

Project specification

MEi:CogSci 1st year semestral project

TOPIC OF SPECIALISATION

The project looks at EEG oscillatory signatures of auditory gating.

PHENOMENON & (PERSONAL) GOALS

Sensory gating refers to the ability to filter out unnecessary stimuli and prevent the brain from being overloaded by irrelevant information. Research has shown that extroversion-introversion, a basic personality trait, determines how an individual processes sensory stimuli and the motor responses in reaction to these [1]. Extroversion-introversion might, therefore, conceivably, have an effect on sensory gating. However, whilst the latter has been studied in relation to certain mental disorders, such as schizophrenia, and even in relation to schizotypal personality, the effect of personality on sensory gating remains largely understudied [2, 3]. Building upon previous work by Siegl, the goal of the present study is to assess and compare the effect of extraversion and introversion on auditory gating using time-frequency analysis [4].

I am interested in the interplay of emotions and cognition and keen on gaining experience within cognitive neuroscience. Specifically, my goal is to improve my programming skills and gain experience with imaging technologies (and analyzing the data thus obtained). This project is a step in achieving all of the above. Cognitive neuroscience as a field and, by extension, my project, is interdisciplinary by combining neuroscience, psychology, and computer science. It examines a psychological phenomenon using modern imaging technologies and programming skills.

References

- [1] R. M. Stelmack & T. H. Rammsayer, 'Psychophysiological and biochemical correlates of personality,' in *The Sage Handbook of Personality Theory and Assessment*, London: SAGE, 2008, pp. 33–55.
- [2] T. Popov et al., 'Evoked and induced oscillatory activity contributes to abnormal auditory sensory gating in schizophrenia,' *NeuroImage*, vol. 56, pp. 307-314, 2011.
- [3] M. H. Hall et al., 'Sensory gating event-related potentials and oscillations in schizophrenia patients and their unaffected relatives,' *Schizophrenia Bulletin*, vol. 37 no. 6, pp. 1187-1199, 2010.
- [4] C. Siegl, *Sensory and Sensorimotor Gating Function in Extraversion-Introversion Personality Trait*. University of Vienna, 2013.

LEARNING OUTCOMES

Working on the project will allow me to gain an in-depth understanding of the theory and current research related to the topic of my project. From a methodological point of view, it will allow me to improve my understanding of the potential of EEG, as well as ways to analyse EEG data using MATLAB and EEGLab. The project will also present an opportunity to write and follow a project plan, thus allowing me to work on my organisational, problem-solving and time-management skills. It will test my ability to quickly navigate a complex field that is new to me, and critically evaluate approaches and methods within the latter. Last but not least, it will enhance my ability to think and work in an interdisciplinary manner.

PROJECT

Project title:

EEG Oscillatory signatures of auditory gating

Short Project Description (300-500 characters)

The goal of the project is to compare the influence of extraversion and introversion on auditory gating, a phenomenon described above. Gating can be operationalized through the mechanism of suppression of mid-latency auditory evoked potentials. It is reflected by the percentage reduction in response to a repeated presentation of auditory click pairs separated by an interval of approx. 500ms. Siegl (2013) collected resting-state EEG data from both introverts and extroverts, and found no significant difference in sensory or sensorimotor gating between the two by examining P50 and PPI measures. The current project takes the same set of EEG data and goes a step further by employing time-frequency analysis in order to reveal potential differences that could not have been revealed by the previous method.

Siegl, Cornelia (2013) *Sensory and Sensorimotor Gating Function in Extraversion- - Introversion Personality Trait*. Master of Science, University of Vienna.

Project Plan

In order to achieve the learning outcomes specified for the project I will take the following measures:

Project steps:

I. Literature research

Purpose and goal: To learn the basics of MATLAB and EEGLAB, and gain a better understanding of the topic and relevant research.

Milestones and deliverables: Present a review of studied literature - 13 April 2016

Amount of working hours: 100

The studied literature included the following:

- B. Hahn and D. T. Valentine, *Essential MATLAB for Engineers and Scientists*. 3rd edition. Oxford: Academic Press, 2007.
- M. H. Hall et al., ‘Sensory gating event-related potentials and oscillations in schizophrenia patients and their unaffected relatives,’ *Schizophrenia Bulletin*, vol. 37 no. 6, pp. 1187-1199, 2010.
- MathWorks, *MATLAB 7: Getting Started Guide*, 2008.
- T. Popov et al., ‘Evoked and induced oscillatory activity contributes to abnormal auditory sensory gating in schizophrenia,’ *NeuroImage*, vol. 56, pp. 307-314, 2011.
- C. Siegl, *Sensory and Sensorimotor Gating Function in Extraversion-Introversion Personality Trait*. University of Vienna, 2013.
- R. M. Stelmack & T. H. Rammsayer, ‘Psychophysiological and biochemical correlates of personality,’ in *The Sage Handbook of Personality Theory and Assessment*, London: SAGE, 2008, pp. 33–55.
- EEGLAB tutorial available at http://scn.ucsd.edu/wiki/EEGLAB_TUTORIAL_OUTLINE

II. Formulating hypotheses

Purpose and goal: To have a clear understanding of the goal of the project.

The hypothesis: Extroverts and introverts will differ in terms of auditory sensory gating.

III. Data analysis & interpretation of data

Since the data had already been collected by others, and pre-processed by my supervisor, my task was to employ time-frequency analysis and look for differences between the two groups of participants. This part of the project has been the most demanding and time-consuming, and will result in the poster that I shall present at the Mei:CogSci conference in Vienna as well as, prior to that, to my classmates on 20 June 2016.

Schedule

- 18.3. Start reading the MATLAB-related literature recommended by my supervisor
- 13.4. Present a review of studied literature, continue reading relevant literature
- 1.5. Obtain data and code from supervisor, start analyzing it
- 1.5. Submit preliminary abstract
- 18.5. Present preliminary results
- 1.6. Submit final abstract
- 8.6. Submit project specification
- 20.6. Present poster in class, make final adjustments
- 24.6. Present poster at the conference

Resources needed:

- data, code, and consultation hours with my supervisor
- the cost of travel and accommodation during the Mei:CogSci conference in Vienna

Notes and reminders:

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Abstract:**EEG Oscillatory Signatures of Auditory Gating**

Sensory gating refers to the ability to filter out unnecessary stimuli and prevent the brain from being overloaded by irrelevant information. Research has shown that extroversion-introversion, a basic personality trait, determines how an individual processes sensory stimuli and the motor responses in reaction to these [1]. Extroversion-introversion might, therefore, conceivably, have an effect on sensory gating. However, whilst the latter has been studied in relation to certain mental disorders, such as schizophrenia, and even in relation to schizotypal personality, the effect of personality on sensory gating remains largely understudied [2, 3]. Building upon previous work by Siegl, the goal of the present study is to assess and compare the effect of extraversion and introversion on auditory gating using time-frequency analysis [4].

Gating can be operationalized through the mechanism of suppression of mid-latency auditory evoked potentials. It is reflected by the percentage reduction in response to a repeated presentation of auditory click pairs separated by an interval of approx. 500ms. We hypothesize that introverts, due to increased sensory reactivity, will show less efficient sensory gating (ERP), while extroverts will show less efficient sensorimotor gating (blink component of the startle reflex).

Out of the 88 volunteers that participated in the experiment, 45 were classified as introverts and 43 as extroverts, using the NEO Five Factor Inventory (NEO-FFI). Two different paradigms were used to assess the gating function based on resting-state EEG data collected from both groups. For each subject, P50, N100, and P200 suppression were measured at two different EEG electrode sites. Similarly, PPI was measured with three different pre-pulse lead intervals at two different EMG electrode sites. Following the screening, further questionnaires - the Revised NEO Personality Inventory (NEO-PI-R), the Schizotypal Personality Questionnaire (SPQ-G), and the General Health Questionnaire (GHQ-12) - were administered to the subjects in order to gain a better understanding of their personalities and mental health status.

Whilst Siegl had examined the inhibition of P50 and concluded that extroverts do not differ considerably in terms of sensory or sensorimotor gating function, the present study goes a step further by employing time-frequency analysis on the same set of data to reveal potential differences that could not have been revealed by the previous method [1]. However, no significant difference was revealed. We thus conclude that extroverts and introverts, indeed, do not seem to differ in terms of sensory gating.

References

- [1] R. M. Stelmack & T. H. Rammsayer, 'Psychophysiological and biochemical correlates of personality,' in *The Sage Handbook of Personality Theory and Assessment*, London: SAGE, 2008, pp. 33–55.
- [2] T. Popov et al., 'Evoked and induced oscillatory activity contributes to abnormal auditory sensory gating in schizophrenia,' *NeuroImage*, vol. 56, pp. 307-314, 2011.
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