Module Number	Title:
5b	**Translational Clinical Neuroscience**

Module type: compulsory elective	**Language:** English	**Group Size:** 10 students
Study semester: 2	**Availability:** summer semester	**Duration:** 1 semester

Workload:	Credits:	Contact time:	Independent study:
420 hrs	14 CP	105 hrs	315 hrs

1 Courses

a) Lectures: 4 SWS
b) Seminar: 2 SWS
c) Practical course: 2 SWS

2 Intended learning outcomes

After completion of this module, students will be familiar with

1. The neuroanatomical and functional basis of human language, speech, and motor control, including their relationship to cognition and the contributions of cortical, subcortical, and cerebellar structures.
2. The role of the cerebellum in motor behavior, speech production (e.g. dysarthria), and non-motor cognitive functions, including language-related processes.
3. Major disorders affecting language, speech, and motor functions, including aphasia and dysarthria, paresis and ataxia and their relation to lesion location and network disruption.
4. Principles of awake brain surgery, including preoperative planning, intraoperative neuromonitoring, electrical stimulation, and functional mapping of language and motor systems for clinical decision making.
5. Experimental and clinical methods to study language and motor systems, including clinical and behavioral testing, sensor-based movement analysis, neuroimaging (task-based and resting-state fMRI, DTI, tractography), and animal models of lesion recovery and motor control such as Caenorhabditis elegans.
6. Digital brain atlases (Julich Brain Atlas) and multiscale neuroanatomical data, and their application for exploratory and programmatic analysis in translational clinical neuroscience using siibra toolsuite.

3 Content

Lectures:

Overview of neuroanatomical and functional organization of language, speech, and motor control, including cortical, subcortical, and cerebellar regions, as well as white matter pathways forming distinct loops and networks. Brain disorders affecting language, speech, and motor behavior, with a focus on aphasia, dysarthria, paresis, and ataxia, lesion–symptom relationships, network disruption, and neural plasticity. Principles of neuroimaging in research and clinical practice, including task-based and resting-state fMRI, DTI, and tractography, and methodological challenges in imaging and analyzing cerebellar functional connectivity. Principles of awake brain surgery for the removal of infiltrative brain tumors, covering neurosurgical planning, direct electrical stimulation, and clinical workflow, including intraoperative monitoring via electrocorticography (ECoG) and functional mapping of speech and language, as well as atlas-based approaches for integrating multimodal neuroimaging and neuroanatomical data across spatial scales using siibra-explorer in translational clinical neuroscience.

Seminars: Basic functional connectivity analysis on fMRI data in SPM12. Design and implementation of intraoperative language and motor tasks for awake brain surgery. Introduction to lesion–symptom mapping approaches (multivariate vs univariate models). Tractography of different white matter pathways and hands-on training in programmatic access to and analysis of brain atlas data using siibra-python, with an emphasis on reproducible workflows and the integration of atlas-based information with clinical and experimental neuroscience data. Video-based walkthrough of an awake brain surgery. Student presentations on selected papers will be held at the end of the course. Each participating student will be instructed about the scope and content of the presentation.

	Practical courses (not mandatory, subject to availability): Observation of an awake brain surgery.
4	**Teaching methods** Lectures covering theoretical foundations of human language, neuroanatomy, and cognitive neuroscience of language, combined with clinically oriented teaching on language disorders, awake brain surgery, and intraoperative mapping. Seminar and practical courses with accompanying lessons.
5	**Prerequisites** **With regards to content:** Basic knowledge of neuroanatomy and neurobiology.
6	**Examination type:** 1. Presentation (power point / chalk talk) (15 minutes + 5 minutes Q&A, 50 % of total grade) 2. Written examination (60 minutes, 50 % of total grade)
7	**Requirements for award of credit points** Regular and active participation during seminars; final presentation and discussion of assigned paper; passing the written examination
8	**Module applicability** None
9	**Assessment** The mark given will contribute to the final grade in proper relation to its credits.
10	**Module convenor and main lectures** Dr. Effrosyni Ntemou, PD Dr. Martina Minnerop, Dr. Nora Bittner, Dr. Fakhereh Attar, Dr. Kimberley Lothmann, Dr. Clara Rentz, Dr. Kai Benning, Dr. Silvia Maglioni, Dr. Juliane Weski, Johann Berger, Nataliia Fedorchenko, Alisha Reinhardt
11	**Further information** The regular participation in the lectures is strongly recommended. The content of the lectures is prerequisite for the seminars and relevant for the written exam.