Study Plan

Welcome to the Cognitive Science Master's Program
The Master's program focuses on conveying in-depth, research-orientated knowledge in the field of cognitive science. Social science and psychology are combined with IT and biology/neuroscience to create a broader field of science from which qualifications for cognitive science are acquired. The combination of those separate fields gives the ability to precisely use the knowledge already acquired within those sciences to further examine the aspects of humans, technology, economy, organization, communication, and social behavior, which are all interconnected.

The Master in Cognitive Science is made up of several different interdisciplinary modules which can be completed within four semesters. The language of Instruction is English.

Structure of the Program
The first semester is made up of one introductory course module and one module on basic research methods including statistics and mathematics.

After completing these two modules, the student selects three of five main thematic fields corresponding to the sub-disciplines of cognitive science:
1. Perception,
2. Cognition and Knowledge,
3. Language and Linguistics,
4. Cognitive Neuroscience and
5. Computation.

In each of these fields, the student selects a minimum of three seminars and/or lectures. Not all courses are offered each semester.

In the second year, the students complete a research project (Laboratory Rotation) in each of the 3 selected fields and present the results as one Research Poster, one oral Presentation and one research paper. These practical research activities are complemented by four seminars on advanced research techniques, such as Eye Tracking, Mental Chronometry, EEG or fMRI Methods or Programming (Python, Matlab, R).

An internship forms a vital part of this course of studies (duration: minimum of 6 weeks).

The final semester consists of writing the Master's Thesis.

If there are any questions, please consult our homepage (https://www.sowi.uni-kl.de/en/study/uebersicht-und-studienangebote/cognitive-science) or make an appointment at the academic advising:

apl. Prof. Daniela Czernochowski
Building 57, Room 575
Phone: 0631-205-4140
E-Mail: czernochowski[at]sowi.uni-kl.de
<table>
<thead>
<tr>
<th>Nr.</th>
<th>Module (Name and Method of Examination)</th>
<th>SWS</th>
<th>CP</th>
<th>Name of the Lecture/Seminar</th>
<th>Course Achievement</th>
<th>Comment</th>
</tr>
</thead>
</table>
| SO-04-2602-M-5 | **Basic Module 1: Foundations of Cognitive Science** (12 CP)  
  *Written exam (90min)* | 2 | 3 | Perception, Cognition and Knowledge | Participation in moderated discussions | Mandatory courses |
| | | 2 | 3 | Linguistics and Language Processing | Written exam | |
| | | 2 | 3 | Cognitive Neuroscience | Method paper (2-4 pages) | |
| | | 2 | 3 | Philosophy of Mind | --- | |
| SO-04-2602-M-5 | **Basic Module 2: Principles of Research in Cognitive Science** (18 CP)  
  *Paper1 in “Design and Analysis of Experiments”*  
  *Paper1 or Written Exams or Exercises in all courses* | 2 | 3 | Mathematical Foundations for Cognitive Science | written exam | Mandatory courses |
| | | 2 | 3 | Design of Experiments and Fundamentals of Diagnostics | Written Paper | |
| | | 2 | 3 | Statistics for Cognitive Science (Lecture) | Written exam | |
| | | 2 | 3 | Statistics for Cognitive Science (Exercise) | Practical exercise | |
| | | 2 | 3 | Scientific Writing | Practical exercises | |
| | | 2 | 3 | Introduction to Programming | Practical exercises | |
| SO-07-2615-M-6 | **Basic Module 3: Advanced Research Techniques:**  
  (3rd semester)  
  *(4 CP + 2-3 x 1CP)*  
  *Exercises in all courses* | 2 | 3 | Introduction to Stochastic Modeling of Cognitive Processes | Discussion or presentation or written exam¹ | Mandatory courses |
| | | 1 | 1 | Human Subjects | Application for ethics approval for a research study | Mandatory courses |
| | | 1 | 1 | **Methods Seminar:** Special Methods according to specific research projects | Practical exercises | Elective courses (choose 3 out of 5) |
| | | 1 | 1 | Methods Seminar: Eye-tracking | Practical exercises | |
| | | 1 | 1 | Methods Seminar: Reaction Time Assessment | Practical exercises | |
| | | 1 | 1 | Methods Seminar: Self-paced reading | Practical exercises | |
| | | 1 | 1 | Methods Seminar: EEG Recording and Analysis | Practical exercises | |
## Study Plan

### Advanced Modules (choose 3 out of 5)

#### Advanced Modules 1: Perception

<table>
<thead>
<tr>
<th>Code</th>
<th>Course Description</th>
<th>Credits</th>
<th>ECTS</th>
<th>Assessment</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>SO-07-2603-M-6-a</td>
<td>Advanced Module 1: Perception – Specialized Seminars</td>
<td>2</td>
<td>3</td>
<td>Psychophysics and Signal Detection</td>
<td>Practical work</td>
</tr>
<tr>
<td></td>
<td>(9 CP)</td>
<td></td>
<td></td>
<td></td>
<td>Elective courses</td>
</tr>
<tr>
<td></td>
<td><em>Oral exam (15-30 min.)</em></td>
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<tr>
<td>SO-07-2603-M-6-b</td>
<td>Advanced Module 1: Perception – Research and Methods</td>
<td>4</td>
<td>6</td>
<td>Laboratory Rotation for Advanced Module 1:</td>
<td>Practical work</td>
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<tr>
<td></td>
<td>(6 CP)</td>
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<td></td>
<td>Perception</td>
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#### Advanced Modules 2: Cognition and Knowledge

<table>
<thead>
<tr>
<th>Code</th>
<th>Course Description</th>
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<th>Notes</th>
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<tbody>
<tr>
<td>SO-08-2605-M-6-a</td>
<td>Advanced Module 2: Cognition and Knowledge - Specialized</td>
<td>2</td>
<td>3</td>
<td>Collaborative Intelligence (lecture)</td>
<td>Practical work</td>
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<td>Seminars</td>
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<td>Elective courses</td>
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<td><em>Oral exam (20-30 min.)</em></td>
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<td></td>
<td>2 3  Collaborative Intelligence (seminar)</td>
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<td></td>
<td>2 3  Judgment and Decision-Making</td>
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<td></td>
<td>2 3  Learning and Behavior</td>
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<tr>
<td></td>
<td>2 3  Human Intelligence, Problem Solving and Creative</td>
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<tr>
<td></td>
<td>Thinking</td>
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<tr>
<td></td>
<td>2 3  Human Memory: Behavioral and Neural Basis</td>
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<tr>
<td></td>
<td>2 3  Reading</td>
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## Study Plan

### Advanced Modules 2: Cognition and Knowledge - Research and Methods (6 CP)

<table>
<thead>
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<th>Remarks</th>
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<tr>
<td>SO-08-2605-M-6-b</td>
<td>Laboratory Rotation for Advanced Module 2: Cognition and Knowledge</td>
<td>4</td>
<td>Practical work</td>
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### Advanced Modules 3: Language and Linguistics

<table>
<thead>
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<th>Module</th>
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<th>Remarks</th>
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<tbody>
<tr>
<td>SO-12-2607-M-6-a</td>
<td>Advanced Module 3: Language and Linguistics - Specialized Seminars (9 CP)</td>
<td>2</td>
<td>Reading</td>
<td>Presentation or written exam or paper (^1)</td>
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<tr>
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<td></td>
<td>3</td>
<td>Syntax</td>
<td>Written exam and exercises</td>
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<tr>
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<td>Sentence Processing</td>
<td>Presentation or written exam or paper (^1) Fehler! Textmarke nicht definiert.</td>
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<td>Language Development</td>
<td>Presentation or written exam or paper (^1) Fehler! Textmarke nicht definiert.</td>
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<td></td>
<td></td>
<td>Psycholinguistics</td>
<td>Presentation or written exam or paper (^1)</td>
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<td></td>
<td></td>
<td></td>
<td>Neural Basis of Language</td>
<td>Presentation or written exam or paper (^1)</td>
</tr>
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<td></td>
<td></td>
<td></td>
<td>Computational Linguistics</td>
<td>Presentation or written exam or paper (^1)</td>
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<td></td>
<td>Heritage Language Acquisition</td>
<td>Presentation or written exam or paper (^1)</td>
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<tr>
<td>SO-12-2607-M-6-b</td>
<td>Advanced Module 3: Language and Linguistics - Research and Methods (6 CP)</td>
<td>4</td>
<td>Laboratory Rotation for Advanced Module 3: Cognition and Knowledge</td>
<td>Practical work</td>
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### Advanced Modules 4: Cognitive Neuroscience

<table>
<thead>
<tr>
<th>Module</th>
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<th>Credits</th>
<th>Type</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>SO-15-2609-M-6-b</td>
<td>Advanced Module 4: Cognitive Neuroscience – Specialized Seminars (9 CP)</td>
<td>2</td>
<td>Human Memory: Behavioral and Neural Basis</td>
<td>Presentation or written exam or paper (^1)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3</td>
<td>Neural Basis of Language</td>
<td>Presentation or written exam or paper (^1)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Introduction to Neuropsychology</td>
<td>Presentation or written exam or paper (^1)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Neuroscience of Cognitive Control</td>
<td>Presentation or written exam or paper (^1)</td>
</tr>
<tr>
<td>SO-15-2609-M-6-b</td>
<td>Advanced Module 4: Cognitive Neuroscience - Research and Methods (6 CP)</td>
<td>4</td>
<td>Laboratory Rotation for Advanced Module 4: Cognitive Neuroscience</td>
<td>Practical work</td>
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<tr>
<td></td>
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<td>6</td>
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</table>

\(^1\) Fehler! Textmarke nicht definiert.
## Study Plan

### Advanced Modules 5: Computation

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
<th>Seminars/Projects</th>
<th>Exam Form</th>
<th>Tracks</th>
<th>Mandatory</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advanced Module 5: Computation – Specialized Seminars</td>
<td>3x 2</td>
<td>Choose 3 Seminars from Computer Science Department, according to one of our tracks</td>
<td>Written exam or paper¹</td>
<td>Choose 3 tracks</td>
<td></td>
</tr>
<tr>
<td>SO-08-2611-M-6-b Advanced Module 5: Computation - Research and Methods</td>
<td>2</td>
<td>Laboratory Rotation for Advanced Module 5: Computation – current Projects</td>
<td>Practical work /Prototype and Presentation</td>
<td>Mandatory course</td>
<td></td>
</tr>
<tr>
<td>Internship Module (8 CP)</td>
<td>---</td>
<td>Internship</td>
<td>Internship report</td>
<td>Mandatory courses</td>
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</tr>
<tr>
<td>Internship Module (8 CP)</td>
<td>---</td>
<td>Internship</td>
<td>Internship report</td>
<td>Mandatory courses</td>
<td></td>
</tr>
<tr>
<td>Master’s Thesis (30 CP)</td>
<td>---</td>
<td>Master’s Thesis</td>
<td>---</td>
<td>Mandatory courses</td>
<td></td>
</tr>
</tbody>
</table>

¹ As specified at the beginning of the course

2 Present a poster or presentation or paper (students prepare all three exam forms – one for each Research and Methods Module)

## 1st Semester: Basic Modules 1 and 2

<table>
<thead>
<tr>
<th>Basic Module 1: Foundations of Cognitive Science</th>
<th>3</th>
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<tbody>
<tr>
<td>Basic Module 2: Principles of Research in Cognitive Science</td>
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</tbody>
</table>

## 2nd/3rd Semester: Advanced Module 1: Perception

<table>
<thead>
<tr>
<th>Advanced Module 1: Perception - Specialized Seminars</th>
<th>7</th>
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</thead>
<tbody>
<tr>
<td>Advanced Module 1: Perception – Applied Research</td>
<td>9</td>
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</tbody>
</table>

## 2nd/3rd Semester: Advanced Module 2: Cognition and Knowledge

<table>
<thead>
<tr>
<th>Advanced Module 2: Cognition and Knowledge - Specialized Seminars</th>
<th>10</th>
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</thead>
<tbody>
<tr>
<td>Advanced Module 2: Cognition and Knowledge - Applied Research</td>
<td>13</td>
</tr>
</tbody>
</table>

## 2nd/3rd Semester: Advanced Module 3: Language and Linguistics

<table>
<thead>
<tr>
<th>Advanced Module 3: Language and Linguistics - Specialized Seminars</th>
<th>14</th>
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<tbody>
<tr>
<td>Advanced Module 3: Language and Linguistics - Applied Research</td>
<td>17</td>
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</tbody>
</table>

## 2nd/3rd Semester: Advanced Module 4: Cognitive Neuroscience

<table>
<thead>
<tr>
<th>Advanced Module 4: Cognitive Neuroscience - Specialized Seminars</th>
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</thead>
<tbody>
<tr>
<td>Advanced Module 4: Cognitive Neuroscience – Applied Research</td>
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</table>

## 2nd/3rd Semester: Advanced Module 5: Computation

<table>
<thead>
<tr>
<th>Advanced Module 5: Computation - Specialized Seminars</th>
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</thead>
<tbody>
<tr>
<td>Advanced Module 5: Computation – Applied Research</td>
<td>26</td>
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</table>

## 2nd/3rd Semester: Internship

| Internship Module | 27 |

## 3rd Semester: Basic Module 3

| Basic Module 3: Advanced Research Techniques in Cognitive Science | 28 |

## 4th Semester: Master’s Thesis

| Master’s Thesis | 30 |
**List of abbreviations:**

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>CP</td>
<td>Credit Points</td>
</tr>
<tr>
<td>en</td>
<td>english</td>
</tr>
<tr>
<td>MOD</td>
<td>Mode</td>
</tr>
<tr>
<td>AT</td>
<td>Attendance time</td>
</tr>
<tr>
<td>RC</td>
<td>Regular Cycle</td>
</tr>
<tr>
<td>La</td>
<td>Language</td>
</tr>
<tr>
<td>PS</td>
<td>Private Study (preparation + follow up)</td>
</tr>
<tr>
<td>ST</td>
<td>Summer Term</td>
</tr>
<tr>
<td>CH</td>
<td>contact hours per week</td>
</tr>
<tr>
<td>PL</td>
<td>Participant limit</td>
</tr>
<tr>
<td>WST</td>
<td>Winter and Summer Term</td>
</tr>
<tr>
<td>WT</td>
<td>Winter Term</td>
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</table>

Please note: You can find the course achievement of every course in the description of the particular content.
1st Semester: Basic Modules 1 and 2

Basic Module 1: Foundations of Cognitive Science

<table>
<thead>
<tr>
<th>Code:</th>
<th>Module Coordinator:</th>
<th>Teaching Staff:</th>
</tr>
</thead>
<tbody>
<tr>
<td>SO-07-2601-M-5</td>
<td>Prof. Dr. Thomas Schmidt</td>
<td>Prof. Dr. Thomas Schmidt</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Prof. Dr. Thomas Lachmann</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Prof. Dr. Daniela Czernochowski</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Prof. Dr. Shanley Allen</td>
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<tr>
<td></td>
<td></td>
<td>Prof. Dr. Karen Joisten</td>
</tr>
</tbody>
</table>

Credit Points (CP): 12 CP  
Workload: 360 h  
Duration: 1 Term/s  
Regular cycle: Winter Term  
Recommended Semester: cf. study schedule

Parts of the module/courses:
In this module, students are required to complete all four courses (for 12 CP).

<table>
<thead>
<tr>
<th>Code</th>
<th>Course</th>
<th>MOD</th>
<th>C</th>
<th>H</th>
<th>A</th>
<th>T</th>
<th>PS</th>
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<th>La</th>
<th>RC</th>
<th>CP</th>
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<tbody>
<tr>
<td>SO-00-26.1000-V</td>
<td>Lecture Perception, Cognition and Knowledge</td>
<td>2</td>
<td>30</td>
<td>60</td>
<td>30</td>
<td>en</td>
<td>W</td>
<td>T</td>
<td>3</td>
<td></td>
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<tr>
<td>SO-04-26.8000-V-5</td>
<td>Lecture Philosophy of Mind</td>
<td>2</td>
<td>30</td>
<td>60</td>
<td>20</td>
<td>en</td>
<td>W</td>
<td>T</td>
<td>3</td>
<td></td>
<td></td>
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<tr>
<td>SO-12-26.1000-S-5</td>
<td>Lecture Cognitive Neuroscience and Neurobiology</td>
<td>2</td>
<td>30</td>
<td>60</td>
<td>25</td>
<td>en</td>
<td>W</td>
<td>T</td>
<td>3</td>
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<td>SO-12-8.1000-S-3</td>
<td>Lecture Linguistics and Language Processing</td>
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<td>30</td>
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<td>en</td>
<td>W</td>
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</table>

Content:

Lecture Perception, Cognition and Knowledge
Understanding of basic concepts, phenomena, and experimental paradigms, with a focus on behavioral cognitive psychology and mental chronometry.  
Course achievement: Participation in moderated discussions.

Lecture Philosophy of Mind
The lecture will discuss different concepts of mind from a historical and systematic perspective. We will read and study original articles in the field.  
Course achievement: Presentation or exam or paper (as specified at the beginning of the course)

Lecture Cognitive Neuroscience and Neurobiology
The lecture will provide information about the basic aspects of brain structure and function and how they relate to cognition. The major focus is on contemporary methods of cognitive neuroscience (EEG, fMRI, TMS, etc.), and how each method can inform us about cognitive processes. This lecture will cover basic aspects of neurophysiology, including the principles of excitability and synaptic connectivity. However, participants with no or very limited knowledge in biology will be required to acquire relevant aspects of neurobiology in guided self-study during this course (e.g., structure of the nervous system, neurotransmitters).  
Course achievement: Method paper (2-4 pages)

Lecture Linguistics and Language Processing
Students will learn foundations of the structure of language, language development, and language processing as understood within the framework of cognitive science.  
Course achievement: Written exam

Competencies and Intended Learning Outcomes:
Intended Learning Outcomes:
On successfully completing the module students will be able to

• gain an understanding of how perceptual and cognitive processes function and interact in humans, animals and artificial systems.
- learn how cognitive science is understood within its central component disciplines, especially psychology, neurobiology, linguistics, and philosophy.

<table>
<thead>
<tr>
<th>Prerequisites for attending:</th>
<th>Requirements for receiving credit points:</th>
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<tbody>
<tr>
<td><strong>Formal admission requirements/Contentual prerequisites:</strong></td>
<td>Successful completion of requirements for four-lectures as well as one written exam (90 min.) covering the entire module.</td>
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<table>
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<tbody>
<tr>
<td>Grade of the written exam.</td>
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<thead>
<tr>
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<table>
<thead>
<tr>
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<tbody>
<tr>
<td><strong>Recommended literature:</strong> Lecture Perception, Cognition and Knowledge</td>
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<tr>
<td><strong>Recommended literature:</strong> Lecture Philosophy of Mind</td>
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<tr>
<td>Will be announced at the beginning of the course.</td>
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<tr>
<td><strong>Recommended literature:</strong> Lecture Cognitive Neuroscience</td>
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<tr>
<td><strong>Recommended literature:</strong> Lecture Linguistics and Language Processing</td>
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Basic Module 2: Principles of Research in Cognitive Science

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<th>Module Coordinator:</th>
<th>Teaching Staff:</th>
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<tbody>
<tr>
<td>SO-04-2602-M-5</td>
<td>Dr. Leigh Fernandez</td>
<td>Prof. Dr. Shanley Allen</td>
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<td>Dr. Radha Nila Mehanathan</td>
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<tr>
<td></td>
<td></td>
<td>Dipl.-Psych. René Reinhard</td>
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<tr>
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<td>M. Sc. Felix Hekele</td>
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<td></td>
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<td>M. Sc. John Gamboa</td>
</tr>
<tr>
<td></td>
<td></td>
<td>M. Sc. Max Wolkersdorfer</td>
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<tr>
<td></td>
<td></td>
<td>Dipl.-Psych. René Reinhard</td>
</tr>
</tbody>
</table>

Credit Points (CP): 18 CP  
Workload: 480 h  
Duration: 1 Term/s  
Regular cycle: Winter Term  
Recommended Semester: cf. study schedule

Parts of the module/courses:  
In this module, students are required to pass all six courses (for 18 CP).

<table>
<thead>
<tr>
<th>Code</th>
<th>Course Title</th>
<th>Credits</th>
<th>Semester</th>
<th>Weekly</th>
<th>Exam</th>
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<tbody>
<tr>
<td>SO-12-2620-U-6</td>
<td>Master’s Seminar Mathematical Foundations for Cognitive Science</td>
<td>M</td>
<td></td>
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</tr>
<tr>
<td>SO-12-36.1000-S-0</td>
<td>Master’s Seminar Scientific Writing</td>
<td>M</td>
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</tr>
<tr>
<td>SO-08-2621-U-7</td>
<td>Master’s Seminar Introduction to Programming using Python</td>
<td>M</td>
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</tr>
</tbody>
</table>

Content:

**Master’s Seminar Mathematical Foundations for Cognitive Science**  
The course will informally introduce basic concepts of set theory, algebra, linear algebra, probability, statistics and signal processing. No previous knowledge is expected except for very basic mathematical knowledge. By the end of the course, the students will have developed an intuition of how mathematical concepts are generally expressed, and how the aforementioned mathematical concepts relate to one another.  
Course achievement: Written exam (90 minutes)

**Master’s Seminar Design of Experiments and Fundamentals of Diagnostics**  
Theoretical foundation and history of quantitative approach to research, fundamentals of experimental design, practical aspects of experiment preparation and procedure, analysis of experimental data.  
Course achievement: Written Paper

**Lecture Statistics in Cognitive Science**  
Introduction to statistical analyses in cognitive science, ranging from simple t-tests to multiple regression and $\chi^2$. How does data determine the choice of statistical tests? What’s the logic behind hypothesis testing? Which requirements have to be met?  
Course achievement: Written Exam (90 minutes)

**Master’s Seminar Statistics in Cognitive Science: Exercise**  
In this course students will learn how to calculate descriptive statistics, visualize data, evaluate assumptions, and perform correlational analysis, simple and multiple regression, logistic regression, t-tests, ANOVA, and generalized linear mixed effects regression (i.e., event history analysis). It is intended to provide practical knowledge introduced in the parallel lecture, and will also introduce data analyses using software SPSS and R. Course achievement: weekly assignments

**Master’s Seminar Scientific Writing**  
In this course, students will learn how to structure and write papers for scientific journals. Furthermore, essential qualities required in scientific writing, such as being clear, concise, convincing, fluid, interesting, and organized are thought and practiced. Exercises will enable students to assess their strengths and weaknesses in scientific writing.  
Course achievement: Practical exercises

**Master’s Seminar Introduction to Programming using Python**
This Seminar introduces basic programming concepts (variables, algorithms, data types, control structures), which will be practiced through written exercises and implementation tasks. The practical Introduction to Programming as employed in various contexts in Cognitive Science will use the Programming Language Python.

**Course achievement:** Satisfactory completion of exercises or weekly assignments (as detailed at the beginning of the class).

## Competencies and Intended Learning Outcomes:

**Intended Learning Outcomes:**
On successfully completing the module students will be able to,

- develop an understanding of the design of experiments.
- understand the mathematical foundations and implement statistical tools for analysing empirical data
- develop fundamental skills in computer programming and data analysis.
- hone skills in scientific writing.

## Prerequisites for attending:

<table>
<thead>
<tr>
<th>Formal admission requirements/Contentual prerequisites</th>
<th>Requirements for receiving credit points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Successful completion of requirements for all seminars, as well as a paper (approx. 15 pages) in &quot;Design of Experiments and Fundamentals of Diagnostics&quot; and „Scientific Writing“, and a Written Exam (90 minutes) covering the contents of the Lecture “Statistics for Cognitive Science”</td>
<td></td>
</tr>
</tbody>
</table>

## Determination of grade:
Grades will be determined for each course in the module separately.

## Applicability of the module/suitability:
As an obligatory module:
- 
As a mandatory module:
- 

## Hints for preparation:

**Recommended literature:**

**Master’s Seminar Design of Experiments and Fundamentals of Diagnostics**

**Recommended literature:**

**Master’s Seminar Statistics: Exercise**

**Recommended literature:**

**Master’s Seminar Scientific Writing**

**Recommended literature:**

**Master’s Seminar Introduction to Programming using Python**
## Advanced Module 1: Perception - Specialized Seminars

<table>
<thead>
<tr>
<th>Code:</th>
<th>Module Coordinator:</th>
<th>Teaching Staff:</th>
</tr>
</thead>
<tbody>
<tr>
<td>SO-07-2603-M-6-a</td>
<td>Prof. Dr. Thomas Schmidt</td>
<td>Prof. Dr. Thomas Schmidt</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sven Panis, PhD</td>
</tr>
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<td>N.N.</td>
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</tbody>
</table>

### Credit Points (CP):
- 9 CP

### Workload:
- 270 h

### Duration:
- 1 Term/s

### Regular cycle:
- Summer / Winter Term

### Recommended Semester:
- cf. study schedule

### Parts of the module/courses:
In this module, students have to complete at least three courses (for 9 CP).

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
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<tbody>
<tr>
<td>SO-07-26.2000-S-7</td>
<td>Master’s Seminar Psychophysics and Signal Detection</td>
<td>E</td>
<td>2</td>
<td>30</td>
<td>60</td>
<td>30</td>
<td>en</td>
<td>ST</td>
<td>3</td>
<td></td>
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</tr>
<tr>
<td>SO-07-26.6000-S-7</td>
<td>Master’s Seminar Visual Attention and Awareness</td>
<td>E</td>
<td>2</td>
<td>30</td>
<td>60</td>
<td>30</td>
<td>en</td>
<td>ST</td>
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<td></td>
</tr>
<tr>
<td>SO-15-26.7000-S-7</td>
<td>Master’s Seminar Perception and Eye Movements</td>
<td>E</td>
<td>2</td>
<td>30</td>
<td>60</td>
<td>30</td>
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<tr>
<td>SO-08-2622-S-6</td>
<td>Master’s Seminar Special Topics in Perception: Perceptual Decisions Under Uncertainty and Time Perception</td>
<td>E</td>
<td>2</td>
<td>30</td>
<td>60</td>
<td>30</td>
<td>en</td>
<td>ST</td>
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</tbody>
</table>

### Content:

**Master’s Seminar Psychophysics and Signal Detection**
The seminar reviews the most important psychophysical models, including signal detection and threshold theories. Special emphasis is on experimental techniques and practical calculation. Lecture on Perception, Cognition and Knowledge (part of Basic Module 1) is highly recommended.

**Course achievement:** Presentation or exam or paper (as specified at the beginning of the course)

**Master’s Seminar Visual Attention and Awareness**
The seminar reviews important models and experimental paradigms in attention and awareness research, using classic and recent original papers. Lecture on Perception, Cognition and Knowledge (part of Basic Module 1) is highly recommended.

**Course achievement:** Presentation or exam or paper (as specified at the beginning of the course)

**Master’s Seminar Perception and Eye Movements**
The seminar will cover the basics of eye movements, the relationship between eye movements, perception and cognition, which information eye movements can provide about cognition and the eye movements outside the healthy adult.
The lecture on Perception, Cognition and Knowledge (part of Basic Module 1) is highly recommended.

**Course achievement:** Presentation or exam or paper (as specified at the beginning of the course)

**Master’s Seminar Auditory and Cross-Modal Perception**
The seminar reviews important models and experimental paradigms in auditory perception and the integration of auditory input into coherent cross-modal representations. Lecture on Perception, Cognition and Knowledge (part of Basic Module 1) is highly recommended.

**Course achievement:** Presentation or exam or paper (as specified at the beginning of the course)

### Competencies and Intended Learning Outcomes:

**Intended Learning Outcomes:**
On successfully completing the module students will be able to,

- present their knowledge of special topics from the field of Perception
- apply the acquired understanding of perceptual processes
- read and interpret scientific English literature in this field
- summarize and compare research papers and highlight relevant information from these papers
- debate scientific issues with peers or lecturers and thereby refer to complex concepts
<table>
<thead>
<tr>
<th>Prerequisites for attending:</th>
<th>Requirements for receiving credit points:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Formal admission requirements/Contentual prerequisites:</strong> Successful completion of Basic Modules 1 and 2 is recommended.</td>
<td>Successful completion of requirements for three elective seminars, as well as one oral exam covering the entire module (15-30 min).</td>
</tr>
<tr>
<td><strong>Determination of grade:</strong></td>
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<tr>
<td>Grade of the oral exam.</td>
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<tr>
<td><strong>Applicability of the module/suitability:</strong></td>
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<tr>
<td>As an obligatory module:</td>
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<td>As a mandatory module:</td>
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<td><strong>Hints for preparation:</strong></td>
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<tr>
<td>Recommended literature:</td>
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<tr>
<td><strong>Master’s Seminar Psychophysics and Signal Detection</strong></td>
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<tr>
<td>Recommended literature:</td>
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</tr>
<tr>
<td><strong>Master’s Seminar Visual Attention and Awareness</strong></td>
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<tr>
<td>Itti, Rees, &amp; Tsotsos (1995): &quot;Neurobiology of Attention&quot;. Elsevier</td>
<td></td>
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<tr>
<td>Recommended literature:</td>
<td></td>
</tr>
</tbody>
</table>
Advanced Module 1: Perception – Applied Research

Code:  Module Coordinator:  Teaching Staff:
SO-07-2603-M-6-b  Prof. Dr. Thomas Schmidt  Prof. Dr. Thomas Lachmann
Ph.D. Sven Panis

Credit Points (CP):  Workload:  Duration:  Regular cycle:  Recommended Semester:
6 CP  180 h  1 Term/s  Winter Term  cf. study schedule

Parts of the module/courses:
In this module, students are required to complete the Laboratory Rotation (for 6 CP).

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<th>Laboratory Rotation for Advanced Module 1: Perception</th>
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<td>P L</td>
<td>RC</td>
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<td>C P</td>
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</tbody>
</table>

Content:
Laboratory Laboratory Rotation for Advanced Module 1: Perception

Group work on a practical research project (e.g., response priming effects) under the supervision of one of the teaching staff. Successful completion of Basic Modules 1 and 2 and the lecture on Perception, Cognition and Knowledge (part of Basic Module 1) are highly recommended.

Course achievement: Practical work

Competencies and Intended Learning Outcomes:

Intended Learning Outcomes:
On successfully completing the module students will be able to,

• recognize and define basic and some more advanced methods in research related to Perception
• transfer the acquired knowledge to related experimental designs
• prepare and conduct an experiment in the laboratory; apply practical research skills
• Summarize and present the results obtained with these specific research methods

Prerequisites for attending:

Formal admission requirements/Contentual prerequisites: Successful completion of Basic Modules 1 and 2 is recommended.

Requirements for receiving credit points:
EITHER prepare and present a poster OR presentation at an annual “mini-conference” (15 min talk and 5 – 10 min discussion) OR write a paper (approx. 15 pages) about laboratory rotation work. Overall, students have to prepare all three exam forms – one for each advanced module.

Determination of grade:
none

Applicability of the module/suitability:
As an obligatory module:
- 
As a mandatory module:
- 

Hints for preparation:
Recommended literature:
Laboratory Laboratory Rotation for Advanced Module 1: Perception
Miller & Haden (2006): "Statistical Analysis with the General Linear Model". Creative Commons Recommended literature:
2nd/3rd Semester: Advanced Module 2: Cognition and Knowledge

Advanced Module 2: Cognition and Knowledge - Specialized Seminars

<table>
<thead>
<tr>
<th>Code:</th>
<th>Module Coordinator:</th>
<th>Teaching Staff:</th>
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<tbody>
<tr>
<td>SO-08-2605-M-6-a</td>
<td>Prof. Dr. Thomas Lachmann</td>
<td>Prof. Dr. Thomas Schmidt</td>
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<tr>
<td></td>
<td></td>
<td>Prof. Dr. Daniela Czernochowski</td>
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<tr>
<td></td>
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<td>Prof. Dr. Maria Klatte</td>
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<tr>
<td></td>
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<td>Prof. Dr. Andreas Dengel</td>
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<tr>
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<td>Prof. Dr. Thomas Lachmann</td>
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<tr>
<td></td>
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<td>Dr. Saskia Jaarsveld</td>
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<tr>
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<td>Dr. Francisca Rodriguez</td>
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<td></td>
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<td>Dr. Radha Nila Meghanathan</td>
</tr>
</tbody>
</table>

Credit Points (CP):
- 9 CP

Workload:
- 270 h

Duration:
- 1 Term/s

Regular cycle:
- Summer & Winter Term

Recommended Semester:
- cf. study schedule

Parts of the module/courses:
In this module, students are required to complete at least three elective (E) courses (for 9 CP).

<table>
<thead>
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<th>Course Title</th>
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<td>INF-71-58-V-7</td>
<td>Lecture Collaborative Intelligence</td>
<td>E</td>
<td>2</td>
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<td>INF-71-58-U-7</td>
<td>Master’s Seminar Collaborative Intelligence</td>
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<tr>
<td>SO-08-26.2100-S-7</td>
<td>Master’s Seminar Judgment and Decision-Making</td>
<td>E</td>
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<tr>
<td>SO-08-26.2300-S-7</td>
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<td>E</td>
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<td>SO-08-8.1000-S-7</td>
<td>Master’s Seminar Cognitive Aging</td>
<td>E</td>
<td>2</td>
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<td>30</td>
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<td>SO-08-26.1300-S-7</td>
<td>Master’s Seminar Reading</td>
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<tr>
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<td>Master’s Seminar Eye Movements and Cognition</td>
<td>E</td>
<td>2</td>
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<td>60</td>
<td>30</td>
<td>en</td>
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<tr>
<td>SO-08-27.1000-S-6</td>
<td>Master’s Seminar Human Intelligence, Problem Solving and Creative Thinking</td>
<td>E</td>
<td>2</td>
<td>30</td>
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<tr>
<td>SO-08-27.1020-S-6</td>
<td>Master’s Seminar Human Memory: Behavioral and Neural Basis</td>
<td>E</td>
<td>2</td>
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<tr>
<td>SO-04-26.2000</td>
<td>Master’s Seminar Man as Machine – Machine as Man</td>
<td>E</td>
<td>2</td>
<td>30</td>
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<td>30</td>
<td>En</td>
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</tr>
</tbody>
</table>

Content:
Lecture Collaborative Intelligence
Methods supporting personal knowledge work; organizational memories; modeling of attention and working context; foundations of Information Retrieval search with respect to mobility, tasks and interests; agile knowledge workflows and emergent systems; enterprise platforms and social networks; success criteria and evaluation methods. Participation in optional exercise sessions is recommended. Lecture on Perception, Cognition and Knowledge (part of Basic Module 1) is recommended.

Course achievement: Presentation or exam or paper (as specified at the beginning of the course)

Master’s Seminar Collaborative Intelligence
Selected topics in socio-technical knowledge work (see topics for the course on “Collaborative Intelligence”). Based on a set of publications, participants are trained in writing scientific (summary) papers and presenting in a quasi-scientific setting. The students are also introduced to the process of paper reviewing. The final presentation will be organized as a one-day-event, where participants of the seminar will present their findings and discuss them with the audience.

Prerequisites: Lecture “Collaborative Intelligence”

Course achievement: Presentation or exam or paper (as specified at the beginning of the course)

Master’s Seminar Judgment and Decision-Making
- Probability and judgment
- models of individual and group decision making, including choices between complex options involving risk and time
- reasoning with uncertainty
- methods of measurement
- practical implication
Lecture on Perception, Cognition and Knowledge (part of Basic Module 1) is recommended.

**Course achievement:** Presentation or exam or paper (as specified at the beginning of the course)

**Master’s Seminar Learning and Behavior**
- Behavioral and cognitive theories of animal and human learning, skills and procedural learning
- neural basis of learning and behavior
- interaction between cognition, motivations and emotion

Lecture on Perception, Cognition and Knowledge (part of Basic Module 1) is recommended.

**Course achievement:** Presentation

**Master’s Seminar Eye Movements and Cognition**
The seminar will cover the basics of eye movements, the relationship between eye movements and cognition, which information eye movements can provide about cognition and the eye movements outside the healthy adult. The lecture on Perception, Cognition and Knowledge (part of Basic Module 1) is highly recommended.

**Course achievement:** Presentation or exam or paper (as specified at the beginning of the course)

**Master’s Seminar Cognitive Aging**
The seminar will focus on cognitive changes while aging. Topics include

- Theories on cognitive aging
- Normal and abnormal cognitive aging
- Mild cognitive impairment (MCI)
- Dementia and Alzheimer's disease
- Measuring cognitive impairment and diagnosing dementia

The lecture on Perception, Cognition and Knowledge (part of Basic Module 1) is highly recommended.

**Course achievement:** Presentation or exam or paper (as specified at the beginning of the course)

**Master’s Seminar Reading**
- Normal processes of reading
- reading disorders
- dyslexia

Prerequisites: Lecture on Linguistics and Language Processing (part of Basic Module 1) is recommended.

**Course achievement:** Presentation or exam or paper (as specified at the beginning of the course)

**Master’s Seminar Human Intelligence, Problem Solving and Creative Thinking**
Convergent and divergent thinking skills in open and closed problem spaces, intelligence, creative production. Lecture on Perception, Cognition and Knowledge (part of Basic Module 1) is recommended.

**Course achievement:** Presentation

**Master’s Seminar Human Memory: Behavioral and Neural Basis**
- Structures and processes in human memory
- working memory theories
- memory development
- memory and attention

Lecture on Perception, Cognition and Knowledge as well as Cognitive Neuroscience (part of Basic Module 1) is recommended.

**Course achievement:** Presentation or exam or paper (as specified at the beginning of the course)

**Master’s Seminar Man as Machine – Machine as Man**
The question of how humans see and represent themselves has been approached via the analogy to artifact and machine, sometimes stressing similarities, sometimes differences. This course discusses pivotal texts from ancient, modern, and recent times with the goal to analyze how the (perceived) relationship between man and machine was, and still is, changing.

**Course achievement:** Worksheet Presentation or exam or paper (as specified at the beginning of the course)

**Competencies and Intended Learning Outcomes:**

Intended Learning Outcomes:
On successfully completing the module students will be able to,
- present their knowledge of special topics from the field of Cognition and Knowledge
- apply the acquired understanding of human and artificial cognitive structures and processes, the acquisition and structure of human knowledge and the organization of artificial knowledge
- read and interpret scientific English literature in this field
- summarize and compare research papers and highlight relevant information from these papers
- debate scientific issues with peers or lecturers and thereby refer to complex concepts

<table>
<thead>
<tr>
<th>Prerequisites for attending:</th>
<th>Requirements for receiving credit points:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Formal admission requirements/Contentual prerequisites:</strong> Successful completion of Basic Modules 1 and 2 is recommended.</td>
<td>One oral exam covering the entire module (15 - 30 min)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Determination of grade:</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Grade of the oral exam.</td>
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</table>

**Applicability of the module/suitability:**
- As a obligatory module:
- As a mandatory module:

**Hints for preparation:**

<table>
<thead>
<tr>
<th>Recommended literature:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Lecture Collaborative Intelligence</strong></td>
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<tr>
<td><strong>Master’s Seminar Collaborative Intelligence</strong></td>
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<tr>
<td><strong>Master’s Seminar Judgment and Decision-Making</strong></td>
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<tr>
<td><strong>Master’s Seminar Learning and Behavior</strong></td>
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<tr>
<td><strong>Master’s Seminar Human Intelligence, Problem Solving and Creative Thinking</strong></td>
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<tr>
<td><strong>Master’s Seminar Human Memory: Behavioral and Neural Basis</strong></td>
<td></td>
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<tr>
<td>Baddeley, Eysenck, Anderson: Memory (Psychology Press, 2009)</td>
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Available documents:
## Advanced Module 2: Cognition and Knowledge - Applied Research

<table>
<thead>
<tr>
<th>Code:</th>
<th>Module Coordinator:</th>
<th>Teaching Staff:</th>
</tr>
</thead>
</table>
| SO-08-2605-M-6-b | Prof. Dr. Thomas Lachmann | Prof. Dr. Thomas Schmidt  
|           |                            | Prof. Dr. Thomas Lachmann  
|           |                            | Prof. Dr. Maria Klatte  
|           |                            | Dr. Kirstin Bergström  
|           |                            | Dr. Patricia de Brito Castilho Wesseling  
|           |                            | Dr. Saskia Jaarsveld  |

### Credit Points (CP):
- **6 CP**

### Workload:
- **180 h**

### Duration:
- **1 Term/s**

### Regular cycle: Winter Term

### Recommended Semester: cf. study schedule

### Parts of the module/courses:
- **Laboratory Rotation** (for 6 CP)

<table>
<thead>
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<th>Code:</th>
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<th>MOD</th>
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<td>SO-08-26.2020-S-7</td>
<td>Laboratory Laboratory Rotation for Advanced Module 2: Cognition and Knowledge</td>
<td>M</td>
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## Content:

**Laboratory Laboratory Rotation for Advanced Module 2: Cognition and Knowledge**

Group work on a practical research project (e.g., document analysis, eye tracking, programming in MATLAB) under the supervision of one of the teaching staff.

**Course achievement:** Practical work

### Competencies and Intended Learning Outcomes:

**Intended Learning Outcomes:**

On successfully completing the module students will be able to,

- recognize and define basic and some more advanced methods in research related to Cognition and Knowledge
- transfer the acquired knowledge to related experimental designs
- prepare and conduct an experiment in the laboratory; apply practical research skills
- summarize and present the results obtained with these specific research methods

### Prerequisites for attending:

**Formal admission requirements/Contentual prerequisites:** Successful completion of Basic Modules 1 and 2 is recommended.

### Requirements for receiving credit points:

EITHER prepare and present a poster OR presentation at an annual “mini-conference” (15 min talk and 5 – 10 min discussion) OR write a paper (approx. 15 pages) about laboratory rotation work. Overall, students have to prepare all three exam forms – one for each advanced module.

### Determination of grade:

---

### Applicability of the module/suitability:

As an obligatory module:
- 

As a mandatory module:
- 

### Hints for preparation:

**Recommended literature:**

*Laboratory Laboratory Rotation for Advanced Module 2: Cognition and Knowledge*

## Advanced Module 3: Language and Linguistics - Specialized Seminars

<table>
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<th>Teaching Staff</th>
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<tr>
<td>SO-12-2607-M-6-a</td>
<td>Prof. Dr. Shanley Allen</td>
<td>Prof. Dr. Shanley Allen, Prof. Dr. Daniela Czernochowski, Prof. Dr. Thomas Lachmann, Dr. Kalliopi Katsika, Dr. Leigh Fernandez, Dr. Gunnar Jacob, Dr. Kirstin Bergström</td>
</tr>
</tbody>
</table>

### Credit Points (CP):

- **9 CP**

### Workload:

- 270 h

### Duration:

- 1 Term/s

### Regular cycle:

- Summer Term

### Recommended Semester:

- cf. study schedule

### Parts of the module/courses:

Courses marked with an (M) are mandatory, whereas courses marked with an (E) are elective. In this module, students are required to complete at least three elective (E) courses (for 9 CP).

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### Content:

#### Master’s Seminar Reading
- Normal processes of reading
- Reading disorders
- Dyslexia

Prerequisites: Lecture on Linguistics and Language Processing (part of Basic Module 1) is recommended.

**Course achievement:** Presentation or exam or paper (as specified at the beginning of the course)

#### Master’s Seminar Syntax
- Structural relations between elements in a sentence
- Syntactic properties
- Syntactic categories and how they differ from semantic categories
- Details of and constraints on 'movement' in syntax
- Extent of shared syntactic properties across all natural languages
- Theories of syntactic structure

Prerequisites: Lecture on Linguistics and Language Processing (part of Basic Module 1) is recommended.

**Course achievement:** Written exam (as specified at the beginning of the course) and exercises

#### Master’s Seminar Sentence Processing
- Theories and mechanisms of sentence processing in children and adults
- Cross-linguistic influence in sentence processing of bilinguals
- Fundamentals of sentence processing methods (e.g., priming, self-paced reading, eye tracking, ERP)
Prerequisites: Syntax (should ideally be taken before or at the same time as Sentence Processing) Lecture on Linguistics and Language Processing (part of Basic Module 1) is recommended.

Course achievement: Presentation or exam or paper (as specified at the beginning of the course)

Master’s Seminar Computational Linguistics

This is an introduction to Computational Linguistics using the Python programming language. We'll learn how to solve a set of problems related to Linguistics and explore linguistic data available in the web. We will introduce the concept of corpus, and understand how we can use corpus data to answer linguistic questions. In addition, we will have a simple introduction to Machine Learning, which will allow us to take advantage of corpus annotations; and talk a little about tokenization and lemmatization, useful for generating our own corpora. Some final remarks on distributional semantics will finish this introduction.

Course achievement: Presentation or exam or paper (as specified at the beginning of the course)

Master’s Seminar Heritage Language Acquisition

This seminar focuses on the grammatical development of Heritage Languages and Heritage Language speakers in light of current theoretical claims and recent experimental research. Heritage Language speakers are individuals whose first language (L1) is a language that is spoken in their family, which is, however, different from the dominant language of the community. Through the analysis of the grammatical characteristics of heritage languages around the globe, we are going to see how language develops in heritage language speakers, and how different or similar heritage language speakers are in comparison to native speakers and second language learners of the dominant language.

Course achievement: Presentation or exam or paper (as specified at the beginning of the course)

Master’s Seminar Language Development

- Theories of language development
- first and second language acquisition
- bilingualism
- language disorders
- relations between language development and cognitive development

Prerequisites: Lecture on Linguistics and Language Processing (part of Basic Module 1) is recommended.

Course achievement: Presentation or exam or paper (as specified at the beginning of the course)

Master’s Seminar Psycholinguistics

- theories and mechanisms of language perception, comprehension, and production
- relations between language, memory and other cognitive processes

Prerequisites: Lecture on Linguistics and Language Processing (part of Basic Module 1) is recommended.

Course achievement: Presentation or exam or paper (as specified at the beginning of the course)

Master’s Seminar Neural Basis of Language

Objectives:

- to introduce and familiarize students with the relationship between brain and language
- to familiarize students with ways in which language and the brain are investigated
- to understand how language is represented in the “typical” brain
- to provide a foundation for students to understand how language breaks down as a result of acquired brain injury
- to understand how language is represented and breaks down in bi/multilingual brains and in visuospatial languages (i.e. sign language)
- to give students the practical skills to properly report, review, and reference research articles in the field

The course focuses on how the brain and language relate from an interdisciplinary perspective. Students will learn about: the history of brain and language, brain anatomy and functions, language and hemispheric specialization, methodological approaches (PET, fMRI, MEG, EEG/ERP, neurostimulation), aphasia (childhood and acquired), the breakdown of language (spoken, auditory, reading, and writing), bilingualism, and the brain and sign language.

Prerequisites: Lecture on Cognitive Neuroscience (part of Basic Module 1) and Lecture on Linguistics and Language Processing (part of Basic Module 1) is highly recommended.
Course achievement: Presentation or exam or paper (as specified at the beginning of the course)

Competencies and Intended Learning Outcomes:
Intended Learning Outcomes:
On successfully completing the module students will be able to,

- present their knowledge of special topics from the field of language and (psycho)linguistics
- apply the acquired understanding of sentence processing and language development, detect structural relations between elements in a sentence and classify syntactic properties and categories, and compare language and reading disorders
- read and interpret scientific English literature in this field
- summarize and compare research papers and highlight relevant information from these papers
- debate scientific issues with peers or lecturers and thereby refer to complex concepts

Prerequisites for attending: Requirements for receiving credit points:

| Formal admission requirements/Contentual prerequisites: Successful completion of Basic Modules 1 and 2 is recommended. | Oral exam covering the entire module (15-30 min.). |

Determination of grade:
Grade of the oral exam.

Applicability of the module/suitability:
As a obligatory module:
- 
As a mandatory module:
- 

Hints for preparation:
Recommended literature:
Master’s Seminar Reading
Snowling & Hulme. The Science of Reading Blackwell
Willows Kruk Corcos. Visual Processes in reading and reading disability. Erlbaum
T. Lachmann, and T. Weis. Reading and Dyslexia. From basic functions to higher order cognition. Springer. Recommended literature:
Master’s Seminar Syntax
Master’s Seminar Sentence Processing
Master’s Seminar Computational Linguistics
The literature will be recommended during the course.
Master’s Seminar Heritage Language Acquisition
Master’s Seminar Language Development
Master’s Seminar Psycholinguistics
Master’s Seminar Neural Basis of Language
Available documents:
Advanced Module 3: Language and Linguistics - Applied Research

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| SO-12-2607-M-6-b | Prof. Dr. Shanley Allen | Prof. Dr. Daniela Czernochowski  
| | | Prof. Dr. Maria Klatte |
| | | Prof. Dr. Thomas Lachmann |
| | | Prof. Dr. Shanley Allen |
| | | Dr. Kalliopi Katsika |
| | | Dr. Kirstin Bergström |
| | | Dr. Gunnar Jacob |
| | | Dr. Leigh Fernandez |

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<th>Regular cycle:</th>
<th>Recommended Semester:</th>
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<tr>
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<td>180 h</td>
<td>1 Term/s</td>
<td>Winter Term</td>
<td>cf. Study schedule</td>
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**Parts of the module/courses:**
In this module, students are required to complete the Laboratory Rotation (for 6 CP). It is highly recommended to also choose the matching course in the Research Techniques Module.

**Content:**

**Laboratory Laboratory Rotation for Advanced Module 3: Language and Linguistics**
Group work on a practical research project using psycholinguistic methods (e.g., priming, eye-tracking, self-paced reading, ERP) under the supervision of one of the teaching staff.

Prerequisites: Successful completion of Basic Modules 1 and 2

Course achievement: Practical work

**Competencies and Intended Learning Outcomes:**

Intended Learning Outcomes:
On successfully completing the module students will be able to,

- recognize and define basic and some more advanced methods in research related to Linguistics
- transfer the acquired knowledge to related experimental designs
- prepare and conduct an experiment in the laboratory; apply practical research skills such as eye tracking
- summarize and present the results obtained with these specific research methods

**Prerequisites for attending:**

**Formal admission requirements/Contentual prerequisites:** Successful completion of Basic Modules 1 and 2 is recommended.

**Requirements for receiving credit points:**

EITHER prepare and present a poster OR presentation at an annual “mini-conference” (15 min talk and 5 – 10 min discussion) OR write a paper (approx. 15 pages) about laboratory rotation work. Overall, students have to prepare all three exam forms – one for each advanced module.

**Determination of grade:**

none

**Applicability of the module/suitability:**

As an obligatory module:

-  

As a mandatory module:

-  

**Hints for preparation:**

Recommended literature:
Laboratory Laboratory Rotation for Advanced Module 3: Language and Linguistics
Advanced Module 4: Cognitive Neuroscience - Specialized Seminars

<table>
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<tr>
<td>SO-15-2609-M-6-a</td>
<td>Prof. Dr. Daniela Czernochowski</td>
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<td>Prof. Dr. Maria Klette</td>
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<td>Dr. Leigh Fernandez</td>
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**Credit Points (CP):**

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<tbody>
<tr>
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<td>1 Term/s</td>
<td>Summer Term</td>
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**Parts of the module/courses:**

In this module, students have to pass at least three elective (E) courses (for 9 CP).

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</table>

**Content:**

**Master’s Seminar Human Memory: Behavioral and Neural Basis**
- Structures and processes in human memory
- working memory theories
- memory development
- memory and attention

Lecture on Perception, Cognition and Knowledge and Cognitive Neuroscience (part of Basic Module 1) is recommended. **Course achievement:** Presentation or exam or paper (as specified at the beginning of the course)

**Master’s Seminar Neural Basis of Language**
Objectives:
- to introduce and familiarize students with the relationship between brain and language
- to familiarize students with ways in which language and the brain are investigated
- to understand how language is represented in the “typical” brain
- to provide a foundation for students to understand how language breaks down as a result of acquired brain injury
- to understand how language is represented and breaks down in bi/multilingual brains and in visuospatial languages (i.e. sign language)
- to give students the practical skills to properly report, review, and reference research articles in the field

The course focuses on how the brain and language relate from an interdisciplinary perspective. Students will learn about: the history of brain and language, brain anatomy and functions, language and hemispheric specialization, methodological approaches (PET, fMRI, MEG, EEG/ERP, neurostimulation), aphasia (childhood and acquired), the breakdown of language (spoken, auditory, reading, and writing), bilingualism, and the brain and sign language.

**Course achievement:** Presentation or exam or paper (as specified at the beginning of the course)

**Master’s Seminar Introduction to Neuropsychology**
Understanding of the structure and function of the brain as it relates to specific psychological processes and behaviors. Topics include foundations of neuropsychology, structure of the nervous system, functional specialization of the brain, cognitive functions, research methods, and clinical assessment and rehabilitation.
Prerequisites: Lecture on Cognitive Neuroscience (part of Basic Module 1) is highly recommended. *Course achievement:* Presentation or exam or paper (as specified at the beginning of the course)

### Master’s Seminar Learning and Behavior

- Behavioral and cognitive theories of animal and human learning, skills and procedural learning
- neural basis of learning and behavior
- interaction between cognition, motivations and emotion

Lecture on Perception, Cognition and Knowledge (part of Basic Module 1) is recommended. *Course achievement:* Presentation

### Master’s Seminar Neuroscience of Cognitive Control

In this Seminar, we will cover proposed mechanisms of Cognitive Control and focus on their neural underpinnings and how these cognitive functions change across the Human Life Span.

Prerequisites: Lecture on Cognitive Neuroscience (part of Basic Module 1) and Introduction to Neuropsychology is highly recommended. *Course achievement:* Presentation or exam or paper (as specified at the beginning of the course)

### Competencies and Intended Learning Outcomes:

Intended Learning Outcomes: On successfully completing the module students will be able to,

- gain an understanding of the neuronal mechanisms underlying cognitive functions in healthy and patient populations, the functioning of neurons, and the essential methods of cognitive neuroscience.
- present their knowledge of special topics from the field of Cognitive Neuroscience
- apply the acquired understanding of the neuronal mechanisms underlying cognitive functions in healthy and patient populations, explain the functioning of neurons and compare the essential methods of Cognitive Neuroscience
- read and interpret scientific English literature in this field
- summarize and compare research papers and highlight relevant information from these papers
- debate scientific issues with peers or lecturers and thereby refer to complex concepts

### Prerequisites for attending:

**Formal admission requirements/Contentual prerequisites:** Successful completion of Basic Modules 1 and 2 is recommended.

### Requirements for receiving credit points:

One oral exam covering the entire module (15 - 30 min).

### Determination of grade:

Grade of the oral exam.

### Applicability of the module/suitability:

As an obligatory module:

As a mandatory module:

### Hints for preparation:

Recommended literature:
**Master’s Seminar Human Memory: Behavioral and Neural Basis**
Baddeley, Eysenck, Anderson: Memory (Psychology Press, 2009) Recommended literature:
**Master’s Seminar Neural Basis of Language**
**Advanced Module 4: Cognitive Neuroscience – Applied Research**

**Code:**
SO-15-2609-M-6-b

**Module Coordinator:**
Prof. Dr. Daniela Czernochowski

**Teaching Staff:**
Prof. Dr. Daniela Czernochowski

**Credit Points (CP):**
6 CP

**Workload:**
180 h

**Duration:**
1 Term/s

**Regular cycle:**
Winter Term

**Recommended Semester:**
cf. study schedule

### Parts of the module/courses:
In this module, students are required to complete the Laboratory Rotation (for 96 CP). Before using specific laboratory equipment, it is required to also attend the associated Method Seminar in the Research Techniques Module.

**SO-15-26.1000-S-7**  
Laboratory Rotation for Advanced Module 4: Cognitive Neuroscience  
MOD  C  H  AT  PS  P  L  a  RC  C  P
M 4 60 120 30 30 6 1

### Content:
**Laboratory Laboratory Rotation for Advanced Module 4: Cognitive Neuroscience**

Group work on a practical research project (e.g., computational neuroscience, electrophysiological recordings, MEG for structural and functional analysis) under the supervision of one of the teaching staff.

**Prerequisites:** Successful completion of Basic Modules 1 and 2 is highly recommended.

**Course achievement:** Practical work

### Competencies and Intended Learning Outcomes:

**Intended Learning Outcomes:**

On successfully completing the module students will be able to,

- recognize and define basic and some more advanced methods in research related to Cognitive Neuroscience
- transfer the acquired knowledge to related experimental designs
- prepare and conduct an experiment in the laboratory; apply practical research skills such as EEG
- summarize and present the results obtained with these specific research methods

### Prerequisites for attending:

**Formal admission requirements/Contentual prerequisites:** Successful completion of Basic Modules 1 and 2 is highly recommended.

### Requirements for receiving credit points:

EITHER prepare and present a poster OR presentation at an annual "mini-conference" (15 min talk and 5 – 10 min discussion) OR write a paper (approx. 15 pages) about laboratory rotation work. Overall, students have to prepare all three exam forms – one for each advanced module.

### Determination of grade:

none

### Applicability of the module/suitability:

As a obligatory module:
-

As a mandatory module:
-

### Hints for preparation:

**Recommended literature:**

**Laboratory Laboratory Rotation for Advanced Module 4: Cognitive Neuroscience**

Advanced Module 5: Computation - Specialized Seminars

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<th>Code:</th>
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| SO-08-2611-M-6-a | Prof. Dr. Achim Ebert | Prof. Dr. Karsten Berns  
|               |                     | Prof. Dr.-Ing. Andreas König  
|               |                     | Prof. Dr. Achim Ebert  
|               |                     | Prof. Dr. Heike Leitte  
|               |                     | PD Dr. Johannes Lenhard |

**Credit Points (CP):**

| 12 CP | 360 h | 1 Term/s | Winter Term | cf. study schedule |

**Regular cycle: Recommended Semester:**

**Parts of the module/courses:**

In this module, students are required to earn at least 12 CP (typically in 3 courses). Note that the list below provides examples for relevant courses in this area; based on their individual background in computer science and relevance for their coursework in the Cognitive Science curriculum, students can select from the current list of advanced courses from the Department of Computer Science (Studienabschnitt Vertiefung). For this selection, a mandatory advisory meeting is necessary. Note that it is necessary to include at least one lecture in your selection.

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</table>

**Content:**

**Master’s Seminar Man as Machine – Machine as Man**

The question of how humans see and represent themselves has been approached via the analogy to artifact and machine, sometimes stressing similarities, sometimes differences. This course discusses pivotal texts from ancient, modern, and recent times with the goal to analyze how the (perceived) relationship between man and machine was, and still is, changing.

**Course achievement:** Worksheet Presentation or exam or paper (as specified at the beginning of the course)
Lecture Human-Computer Interaction
The course introduces students to the theory and applications of human computer interaction (HCI). Students should achieve an understanding of human perception and psychology related to HCI, as well as learn about concepts and methods of interactive systems. The course builds on theoretical principles and numerous examples from research and practice.
Prerequisites: Lecture on Introduction to Programming or Analysis of Complex Systems (part of Basic Module 1) is highly recommended.
Course achievement: Worksheet Presentation or exam or paper (as specified at the beginning of the course)

Lecture Biologically Motivated Robots
Biologically motivated robots (Bio Bots) are systems whose mechanical construction, sensor and perception concepts and control methods have been inspired by nature. The following themes will be considered:
- status of research and requirements for the development of BioBots
- sensor systems, sensor fusion and actuation concepts
- adaptive control (neural networks, fuzzy-control, reinforcement learning, genetic algorithms and neuro-oscillators)
- behavior-based control architectures
- bipedal locomotion
- Interaction concepts for humanoid robots
- application for BioBots
Prerequisites: Basic knowledge of artificial intelligence and Lecture “Biologically Motivated Robots”
Course achievement: Presentation or exam or paper (as specified at the beginning of the course)

Tutorial Biologically Motivated Robots
State of the art in science and development of biologically motivated robots (BioBots), including sensors, sensor fusion, propulsion systems, adaptive approaches to steering, neuronal networks, fuzzy control, reinforcement learning, genetic algorithms, neuro-oscillators and behavioral control architectures.
Prerequisites: Basic knowledge of artificial intelligence and Lecture “Biologically Motivated Robots”
Course achievement: Presentation or exam or paper (as specified at the beginning of the course)

Master´s Seminar Visualization and HCI
Selected topics from visualization, such as:
- information visualization
- scientific visualization
- adaptive/ mobile visualization
- visualization of medical and biological data
Prerequisites: Lecture “Human Computer Interaction” is highly recommended.
Course achievement: Presentation or exam or paper (as specified at the beginning of the course)

Lecture Data Visualization
The lecture will cover the following topics:
- History of visualization
- Human perception
- Processing chain in visualization (visualization of tables / visualization of high-dimensional data)
- Visualization of graphs
- Interaction and data exploration
- Visualization of scalar and vector data
Course achievement: Presentation or exam or paper (as specified at the beginning of the course)

Master´s Seminar Computational Linguistics
This is an introduction to Computational Linguistics using the Python programming language. We'll learn how to solve a set of problems related to Linguistics and explore linguistic data available in the web. We will introduce the concept of corpus and understand how we can use corpus data to answer linguistic questions. In addition, we will have a simple introduction to Machine Learning, which will allow us to take advantage of corpus annotations; and talk a little about tokenization and lemmatization, useful for generating our own corpora. Some final remarks on distributional semantics will finish this introduction.
Course achievement: Presentation or exam or paper (as specified at the beginning of the course)
Lecture Collaborative Intelligence
Methods supporting personal knowledge work; organizational memories; modeling of attention and working context; foundations of Information Retrieval search with respect to mobility, tasks and interests; agile knowledge workflows and emergent systems; enterprise platforms and social networks; success criteria and evaluation methods. Participation in optional exercise sessions is recommended. Lecture on Perception, Cognition and Knowledge (part of Basic Module 1) is recommended. 
Course achievement: Presentation or exam or paper (as specified at the beginning of the course)

Master´s Seminar Collaborative Intelligence
Selected topics in socio-technical knowledge work (see topics for the course on “Collaborative Intelligence”). Based on a set of publications, participants are trained in writing scientific (summary) papers and presenting in a quasi-scientific setting. The students are also introduced to the process of paper reviewing. The final presentation will be organized as a one-day-event, where participants of the seminar will present their findings and discuss them with the audience. Prerequisites: Lecture “Collaborative Intelligence”
Course achievement: Presentation or exam or paper (as specified at the beginning of the course)

Lecture/Tutorial Neurocomputing
Qualification aims:
- Understanding of the concepts of dedicated neural and bio-inspired hardware and its application potential and limitations
- Understanding of design principles of circuits with alternative signal representation and adaptive structures
- Understanding of the effect of simplified implementations
- Understanding of fault-tolerance and robustness issues
- Ability of contents/result abstraction to MEMS/microsystems application

Teaching contents:
- Introduction to the field of innovative computer architectures and systems for the technical implementation of biological information processing principles
- Presentation of diverse aims and solution concepts: Hardware for technical cognition systems, biological-technical interfaces, simulation and verification of models of biological evidence
- Rehearsal of relevant and commonly applied neural algorithms, including deep-learning and spiking neural networks, and analysis of computational requirements and operators
- Presentation and effect of potential simplification options for the regarded algorithms
- Basics of circuit technology (digital, analog, opto-electronic/optisch) and related implementation technologies (CMOS, WSI, MEMS, etc.) for neural hardware
- Overview of fundamental architectural principles of neurochips, -processors and -computers
- Assessment criteria and taxonomy for neural HW
- Presentation and detailed discussion of selected, representative implementations
- Outlook on new lines in the field, e.g., evolvable hardware, organic computing, and self-monitoring and repairing sensor systems

The 2 hour lecture is accompanied by a 1 hour computer-based lab, where students will have the opportunity to explore typical neural simulation environments for amplitude and time domain representation in neural networks, e.g., the Neuron simulator, the Caffe environment, the Brian simulator etc. Further, available Neurocomputers Silimann (analog) and ZISC (digital) with their dedicated application software and GUI will be applied. Additionally, custom FPGA-based platforms programmed by, e.g., VHDL will be considered for students with corresponding experience, too. Step by step the lab guides students to the design of neurocomputing modules & systems, e.g., for real-time classification with the Silimann, learning intelligent systems, or adaptive signal processing. Prerequisites: Basic programming in Matlab/Python, interest in hardware design, e.g., FPGA programming; Lecture on Introduction to Programming or Analysis of Complex Systems (part of Basic Module 1) is highly recommended.
Course achievement: Oral examination based on semester project given after lab completion. Topics for semester projects, as individual or group projects will be given to students, which shall be elaborated, documented, and presented. The projects focus on the design and implementation of a real-world task by either neurocomputing algorithms or hardware. (20 min. slide presentation, discussed, and assessed in the oral examination.
Examples of prior students work: ISE-NEUCOM-Page )
Lecture/Tutorial Sensorsignalprocessing
Qualification aims:
- Understanding of relevant principals and methods from the field of Computational Intelligence/Machine Learning, in particular for the field of sensor technology
- Mastery of application of selected relevant methods and their configuration in a common design environment (Matlab/Python)
- Ability to design, validate, and optimize complete application-specific system system from sensory acquisition to perception & cognition.
- Develop ability to adapt and extend the achieved implementation to changing needs
- Understanding of interdependence of system solution with available, potentially restricted implementation platforms (Sensors/Hardware)

Teaching contents:
- Basic methods of multi-dimensional signal analysis and the computation of characteristic and invariant descriptors (features)
- Processing of signals from single sensors and homogeneous or heterogeneous Sensor-Arrays
- Dimensionality reduction of high-dimensional sensor data by linear and non-linear methods, e.g., by explicit selection of features
- Methods of cluster analysis
- Methods for multi-dimensional sensor data analysis: projection and visualization, fusion
- Methods for classification of sensor data: statistical pattern recognition, artificial neural networks, rule-based and fuzzy classification
- Advanced optimization methods for parameter or structure optimization of sensor systems for automated intelligent system design
- Relations, dependencies, and optimization potential between sensor realization, electronics, and algorithmics.

New aspects of reliable sensor systems (self-x properties)
The 2 hour lecture is accompanied by a 2 hour computer-based lab, where students will have the opportunity to acquire sensory data from, e.g., visual range, infrared, depth, and hyperspectral cameras, as well as acoustic, acceleration, magnetic, impedance, EEG-like and other sensors for typical application scenarios. Step by step the lab guides students to the design of a dedicated intelligent system, e.g., from general quality control, food inspection to behavior and/or intention recognition of humans. Prerequisites: Basic programming in Matlab/Python and Arduino systems preferably on Linux; Lecture on Introduction to Programming or Analysis of Complex Systems (part of Basic Module 1) is highly recommended.
Course achievement: Oral examination based on semester project given after lab completion. Topics for semester projects, as individual or group projects will be given to students, which shall be elaborated, documented, and presented. The work will be presented (20 min. slide presentation, discussed, and assessed in the oral examination. Examples of prior students work: ISE-SENSIG-Page )

Competencies and Intended Learning Outcomes:
Intended Learning Outcomes:
On successfully completing the module students will be able to,
- prepare and manage a scientific discussion on specific topics related to the module
- explain fundamental models and methods in human computer interaction (HCI)
- explain state-of-the-art concepts and methods for designing complex robotic systems
- characterize the control of biological movement systems and basic methods of soft computation
- explain methods for controlling complex biologically motivated robots (e.g. humanoid robots)
- prepare special topics and present them to the audience comprehensibly using electronic media
- understand the concepts of dedicated neural and bio-inspired hardware and its application potential and limitations
- understand the design principles of circuits with alternative signal representation and adaptive structures
- understand the effect of simplified implementations
- understand the relevant principals and methods from the field of Computational Intelligence/Machine Learning
### Prerequisites for attending:

**Formal admission requirements/Contentual prerequisites:** Successful completion of Basic Modules 1 and 2 is recommended. Some classes require advanced knowledge in the respective topics. Hence, an academic advisory meeting is necessary before the selection is made.

### Requirements for receiving credit points:

The format of the exam and course achievements are determined by the requirements of each course as specified in the respective departments of computer science and/or electrical engineering.

### Determination of grade:

Weighted average of individual courses.

### Applicability of the module/suitability:

As an obligatory module:

- 

As a mandatory module:

- 

### Hints for preparation:

**Recommended literature:**

**Lecture Human-Computer Interaction**

- Buxton: Sketching User Experience
- Dix, Finlay, Abowd, Beale: Human-Computer Interaction
- Kerren, Ebert, Meyer: Human-Centered Visualization Environments
- Maeda: The Laws of Simplicity
- Sharp, Rogers, Preece: Interaction Design

**Recommended literature:**

**Lecture Biologically Motivated Robots**

- S. Kajita (Ed.), "Humanoid Roboten", AKA
- Gerdes, F. Klawonn, R. Kruse, "Evolutionäre Algorithmen", Vieweg
- Hamill, K.M. Knutzen, "Biomechanical Basis of Human Movement", LWW
- J.M. Fellous and M.A. Arbib (Eds.), "Who Needs Emotions?! – The Brain Meets the Robot", OUP

Other textbooks and research papers will be announced in the lecture.

**Recommended literature:**

**Tutorial Biologically Motivated Robots**

- Kajita (Ed.), "Humanoid Roboter", AKA
- Gerdes, F. Klawonn, R. Kruse, "Evolutionäre Algorithmen", Vieweg
- Hamill, K.M. Knutzen, "Biomechanical Basis of Human Movement", LWW
- J.M. Fellous and M.A. Arbib (Eds.), "Who Needs Emotions?! – The Brain Meets the Robot", OUP

Other textbooks and research papers will be announced in the lecture.

**Recommended literature:**

**Master’s Seminar Visualization and HCI**

- Buxton: Sketching User Experience
- Dix, Finlay, Abowd, Beale: Human-Computer Interaction
- Kerren, Ebert, Meyer: Human-Centered Visualization Environments
- Maeda: The Laws of Simplicity
- Sharp, Rogers, Preece: Interaction Design

**Recommended literature:**

**Lecture/Tutorial Neurocomputing**

- R. Hecht-Nielsen, Neurocomputing, Addison Wesley, 1991 Recommended literature:

**Lecture/Tutorial Sensorsignalprocessing**


Available documents:
**Advanced Module 5: Computation – Applied Research**

<table>
<thead>
<tr>
<th>Code:</th>
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<th>Teaching Staff:</th>
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<tbody>
<tr>
<td>SO-08-2611-M-6-b</td>
<td>Prof. Dr. Achim Ebert</td>
<td>Prof. Dr. Karsten Berns</td>
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<td>Prof. Dr. Karsten Berns</td>
<td>Prof. Dr.-Ing. Andreas König</td>
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<tr>
<td></td>
<td>Prof. Dr. Achim Ebert</td>
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</table>

**Credit Points (CP):**

- 4CP

**Workload:**

- 120 h

**Duration:**

- 1 Term/s

**Regular cycle:**

- Winter and Summer Term

**Recommended Semester:**

- cf. study schedule

**Parts of the module/courses:**

In this module, students are required to complete one Laboratory Rotation Project (for 4 CP).

**Content:**

**Project Laboratory Rotation for Advanced Module 5: Computation Option 3:**

**Neurocomputing & Sensorsignalprocessing**

The participants will be actively in an ongoing research project, for instance in the area of Human Computer Interaction, Sensor-Signalprocessing, Cognitive Ergonomics or Robotics. Depending on students’ previous theoretical knowledge and practical skills in this area, topics will be entirely algorithmic and software oriented or encompass the application and/or design of dedicated hardware realizations as contributions to adaptive technical cognition systems.

**Competencies and Intended Learning Outcomes:**

Intended Learning Outcomes:

On successfully completing the module students will be able to

- design human-centered man-machine interfaces and prototypically implement them
- design and perform evaluations for hard- and software systems
- design and develop some basic functions a robot system
- design, validate, and optimize complete application-specific systems from sensory acquisition to perception & cognition
- adapt and extend the achieved implementation to changing needs
- prepare special topics and present them to the audience comprehensibly using electronic media
- prepare and manage a scientific discussion on specific topics related to the module

**Prerequisites for attending:**

**Requirements for receiving credit points:**

**Formal admission requirements/Contentual prerequisites:** Successful completion of Basic Modules 1 and 2 is recommended.

Either prepare and present a poster OR presentation at an annual “mini- conference” (15 min talk and 5 – 10 min discussion) OR write a paper (approx. 15 pages) about laboratory rotation work. Overall, students have to prepare all three exam forms – one for each advanced module.

**Determination of grade:**

none

**Applicability of the module/suitability:**

As an obligatory module:
- 
As a mandatory module:
- 

**Hints for preparation:**

Recommended literature:
# 2nd/3rd Semester: Internship

## Internship Module

<table>
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<tr>
<td>SO-00-2613-M-7</td>
<td>Prof. Dr. Thomas Lachmann</td>
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### Credit Points (CP):

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<th>Workload:</th>
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<tr>
<td>8 CP</td>
<td>240 h</td>
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<td>Winter and Summer Term</td>
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### Parts of the module/courses:

Courses marked with an (M) are mandatory.

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### Content:

#### Internship

The student will gain practical experience in the field of cognitive science and can associate this experience to the contents of the Master’s program. This Module further requires a total of 20 hours of participation in experiments related to cognitive science.

**duration:** 6 weeks

**Course achievement:** Submit a letter from the supervisor(s) confirming successful completion of the Internship as well as an Internship report (1-2 pages).

### Competencies and Intended Learning Outcomes:

**Intended Learning Outcomes:**

On successfully completing the module students will be able to,

- associate these experiences to the contents of the master study.
- get practical experiences in the field of cognitive science.

### Prerequisites for attending:

**Formal admission requirements/Contentual prerequisites:** Successful completion of Basic Modules 1 and 2 is recommended.

**Requirements for receiving credit points:**

The Internship application form must be submitted to the Examination Committee at least 2 weeks before starting the Internship.

The Internship should be performed during the lecture-free time to avoid overlap with lectures and seminars.

### Determination of grade:

not graded

**Applicability of the module/suitability:**

- As an obligatory module:
- As a mandatory module:

### Hints for preparation:

**Recommended literature:**

| Internship
| Available documents: | Internship |

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3rd Semester: Basic Module 3

<table>
<thead>
<tr>
<th>Basic Module 3: Advanced Research Techniques in Cognitive Science</th>
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<tr>
<td>Code: SO-07-2615-M-6</td>
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<tr>
<td>Module Coordinator: Leigh Fernandez</td>
</tr>
<tr>
<td>Teaching Staff: Department of Mathematics, Dr. Sonja Föhst</td>
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<td>Course achievement:</td>
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<tr>
<td>Content:</td>
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<tr>
<td>Lecture Introduction to Stochastic Modeling of Cognitive Processes</td>
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<tr>
<td>- Markov chains</td>
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<tr>
<td>- Basic model fitting and validation of models for cognitive processes.</td>
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<tr>
<td>- Students are introduced to simple stochastic models of learning processes. Methods for parameter estimation and testing the fit of the model to the data are presented.</td>
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<tr>
<td>- On successfully completing the course, students will be able to appreciate the usefulness of formal modeling of cognitive processes and learn about more complex models by self-study.</td>
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</table>

Course achievement: Regular and active participation in the lecture; at the end of the semester, each student demonstrates familiarity with the concepts of the lecture e.g., during an oral discussion with the teacher or by giving a short presentation. The exact mode of examination will be announced in the beginning of the semester. This course is mandatory for all students.

Pre-requisites: In addition to advanced background of mathematical and statistical concepts from Basic Module 2, experience in programming using R will be required.

Master’s Seminar Human Subjects
The importance of respecting research participants as fellow human beings, ethical principles for conducting research, writing applications for ethics approval for research studies, writing informed consent forms and debriefing forms, and managing research data to ensure participant confidentiality.

Course achievement: Application for ethics approval for a research study

Methods Seminar Mental Chronometry
Students will learn how to design a RT experiment, and measure, preprocess and analyse reaction time and accuracy data. Next to classical methods (outlier detection, repeated-measures analysis-of-variance), students will also learn more advanced methods including (macro- and micro-level) speed-accuracy trade-off functions, and describing RT data using statistics such as hazard and survivor functions. Prerequisites: Successful completion of Basic Modules 1 and 2 is highly recommended.

Course achievement: Exercises
**Method Seminar: Introduction to R**
Students will learn how to use R in the context of Experimental designs and analysis of empirical data.

*Course achievement:* Practical work

**Method Seminar: Eye Tracking**
Students will learn how to use Eye-Tracking equipment, remove artifacts and apply this technique in the context of experimental paradigms.

*Course achievement:* Practical work

**Method Seminar: EEG Recording and Analysis**
Preparation of experimental materials, identifying and removing artifacts in EEG data, analyzing and correlating neuronal activity with behavior using specific software, interpretation of experimental results.

*Course achievement:* Practical work

**Method Seminar: Special Methods**
Introducing special issues in research methodology, such as techniques working with specific populations or using non-standard research equipment or experimental design for longitudinal studies.

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### Competencies and Intended Learning Outcomes:

Intended Learning Outcomes:
On successfully completing the module students will be able to,

- develop an understanding of stochastical modeling as used in Cognitive Science.
- gain knowledge about the fundamentals of ethics and philosophy of science and their relevance to cognitive science research.
- Enhance a variety of advanced research skills as required for the applied research projects and in preparation of the Master’s Thesis.

### Prerequisites for attending:

**Formal admission requirements:** These advanced Research Techniques require the successful completion of Basic Module 1 and Basic Module 2.

### Requirements for receiving credit points:

Active participation, including completing weekly assignments in the mandatory courses.

### Determination of grade:

none

### Applicability of the module/suitability:

- As an obligatory module:
- As a mandatory module:

### Hints for preparation:

**Recommended literature:**

*Lecture Introduction to Stochastic Modeling of Cognitive Processes*

**Recommended literature:**

*Master’s Seminar Human Subjects*

# 4th Semester: Master’s Thesis

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<td>SO-00-2614-M-7</td>
<td>Prof. Dr. Thomas Lachmann</td>
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### Credit Points (CP):
- 30 CP

### Workload:
- 900 h

### Duration:
- 1 Term/s

### Regular cycle:
- Winter and Summer Term

### Recommended Semester:
- cf. study schedule

### Parts of the module/courses:
Courses marked with an (M) are mandatory.

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## Content:

### Master’s Thesis

The master thesis serves as a final exam. The Master’s thesis reports original empirical research in the field of cognitive science conducted by the candidate as outlined in the “Learning Objectives” for the Master’s Thesis Module. The thesis is prepared under the supervision of two instructors, preferably from different fields of research.

### Competencies and Intended Learning Outcomes:

**Intended Learning Outcomes:**

On successfully completing the module students will be able to,

- argue and discuss his/her results and conclusions.
- demonstrate interdisciplinary knowledge, skills and competencies in the cognitive sciences.
- develop a research agenda.
- prove his/her ability to conduct and complete a research project, including planning and preparation, technical implementation, analysis, and communication of the research and its results.
- reflect on methodological and theoretical aspects of his/her research.

### Prerequisites for attending:

**Formal admission requirements/Contentual prerequisites:**

See examination regulation.

### Requirements for receiving credit points:

- Master’s thesis.

### Determination of grade:

- Grade of the Master’s thesis.