniques.

This course focuses on practical applicability. This mainly concerns the proper application and correct interpretation of the results of your research.
The refresher course ‘Statistics for PhD Candidates,’ is intended for PhD candidates who already possess a basic understanding of methodology and statistics and would like to refresh and expand this knowledge. The different analysis techniques that are taught in the Bachelor’s programmes are revisited in this course. Relevant theoretical examples are applied to existing and realistic data which ensures an optimum learning experience. After six half-day classes and diligent self-study, you will have a good command of a range of statistical analysis techniques.

Lecturers
C. Visscher, and L. Veenstra
SOFT SKILL COURSES

Donders Graduate School

Academic writing (3 EC) (link)

Objectives
Students will be introduced to the art of academic writing. They will be introduced to the differences between and the challenges of writing different kinds of documents, including: shorter and longer research articles, grant proposals, CVs, reviews, and letters to the editor. At the end of the course students will (1) have learned how to write better academic English and (2) have learned to evaluate their own writing and that of others.

Contents
This course consists of a plenary and a student-specific part. The plenary part consists of lectures with short writing assignments. It will cover guidelines on how to prepare, structure and write scientific articles. In addition, advice will be given on how to write reviews, letters of motivation, and grant/project proposals. The student-specific part of the course will consist of individual feedback on a writing sample: usually part of the student’s MSc thesis (but note that the thesis supervisor is responsible for the scientific content of the thesis; this course is concerned with writing skills only, and the final thesis will be evaluated separately). Writing samples will be reviewed by the other students following the course. Students will revise their sample on the basis of these reviews. They will then send in the rewritten sample with a “letter to the editor” explaining how they have dealt with the issues raised by their reviewers and then receive written feedback from the lecturers on all components of their assignments. The course will be graded as pass/fail. Note that this course is for second-year master students.

Lecturers
prof. dr. J.M. McQueen

Communication in Cognitive Neuroscience (6 EC) (link)

Prerequisites
The students who attended less than 75% of the meetings, will not pass the course.

Objectives
Science is not only about having ideas, but also about communicating ideas. In this course, you will work on your communication skills to different audiences and in different formats. An ability to clearly communicate your ideas appropriately to your audience is crucial for a future career both as a scientist and outside of academia.
You will learn to shape your communication to a) your audience (lay audience, editors, prospective employers, your peers), b) your aims (enthuse, argue a point, sell your work, inform) and c) the format (written, oral).

Contents
You will work together with the other students and lecturers to evaluate each other’s performance to help you think critically about your own work. This course is set up so that you will learn through discussions, practical assignments and peer feedback. Rather than through a final exam, you will learn and be tested throughout this course by completing a number of assignments, to assess how well you are able to communicate to different audiences, with different purposes, and in different formats.

These assignments include writing reviews of submitted papers, writing essays about central topics in cognitive neuroscience, giving presentations, debating ideas, writing application letters, etcetera. After completion of this course, you will understand the general rules and
guidelines of various forms of academic communication, and will be able to use these to appropriately communicate and present your scientific ideas.

**Lecturers**
prof. dr. P. Hagoort, and dr. J.F.M. Jehee
International Max Planck Research School for Language Sciences

The courses listed below are representative of those organized by the IMPRS regularly or by request. Topics discussed and course-content are tailored to the wishes of the IMPRS PhD students. Therefore, dependant on these needs the number of credits can vary annually. For some courses / workshops no points are granted.

Data Visualization (0.5 EC)
This course covers the basic science of why certain visualizations work better than others and provides students with practical skills to implement plots in R. Students will better understand how to communicate visually, in theory and practice.

Illustrator Workshop (no EC)
Adobe Illustrator is a vector graphics drawing package that can be used for creating two-dimensional illustrations, diagrams and layouts for printed materials. Vector graphics have an advantage over raster graphics (e.g. Photoshop) for these purposes, because they can be scaled to any size without pixelation (blurring), and are more easily adapted after creation. This one-afternoon workshop is aimed at those who have never used Illustrator before, and will cover the basics of Illustrator for several purposes that will be useful to PhD students:
- Creation of diagrams and illustrations for publications and slides
- Creation of visual stimuli
- Creation of posters
- Modification / annotation of plots made with other software

Participants will be able to independently use Illustrator to create graphics for publications and slides and posters.

Peer Review (1 EC)
The peer review process is an important component of research. It puts your research under rigorous scrutiny of fellow peers to ensure accurate and high-quality published science. However, formal instruction is rarely provided to researchers on how to approach this essential phase of research. A reviewer acts as a gatekeeper in determining whether a submission meets various criteria for publication. At the same time, this very mindset should also guide you on how best to conduct and report your research. The course is intended to provide a general overview of the review process. This includes learning the essentials from the perspective of a reviewer and an author. As a reviewer, how do you go about providing constructive criticism? How far should you go without going overboard? As an author, how should you handle reviewer comments? How do you (diplomatically) craft your responses? This course will provide insight into these issues and more:
- Understand the peer review process
- Competently review scientific journal articles
- Learn how to respond to reviewers’ comments
- Understand the role of the editor in peer review
- Know best practice for ethical and competent reviews
Radboud University

Achieving your goals and performing more successfully in your PhD (1.5 EC; English course) (link)

Objectives
After this course, you will:
(1) Be able to set clear and effective goals, understand how you can structure and prioritize your work, and better manage your time and risk;
(2) Have a clear sense of your drivers, strengths and skills, guiding your future (career) choices;
(3) Be more proficient in how you interact and collaborate with people in order to get things done and attain your goals.

Contents
This evidence-based course helps you achieve your goals and become more effective in your PhD project, considering your personal situation. We'll discuss how to set good goals and achieve them, how to structure and prioritize your work, how to get the most out of the people that you work with, and how to best manage your time and the risks in your project. Along the way, you'll gain important insights into your personality, your personal strengths and your pitfalls.

Previous participants characterized the course as engaging, fun and open to interaction. One PhD candidate described it as “a course where you will not only learn the theory of how you should manage your project and yourself but will also discuss how you can directly implement it in your own situation.”

Lecturers
M. Jongerden, and J. Jongerden

Advanced Conversation (1.5 EC; English course) (link)

Objectives
This course aims to improve your English fluency and pronunciation, with a focus on informal communication with international colleagues at conferences. The course structure and material is based on the learning by doing principle.

Contents
The following aspects are dealt with:
(1) Conversational skills: networking, discussing, convincing, making small talk, and other conversation strategies.
(2) Pronunciation: problematic sounds (eg.’th’), intonation, differences between British and American English.
(3) Diplomacy: politeness, agreeing and disagreeing, making requests, apologizing, changing the topic, maintaining a conversation, and intercultural communication.

During 8 sessions, students will participate in a variety of tasks to improve their pronunciation and spoken English. These include debates, teamwork, group discussions and role plays. Before the first session, each participant will meet with the instructor to evaluate current pronunciation skills and to set learning goals. At the end of the course, participants will receive final individual feedback on their pronunciation in their second tutorial. In addition, participants are expected complete tasks and practice for their final tutorial outside of class.

Lecturer
L Faulds, P. Graman, C. Struijke, A. de Beer
Analytic Storytelling (1 EC; English Course)
(link)

Objectives
What you will learn:
(1) Adapt your complex content to the interests and knowledge-level of your audience.
(2) Structure your content into a clear and coherent story.
(3) Provide an engaging context that makes your story meaningful for others
(4) Use strong visuals and writing techniques to add attractive, lively and concrete story elements.

Contents
Analytic Storytelling is a storytelling method for people working with complex content. As a researcher you have to collect, analyze, and structure complex information into a coherent story. But you also have to communicate your findings, be it in the form of a presentation, a paper, or funding application. To do this, Analytic Storytelling offers a step-by-step method that will help you deliver a clear and compelling message.

The resulting skills can be applied to any type of communication for any type of audience (e.g. publications, presentations, grant applications, for peers or laymen).

Lecturers
Trainers from Analytic Storytelling

Career guidance for international PhD's (No EC; English course)
Workshop "Expanding Opportunities"
(link)

Prerequisites
This course focuses on international PhD students in their third or fourth year. Note that English is the language of instruction for this course.

Objectives
This series of workshops is aimed at clarifying career development for international PhD's at the beginning of their career. After the workshops you will have an action plan for career development and you will be able to act upon this plan to take your career to the next level.

Contents
PhD's often face questions concerning career development - you have to prepare for the next step in your career, one that is not necessarily taking place in the academic world. To be able to make progress, you may want some guidance. You need to know your strong and weak points. You need to understand the power of networking. You need an understanding of the job market in both academia and the profit sector. You should be aware of (international) employment opportunities. In short, we will be working with these topics:
(1) Creating an insight into personal and career goals;
(2) Providing a systematic process for exploring career needs;
(3) Focusing on current position, desired goals, and unique personal resources;
(4) Enhancing practical career skills (in a global world);
(5) Comparing career options to formulate an action plan.

Lecturer
N. Ripmeester
**Design and Illustration (1 EC; English course)**
Convert your research into graphs and visuals with impact!  
([link](#))

**Contents**
To make impact on your audience you need appealing visuals. During this course you learn how to design the perfect graphs and visuals to communicate your information.

Learn to apply design principles to make crisp visuals, animate your graphs, and tailor your visuals to the needs of your target audience. What story do you want to tell? What should your audience remember? We will guide you in the process from determining the purpose, constructing the visual story and designing the ultimate graph or visual.

**Lecturer**
L. Opsteegh ([StatStories](#) and DataRegisseurs), and C. Franken ([Bureau Visuele Vertalingen](#))

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**Digital tools (No EC; English course)**
*Workshop: Obtaining your PhD 2.0: Digital tools for academic information*  
([link](#))

**Objectives**
Familiarising PhD candidates with modern tools for academic data collection and processing.

**Contents**
1st session (90 minutes)
1. Introduction to digital library;
2. Some quick search terms;
3. Search engine accessibility and fulltext;
4. Setting up your own information environment to stay up to date on literature and academic developments through RSS;
5. Literature reference management systems: Endnote and Mendeley

2nd session (90 minutes)
1. Managing and processing literature references: Emphasis on Endnote and Mendeley

Between first and second session: course participants create their own information environment, install Endnote and start filling this with their own material. If useful this can also be done in Mendeley.

**Lecturers**
R. Exterkate, S. van Putten, and M. Zwerver

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**Diversity & Inclusion (No EC; English course)**  
([link](#))

**Target audience**
The Course is designed for PhD candidates, both international and Dutch with interest in contributing to an intercultural and inclusive organizational culture.

**Contents**
The course is designed for PhD candidates with interest in contributing to a diverse and inclusive organizational culture. The course consists of four meetings:
1. Exclusion of the everyday settings
2 and 3. My intercultural being
4. Rocking the boat without causing too much trouble

**Lecturer**
S. Tómasdóttir ([JUST Consulting](#))
Education in a nutshell (1 EC; English course)
(link)

Contents
Are you interested in teaching, and would you like to exchange thoughts on this subject with other PhD candidates? Or does your PhD project occasionally involve teaching assignments, for which you would like to be better prepared? In these cases, Education in a Nutshell is just what you need. This course teaches you the basic principles of teaching, and you will acquire some useful tools for teaching and designing courses.

Please note: all course material and communication is in English unless all participants are proficient in Dutch; Dutch may be spoken in subgroups.

Lecturers
O. Peeters, and S. Rademakers

Effective Writing Strategies (3 EC; English course)
(link)

Objective
This course focuses on the writing process.
An important condition for taking this course is that you have something that you can write during the course, whether it is a research paper, a proposal or a thesis chapter. When you choose to write a research paper, we advise you to have gathered the necessary data before the second meeting.
If you would like to improve the style, readability and coherence of your text, we advise you to take the academic writing course offered by the Donders Graduate School.

Contents
Are you struggling to put your thoughts on paper? Would you like to become a more efficient writer and improve your productivity?

Effective Writing Strategies will teach you how to divide your writing process in different steps. The six sessions will guide you through the different stages of an effective writing process. You will discover your own strengths and weaknesses and the writing strategies that work best for you. If you attend all sessions and perform all assignments, you will make great progress in your own writing task.

You can take this course in each stage of your PhD programme, but it is probably most useful in the earlier stages.

Lecturer
dr. G. Coupé

Entrepreneurship and Innovation for PhD-students (3 EC; English course)
(link)

Objectives
After completion of the course, Ph.D.-students are familiar with the setup of a business plan, and are able to apply strategy, marketing, finance, and innovation concepts in order to substantiate critical strategic decisions underlying the start of a new business.

Prime learning objectives are that:
(1) participants acquire insights regarding strategy, marketing, finance and innovation concepts relating to creating a new business in high technology markets;
(2) participants learn to apply these concepts from business administration to analyze the challenges that entrepreneurs encounter when starting a business in a high-technology / high-service context;
(3) participants learn to substantiate the critical decisions underlying the development of a feasible business plan;

**Contents**
This is a course for third-year Ph.D.-students focused on developing innovative products and/or services and writing a business plan aimed at starting a new business.

Key to both entrepreneurship and innovation is creating a new venture through the development of new products and/or services. Both practices do not only have societal benefits like economic growth and employment but become increasingly also a career path for individuals aiming at initiating a start-up enterprise (business or as freelancer (e.g. “zzp’er”) or within an existing company as an intra-preneur. Also within the “business” of scientific research, researchers are considered to be more and more focussed on valorisation.

The focus of this course will be on the challenges an entrepreneur faces when starting a business in a high-technology and/or high-service context. To increase the chances of success in such a context, the entrepreneur has to anticipate key decisions with respect to 1) the development of product/service innovation, its proactive marketing and 2) the development of the business/organization (e.g. strategic positioning, organizational structures, financial feasibility) to realize the added value of the innovation. The aim of this course is to apply models and concepts from strategy, marketing, finance and innovation management to substantiate key decisions of a (starting) enterprise.

**Lecturers**
dr. R. Kok, and dr. P. Ligthart

**Grant Writing and Presenting for Funding Committees (1 EC; English course)**
(link)

**Objectives**
After this course, you will have acquired the following knowledge:
(1) Tips on how to deal with different types of funding agencies
(2) The contents of a good summary
(3) The contents of a good valorization chapter
(4) The characteristics of a presentation for a funding committee

You will acquire the following skills:
(1) Extracting the heart of your proposal message
(2) How to construct a convincing story about your research proposal ideas
(3) How to write a convincing summary including elements of valorization
(4) How to convincingly present before a funding committee
(5) How to deal with criticism, resistance, and questions

**Contents**
This two-day course focuses on grant writing the first day and presenting for funding committees the second day. In the competitive world of science, the modern scientist needs such skills to get funded and acquire research projects. What is a ‘good’ research proposal? How can you shape the impact chapter or valorization chapter? Who is in a funding committee, and how is presenting for such a committee different from other presentations?

**Lecturer**
ElroyCOM Training

**Loopbaanontwikkeling in korte workshops (No EC; Dutch Course)**
(link)

**Inhoud**
Dienst P&O van de Radboud Universiteit biedt een aantal workshops aan die je helpen bij je loopbaanontwikkeling. De workshops hebben een logische volgorde. Je kunt ze allemaal volgen, maar er ook één of enkele uitkiezen.
Onderwerpen:

(1) 'Inzicht in wat je wilt en kunt'
Deze workshop geeft inzicht in wat je energie geeft, wanneer je in je element bent. Ook ontdek je wat jouw kerncompetenties zijn en welke waarden in relatie tot werk belangrijk voor je zijn. Je krijgt een beter beeld van- en meer woorden voor- wie je bent, wat je wilt en wat je kunt, bovenop de inhoudelijke kennis die je hebt.

(2) 'Personal Branding'
Personal Branding gaat over jezelf profileren, jezelf neerzetten als merk. Wie ben je, waar sta je voor, wat kun je en waar ben je naar op zoek? Welk (kloppend!) beeld van jezelf wil jij neerzetten? Je onderzoekt eerst op een speelse manier hoe jouw personal brand eruit ziet. Vervolgens krijg je tips hoe je dit helder en krachtig kunt neerzetten en maak je een begin met je elevator pitch.

(3) 'Arbeidsmarktorientatie'
Deze workshop gaat over je eigen arbeidsmarkt. Hoe kun je je hierop oriënteren en hoe benader je jouw arbeidsmarkt?

(4) 'Netwerken'
Netwerken is een vaardigheid die belangrijk is in iedere baan, maar vooral als je je wilt oriënteren op een andere functie. Maar liefst 70% van de vacatures wordt via netwerken ingevuld. Netwerken kan op allerlei manier manieren. Deze workshop zoomt in op het geplande netwerkgesprek. Hoe pak je dat aan? Hoe leg je contact en hoe ga je jezelf presenteren?

(5) 'LinkedIn: de basis'
De basis voor effectief gebruik van LinkedIn is een professioneel profiel. In deze workshop ga je aan de slag met het aanscherpen van je profiel en krijg je tips om LinkedIn goed te gebruiken. We vragen je om je eigen laptop mee te nemen.

(6) 'CV en motivatiebrief'
Het schrijven van een goede motivatiebrief is een waardevolle vaardigheid. Evenals het opstellen van een passend CV. Er zijn zeker do's, don'ts én trends te noemen. Zo is het steeds gebruikelijker om een korte profielschets op te nemen op je CV. Het beste resultaat krijg je door beide op te stellen of aan te passen aan een concrete vacaturetekst.

(7) 'Het sollicitatiegesprek'
Wil je als voorbereiding op het zoeken naar werk een keer het sollicitatiegesprek oefenen? Wat jij lastig vindt in een sollicitatiegesprek staat centraal. Vooraf ontvang je informatie over de voorbereiding op het sollicitatiegesprek en het sollicitatiegesprek zelf zodat je goed voorbereid de workshop in kunt stappen. Tijdens de bijeenkomst ben je actief en in verschillende rollen bezig, als sollicitant, interviewer, en observator. Aan de hand van (moeilijke) situaties wordt theorie toegelicht en feedback gegeven.

Mindfulness-Based Stress Reduction (No EC; English course)
(link)

Objectives
During the course you will learn to become aware of your experience without judging them. The course aims to teach you how to have a more accepting attitude towards your thoughts, feelings and emotions. This might help you to cope more effectively with stressful situations.

Content
Doing a PhD demands a lot of you. Supervisors who set high standards, data collection that doesn't get going, all the courses, lectures and conferences you need to attend and don't forget the pressure to publish your papers. PhD students experience a lot of pressure and often feel distressed.
Mindfulness means: “being aware of the present moment with a non-judgmental attitude”. When unpleasant thoughts or feelings arise we tend to reject or to avoid them. During the course you will learn to become aware of your experience without judging them. The course aims to teach you how to have a more accepting attitude towards your thoughts, feelings and emotions. This might help you to cope more effectively with stressful situations.

Lecturer
J. Karremans, K. Teunissen, F. Compen
Optimizing the Relationship with your Supervisor (1 EC; English course)

Contents
If you want to have a great time during your PhD, with sufficient progress and results, you will need a good relationship with your supervisors. In fact, studies show that supervision is the number one success factor in the wellbeing of the PhD student and the timely and successful completion of the PhD project. However, PhDs without proper training tend to have difficulties communicating effectively with their supervisors.

With the help of a professional training actor, we practice different types of supervisors and difficult situations. Based on your individual wishes and suggestions we create cases that fit your context and wishes. We practice various techniques in such situations with the actor: Convincing, saying no, giving and receiving feedback, negotiation and conflict management. This fun and interactive training is a great way to optimize the relationship with your supervisors!

Lecturer
ElrovCOM Training

Poster Pitching (1 EC; English course)

Contents
A poster presentation gives you the opportunity not only to disseminate your research, but also to share ideas and establish discussion with other researchers, to receive valuable input, and to create professional contacts. During this workshop you will learn how to create interaction with each member of the audience so that all benefit. You will learn how to design your poster in such a way that the audience is attracted, and you will practise how to 'pitch' your ideas in interaction rather than deliver a monologue. You will also identify your strengths and weaknesses as a presenter through peer and teacher feedback and start to develop your own pitching style.

Course objectives
- Design an appealing and informative poster
- Design an enticing pitch
- Inspire and engage your audience instead of teach
- Communicate your passion to your audience
- Learn to engage your audience in mini conversations about your research
- Learn the powerful technique of storytelling
- Learn to establish professional relationships
- Give and receive constructive feedback on your posters and poster pitch.

Learning Objectives
- Identify your strengths and weaknesses in poster design and pitching skills
- Learn to cope with nerves and stress
- Interact with your audience in a natural and goal-oriented way
- Develop and practise poster and pitch language
- Develop and practise networking skills

Presentation Skills (1.5 EC; English Course)

Objective
This course aims to improve the skills you need when giving a presentation about your research in English.

Content
Both presentation skills and various aspects of the English language are dealt with. Through a combination of theory and practical exercises, participants are prepared for a final presentation.
in English. Presentation is a skill, and for that reason the emphasis of this course is on learning by doing. The course also includes a guest lecture on the use of voice by a voice teacher.

The programme includes the following:
(1) Public speaking
(2) Organisation and structure
(3) Language use (vocabulary, grammar, spoken versus written language)
(4) The major components of a presentation
(5) Making a ‘speaking outline’
(6) Using visuals
(7) Voice (pronunciation, intonation, volume, tempo, body language).

Lecturer
A. de Beer, P. Graman, J. Hemsing, R. Staats, C. Struijke

Project Management for PhD candidates (2 EC; English course)
(link)

Objectives
In this course focus is on project-based work, communicative skills, self-knowledge and collaboration.
In this course practising exercises have ay a key role; participants will do assignments and receive feedback on them. In the weeks between the course meetings the participating PhDs have the opportunity to put the acquired knowledge into practice through ‘homework’. This experience will be discussed in the following meeting(s).
There will be plenty of room to exchange experiences: it can be comforting to know that other participants have the same kind of issues in their work and talking about this is inspiring and will lead to giving each other good advice.
At the end of the course participants will formulate an individual action plan.

Inhoud
(1) Time Management
In ‘Time management’-section you will learn the difference between the time management of a day/week, of a long-term project and a research program. Participants learn to analyze the way they spend their time in a day and a week in different ways. This gives them new insights into their strong points and also provides options for improving their working method.
(2) Projectmanagement
In ‘Project management’ participants learn the rules of project management and how to apply them to scientific research. In the course they will each make a concrete planning schedule for their own research projects.
(3) Negotiating
When people think of negotiations they often imagine a hard-fought battle between two parties with irreconcilable viewpoints. But negotiation is actually an everyday occurrence and need not result in battle. The two parties can even both come out of negotiations as winners, if you deploy a little creativity and pay respectful attention to everyone’s interests.
(4) Networking
Networking is not about selling yourself though, it’s about being interested in other people and their work, and about finding common ground and seeing where you can help each other. Networking is about investing in a relationship without trying to get something in return immediately.
(5) How to deal with your supervisor
Research shows that the working relationship with the supervisor is crucial for the success of the PhD trajectory. However, it is not self-evident that the supervision is exactly as the PhD student would like it to be. PhD students are expected to take responsibility for the cooperation with the supervisor. In this training we therefore discuss everyone’s expectations with regard to the supervision. We practice giving positive feedback and expressing wishes which are not yet fulfilled.

Lecturer
D. Schut
Science journalism and communication (3 EC; English Course)
(link)

Are you considering a career in journalism or science communication after you finish your PhD or would you like to learn how to make your research field interesting to a wider audience? This Science Journalism and Communication course may be just the thing for you. In six afternoon sessions we will discuss the most important skills required to write an opinion piece in a national newspaper, a journal article, a blog for your research school or a web text for a patients' association, for example.

We will explore the definition of 'news', discuss how to structure an exciting story, what to ask during an interview and how to find attractive images and examples. We will also discuss how science communication and journalism can make an important contribution to a sustainable society. You will produce one or more publishable articles, blogs, web texts or video clips about your own or someone else's research. By the end of the course you will have a better idea of how to tackle projects like this and whether this could be a career for you.

The course will also discuss the following:
(1) Differences between writing for peers (the academic article), writing for professionals, such as potential funders, physicians or policymakers, and writing for a wide audience.
(2) How to collect and select information for your work.
(3) How to make your writing readable, understandable and attractive.
(4) How to visualise information.

Lecturer:
M. Heselmans from www.sciencejournalist.eu

Solliciteren en netwerken (No EC; Dutch course)
(link)

Je wilt na de promotie snel doorstromen naar een baan die je ambieert. Dat betekent dat je strategisch en effectief de arbeidsmarkt wilt benaderen. Deze training biedt de mogelijkheid om jezelf daar tijdig op voor te bereiden. De training Solliciteren en netwerken biedt handvatten en oefenmogelijkheden om de arbeidsmarkt doelgericht te benaderen.

Doelgroep
Promovendii in het laatste jaar van hun aanstelling. Voorwaarde is dat je een globaal beeld hebt van wat je te bieden hebt en ambieert.

Doelstellingen
(1) Ontwikkelen van handvatten en vaardigheden om actief en effectief de arbeidsmarkt te benaderen
(2) Oefenen in het presenteren, mondeling en schriftelijk.

Inhoud
(1) Kunnen benoemen van eigen kwaliteiten en vaardigheden
(2) Informatie over principes van het strategisch benaderen van de arbeidsmarkt
(3) Oefenen in het voeren van netwerkgesprekken
(4) Analyse van vacatures
(5) Handvatten voor het schrijven van een c.v. en brief
(6) Oefenen in het voeren van een sollicitatiegesprek.

Lecturer
J. van Beckhoven
The art of finishing up (1 EC; English course)
(link)

Contents
The Art of finishing up – a training to help PhD students to complete their PhD trajectory. With tools for good time management, help with implementing and planning the requirements of a good defense of your dissertation. Furthermore you will get aware of your transferable skills; very important social, communicative and managerial qualities which can be applied in many situations and have a high transferability to non-academic contexts.

At the end of the training you:
(1) can apply time management tools (again) to your own work;
(2) know the importance and basic principles of project management and you will have made a new realistic schedule;
(3) will have incorporated the faculty rules for defending the dissertation in the planning;
(4) have formulated concrete actions to achieve your planning;
(5) know your individual transferable skills;
(6) have a personal action plan to actively work on finding a new job and developing skills.

Lecturer
C. Rehbach

The art of presenting science (1.5 EC; English course)
(link)

Contents
If there is such a thing as an end product of science it would be communication about science. Whatever your findings are, it is com­munication that will lead your results to where you want to have them.
Conference presentations however often fail to be very effective and their quality seldom matches the quality of the work presented. The Art of Presenting Science shows that you can make a difference when it comes to presenting. This course is specially designed for Ph.D. candidates and Postdocs wanting to make the most of presenting their work and for whom good is not good enough.
In this course you will learn to use theatre techniques that will enhance the impact of your presentation considerably and will make the common decay of audience attention disappear. Along with theatre techniques the course focuses on the use of story construction techniques that will make your audience involved, curious and attentive until the end. As a reference we will use the best stories from literature.
Along with a thorough look at both theatre and story, other subjects like use of slides, reacting to questions, effectiveness of presentations and the relation form and content are part of the program.

Lecturer
dr. ir. G. Meeusen

University Teaching Qualification (No EC; English course)
(Dutch title: Basiskwalificatie Onderwijs - BKO)
(link)

Contents
Radboud University offers various kinds of support to teachers who wish to obtain a University Teaching Qualification (UTQ).
(1) You can receive support from a UTQ coach.
(2) You can participate in independent UTQ programme courses.
(3) You can participate in the entire UTQ programme, which includes coaching.
Advanced Components
The goal of an advanced component is to bring the course participants in contact with the
current front of research in some area. The Advanced Components Stage is the major part of the
SIKS teaching program. It comprises Advanced Courses and so-called "Other advanced
components activities". These other advanced activities typically include master classes,
workshops, seminars, research colloquia, tutorial programs, summer schools and doctoral
consortia.

Please have a in the SIKS online agenda for upcoming events.

Netherlands Graduate School of Linguistics
LOT is the acronym of 'Landelijke Onderzoekschool Taalwetenschap'. The research by the LOT
institutes covers all major areas of linguistics, and exploits a wide range of methodological tools
and theoretical frameworks.

Exchanges, joint seminars, lecture series and collaborations of various kinds between
researchers from participating institutes are institutionalized in a weekly LOT newsletter.

Summer and Winter Schools
LOT institutes take turns in organizing the Winter School (in January) and Summer School (in
June/July). The topics of the courses are determined by general considerations in accordance
with the research topics of LOT, and the proposals made by the curriculum committee in

Local Courses and Extracurricular Activities
(If interested, please inquire with the local organizers whether participation is possible and/or
allowed)

The local courses offered by the participating LOT institutes are principally aimed at their own
students. However, these courses are also open to PhDs of Language in Interaction. The local
courses are primarily aimed at filling gaps in the basic linguistic training and skills of the
students, or at providing education which is typical for the character of the research at the
institute/group. Moreover, other forms of education are offered such as individual training,
participation in discussion groups, tutorials etc.

In addition, all institutes organize extra-curricular activities which are directly related to the
research of the graduate students, such as colloquia in which senior and junior researchers
discuss their work, participation in international conferences and workshops, and training in
international summer schools.

For more details and an up to date agenda, please visit the LOT-website.