

Learning Contract for the Mobility Semester

Home University: Comenius University in Bratislava

Student Name:

Immatriculation Nr.:

Study Programme ID:

Host University: University of Zagreb

This learning contract ensures that the ECTS credits the MEi:CogSci student acquires at the host university will be accredited at the home university. In order to make this contract valid, please follow the procedure/steps listed below:

A Preparation Phase at the home university

- 1.) Negotiation of Special Topic of Interest Module(s):** The student negotiates the *special topic of interest/phenomenon* (i.e., a cognitive phenomenon) he/she wants study and the way how he/she wants to study it (i.e., a combination of courses, lab work, self-study, literature used) with the supervisor and/or local coordinator at the *host* university.
- 2.) Concrete plan of the project:** The student fills in the subject specific learning outcomes which he/she will have acquired after completing the module and specifies the work-plan for the module (elements of module, milestones, deliverables, dates,...) according to the negotiations with the supervisor at the host university.
- 3.) Acknowledgement of the supervisor:** The supervisor checks and verifies the contract; by sending it (in digital version) to the local coordinator at the *home* university of the student (+ cc to the student) the supervisor acknowledges that he/she accepts the proposal
- 4.) Approval by the home university:** The local coordinator at the home university approves it or requests changes (go back to step 2)
- 5.) Signature of student**

B Mobility phase at the host university

- 6.) Planning of studies and courses at the host university:** Student fills out the semester contract in negotiation with local coordinator
- 7.)** Grade for the project, signature & stamp of supervisor at host university (at end of semester at host university)

C Grading & acknowledgement phase at home university

- 8.) Final grading & acknowledging:** Signed contract & certificates/transcripts are returned to local coordinator at *home* university, who accredits the contract.

SEMESTER CONTRACT**S-I-CS New Trends in Cognitive Science Module****10 ECTS**

| Course Title | Course Type (e.g. lecture, seminar,...) | ECTS | Grade (host) | Grade (home) |
|-----------------------------------|---|------|--------------|--------------|
| Research methods | Seminar | 4 | | |
| Drugs and brain | Seminar | 2 | | |
| Neurophysiological origins of EEG | Project | 4 | | |
| | | | | |
| Module Grade | | | | |

S-I-PJ Special Topic of Interest (Project) Module**20 ECTS**

| Project Title | Supervisor | ECTS | Grade (host) | Grade (home) |
|---|---|------|--------------|--------------|
| Mirror neurons and the perception of movement | Dr. Marijan Palmovic | 18 | | |
| Course Title | Course Type (e.g. lecture, seminar,...) | ECTS | Grade (host) | Grade (home) |
| Journal Clubs | Seminar | 2 | | |
| | | | | |
| | | | | |
| | | | | |
| Module Grade | | | | |

S-I Special Topic of Interest Module**5 ECTS**

| Course Title | Course Type (e.g. lecture, seminar,...) | ECTS | Grade (host) | Grade (home) |
|-----------------------|---|------|--------------|--------------|
| Methodology workshops | Workshop | 5 | | |
| | | | | |
| | | | | |
| | | | | |
| Module Grade | | | | |

W-D-C Elective Module**0 ECTS**

| Course Title | Course Type (e.g. lecture, seminar,...) | ECTS | Grade (host) | Grade (home) |
|---------------------|---|------|--------------|--------------|
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| Module Grade | | | | |

Date, Stamp & Signature of *Local Coordinator*
at *Host* University

Date, Stamp & Signature of *Local Coordinator*
at *Home* University

Dieses Dokument gilt als Ansuchen zur Anerkennung von Prüfungen (gem. § 78 UG, BGBl. Nr. 120/2002).

1.) SPECIAL TOPIC OF INTEREST**20 ECTS**

Your first special topic of interest must include project work (to be specified in box 1.c). Beyond that it can include courses (to be specified in box 1.b).

Name of Supervisor, Host University:

Dr. Marijan Palmovic, University of Zagreb

1.a**TOPIC OF SPECIALISATION**

Cognitive Neuroscience / Brain-computer Interfaces

PHENOMENON & (PERSONAL) GOALS

The fortuitous discovery of mirror neurons in the brain of a macaque monkey inspired numerous studies in the last decade, trying to declare them as a neural correlate of various cognitive phenomena. Neural cells that fire both when an animal is performing an action and also when it is observing others carrying out the same action seem to be a plausible mechanism underlying behaviour like imitation and empathy. The activity of mirror neurons is linked to a brain oscillation called the sensorimotor rhythm or *mu rhythm*. This idling 8-13 Hz oscillation emerges in frontoparietal networks and its suppression reflects the processing during motor action execution and observation, when the increased load in these areas causes the neurons to fire asynchronously.

In our project, we consider the mu rhythm as a proof of mirror neuron activity and conduct a series of experiments aimed at finding differences in its suppression during action observation of several kinds of movement.

LEARNING OUTCOMES**Subject specific**

- Measuring and analysis of human sensorimotor rhythm

Methodological

- Ability to approach a phenomenon in an interdisciplinary manner
- Theory and practice of EEG/ERP experiments
- Analysis and presentation of research data

Generic**Instrumental**

- Ability to write and follow a project plan
- Ability to follow laboratory rules

Interpersonal

- Team competences:
 - Work within an interdisciplinary team
 - Deal with conflicts and different viewpoints
 - Moderating group work

Systemic

- Interdisciplinary work/thinking
- Project-oriented work and organisational skill
- Critical evaluation of approaches & methods
- Quick orientation & navigation in mother and/or novel complex field
- Change of viewpoint/perspectives (intellectual mobility)
- Phenomenon-oriented thinking
- Problem-solving abilities

1.b

| LECTURE & COURSES | | | |
|-----------------------|-------------|--------------|------|
| Course Title | Course Type | Discipline | ECTS |
| Methodology workshops | Workshop | Neuroscience | 5 |

1.c

As part of your special topic of interest you will have to do project work. Please specify below the concrete plan and workflow of your project.

| PROJECT | 18 ECTS |
|--|----------------|
| <p>Project Title <i>"Mirror neurons and the perception of movement"</i></p> <p>In our experiments, we focused our efforts on matters of mirror neuron activity during observation of movement. Contrary to lower primates, mirror neurons in human brain should not be strictly object directed, meaning they are active during observation of an action both with or without a target object - but not in the same magnitude. To test this, we decided to measure the level of mu rhythm suppression during both observation conditions. Two additional conditions are introduced in the experiment – an action performed by an artificial hand (e.g. robot arm) in the same manner with or without a target object. The purpose of using an artificial hand is to find out, whether our mirror neuron system is sensitive only to actions of humans and closely related species, or if it is also able to represent a rather abstract movement using our motor repertoire.</p> <p>Project Plan In order to achieve the learning outcomes specified for the module I will take the following measures:</p> <p>1.) Project steps:</p> <p>Literature research <i>October 11th – November 5th</i> Preliminary literature was provided by project supervisor serving both as an introductory and inspirational reading on the topic of mirror neurons. Further reading consisted mostly of journal papers discussing mirror neuron system in context of action execution/observation and connection with autism spectrum disorder (e.g. Rizzolatti et al. 2001, Oberman et al. 2007, Iacoboni 2009).</p> <p>Acquired insight into this topic was demonstrated during the literature review meeting and by submitting a research draft comprising of an introduction to mirror neuron research and outlines for our own project, prior to the first journal club.</p> <p>Formulating hypotheses We expect certain levels of mu rhythm suppression in each tested condition, except the white noise. Stronger suppression is expected in human and with-object conditions.</p> <p>Planning of experiment <i>November 5th – November 20th</i> Prior to actual measurements with participants, a series of exercise sessions took place in order to familiarise the team with both methods and equipment used for the research. These sessions also served as an opportunity to discuss and fine tune the outlines proposed in submitted draft (e.g. adjusting the duration of stimuli, using different filters, truncating segments)</p> <p>Finalised research plan was presented during the first journal club meeting</p> | |

Realisation of the experiment

Fourteen university students (8 male, 6 female) participated in the experiment with average age of 23.6 years. All were right handed and of Slovak, Croatian or Slovenian nationality. Two were considered outliers and not used in data analysis.

The experiment consisted of 40 video clips presented to the participant seated in front of a computer whilst being recorded by an EEG. The video clips were 15s long, repeated 8 times per condition and separated with a 1s pause. Each participant was seated ca. 60-70cm away from the computer screen and instructed not to move during the experiment.

Signal was recorded using 32 channel EEG with 250 Hz sampling rate using extended 10-20 electrode placement system, plus 2 ocular electrodes used for rejection of eye movement artefacts.

The experiment was sequenced in ePrime Studio and the data recorded using BrainProducts Recorder.

Data analysis & interpretation of data

Segmented EEG signal was filtered using 0.1 / 30Hz hi/low pass filter, cleared of artefacts and subjected to Fast Fourier Transform. Power spectrum density from C3 and C4 electrodes was pooled together in order to get a bilateral spectrum from over sensorimotor cortex. Highest mu peaks were manually identified in both alpha and beta spectrum and a range of ± 1.5 Hz was extracted as a mean spectrum value for statistical analysis.

Analysis of variance was carried out using the extracted spectrum values. P-values of 0.9167 and 0.9115 for alpha and beta spectrum respectively were obtained, indicating extreme similarity in sample means, which in our case meant similar mu suppressions in all conditions. No more post-hoc analysis was done. The obtained data was plotted on several types of graphs to show comparison of results for individual conditions.

The experiment proved our hypotheses being true. The level of mu rhythm suppression seen in all conditions – except white noise – was very similar. The differences, though not being statistically significant, proved the human hand with-object condition showing the highest level of suppression and lower levels in artificial and/or without-object conditions.

We can therefore conclude that human perception of both human and artificial movement is practically identical and that our mirror neuron system, unlike that of lower primates, is active during observation of both object and non-object directed actions.

2.) Resources needed:

- access to laboratory of Centre for Postgraduate Studies
- equipment necessary for conducting EEG experiments (amplifier, cap, electrodes)
- software for recording and analysing EEG data
- set of stimuli (video clip of each condition)

Final Grade for the Project

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host grade/home grade
see grade conversion matrix on last page

Date, Stamp & Signature of Supervisor
at Host University

I herewith confirm that I will follow the module plan in order to successfully complete the module.

Signature of Student

Grade Conversion Matrix

| BRAT | | BUD | | LJUB | | VIE | | ZAG | |
|----------|--------------------------------|----------|-----------------------------|-----------|------------------------------|----------|----------------------------------|----------|--------------------------------|
| A | výborne (excellent) | 5 | jeles (excellent) | 10 | odlično (excellent) | 1 | sehr gut (excellent) | 5 | odličan (excellent) |
| B | vel'mi dobre (very good) | 4 | jó (good) | 9 | prav dobro (very good) | 2 | gut (good) | 4 | vrlo dobar (very good) |
| C | dobre (good) | 4 | jó (good) | 8 | prav dobro (very good) | 2 | gut (good) | 4 | vrlo dobar (very good) |
| D | uspokojivo (satisfactory) | 3 | közepes (fair) | 7 | dobro (good) | 3 | befriedigend (satisfactory) | 3 | dobar (good) |
| E | dostatočne (sufficient) | 2 | elégséges (satisfactory) | 6 | zadostno (sufficient) | 4 | genügend (sufficient) | 2 | dovoljan (satisfactory) |
| F | nedostatočne (insufficient) | 1 | elégtelen (fail) | 5 | nezadostno (insufficient) | 5 | nicht genügend (insufficient) | 1 | nedovoljan (insatisfactory) |