

## Project specification - Empirical research

### MEi:CogSci 1<sup>st</sup> year semester project

#### General Project Information

<b>Project Title</b>	Effects of transcranial electrical stimulation on verbal working memory.
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#### Summary of Topic/Phenomenon

Working memory is a theoretical concept referring to the accessed information in our brain that we are currently manipulating. In the model proposed by Baddeley and Hitch (1974), working memory has been subdivided into categories, differentiating phonological and visuo-spatial processes and assigning each to their respective areas in the brain. Verbal working memory is believed to be processed mainly in the dorsolateral prefrontal cortex (DLPFC) and the left temporal lobe. Since it has been shown (Hampson, 2010) that cognitive function is altered by changes in functional connectivity between associated areas, and there is ongoing research about the possible enhancement of functional connectivity using transcranial alternating current stimulation (tACS) (Alekseichuk et al., 2017), this latter equipment will be used in this study to stimulate the DLPFC and left temporal lobe to test whether this results in an alteration in verbal working memory expression.

The same setup will also be used to test the effect of tACS on verbal fluency. It is often thought that verbal fluency is a good measure of executive function, however, Whiteside et al. (2016) have shown that this claim is possibly unsupported. In this study, we are aiming to find out whether stimulating the same areas of the brain responsible for verbal working memory, will similarly influence verbal fluency tasks.

My preference towards this field of research is due to the exposure to the various equipment of brain stimulation and brain imaging. The experimental design will involve stimulation by tACS and imaging by Electroencephalography (EEG). The brain is an organ which is still widely undiscovered and I believe that brain imaging and brain stimulation techniques are very effective means of narrowing down this knowledge gap. This study is also a good combination of psychology and neuroscience and is an example of how altering the physical nature of our brain will consequently change our behaviour and cognitive function.

## **References**

Alekseichuk, I., Pabel, S. C., Antal, A., & Paulus, W. (2017). Intrahemispheric theta rhythm desynchronization impairs working memory. *Restorative neurology and neuroscience*, 35(2), 147-158.

Baddeley, A. D., & Hitch, G. J. (1974). Working memory. *The psychology of learning and motivation*, 8, 47-89.

Hampson, M. (2010). Relating variations in network connectivity to cognitive function. *Analysis and Function of Large-Scale Brain Networks*, 35-42.

Whiteside, D. M., Kealey, T., Semla, M., Luu, H., Rice, L., Basso, M. R., & Roper, B. (2016). Verbal fluency: language or executive function measure?. *Applied Neuropsychology: Adult*, 23(1), 29-34.

## **Learning Outcomes<sup>1</sup>**

### **Subject specific**

- Advanced knowledge and understanding of verbal working memory and the areas of the brain responsible for the phenomenon. The study of verbal working memory will be tackled from a psychological perspective by subjecting the participants to tasks specifically targeted for verbal working memory and verbal fluency. The phenomenon will also be investigated from a neuroscience standpoint which will require knowledge in the anatomy and physiology of the brain and sufficient understanding of the use of EEG and tDCS.
- I will also gain knowledge on functional connectivity in the brain, how it works and how it could be manipulated.

### **Methodological**

- I will enhance my abilities to plan ahead and work systematically.
- I will gain knowledge of how I can organize a study within a team and to work together effectively and efficiently.
- Being a cognitive science study it is very important to look at the phenomenon from different aspects and apply both knowledge and skills obtained both from psychology and neuroscience.

### **Generic/Instrumental**

- Ability to use EEG and process the signal
- tACS knowledge using different setups
- Enhance skills of interacting with participants, how to simplify and ease the process of experimentation.

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<sup>1</sup> as defined in the MEi:CogSci curriculum

## Systemic

- Trouble shooting, outside-the-box thinking and the ability to change perspectives
- improve my interdisciplinary thinking skills
- enhancing my organisational skills
- Practice teamwork
- Learn to critically evaluate results and methods to fully optimise time and resources
- Necessity of quick orientation without this new field and ability to adapt to complex scenarios.

## Short Project Description

The experimental design will include a within subject part comparing the task outcomes under synchronized, desynchronized and sham tACS conditions. These same results will also be compared between subjects. EEG readings will be taken prior and after the completion of the task under online stimulation.

The tasks will be designed to test verbal working memory and verbal fluency. They will be presented on a computer application and analysed manually.

## Project Plan

Deadline	Task	Details
31 <sup>st</sup> March	Assessment of plan and methods	<ul style="list-style-type: none"> <li>• preparation of equipment</li> <li>• Financing and ethical committee</li> <li>• Preparation of participant-recruitment posters</li> <li>• Creation of computerized tasks</li> <li>• Study literature</li> </ul>
27 <sup>th</sup> April	Data gathering	
30 <sup>th</sup> April	Statistics (preliminary)	
2 <sup>nd</sup> May	Results (preliminary)	
16 <sup>th</sup> May	Statistics and results (final)	
25 <sup>th</sup> May	Poster (draft)	
28 <sup>th</sup> May	Poster (final)	

### Project Steps

1. Literature Research				Total Working Hours (WH)/ECTS: __ / __	
Working-package (WP)	Start – End	WH / ECTS	Activities	Resources required	Milestones (M)

2. Formulating Hypotheses/Theses				Total Working Hours (WH)/ECTS: __ / __	
Working-package (WP)	Start – End	WH / ECTS	Activities	Resources required	Milestones (M)

3. Planning Means of Data Acquisition				Total Working Hours (WH)/ECTS: __ / __	
Working-package (WP)	Start – End	WH / ECTS	Activities	Resources required	Milestones (M)

4. Data Acquisition/Collection				Total Working Hours (WH)/ECTS: __ / __	
Working-package (WP)	Start – End	WH / ECTS	Activities	Resources required	Milestones (M)

5. Data Analysis/Interpretation				Total Working Hours (WH)/ECTS: __ / __	
Working-package (WP)	Start – End	WH / ECTS	Activities	Resources required	Milestones (M)

6. Project Documentation				Total Working Hours (WH)/ECTS: __ / __	
Working-package (WP)	Start – End	WH / ECTS	Activities	Resources required	Milestones (M)

## Project Milestones

Milestone	Result/"Product" and/or Deliverables

## Project Schedule<sup>2</sup>

make a nice Gantt chart of your outlined workpackages (WP1.1, WP1.2 .. WP6.n) and milestones (M1.1..)

## Short Project Report [Conference Abstract]

(~1 page, 3000-5000 characters)

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