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Does exercise improve cognitive abilities? An inquiry into inhibitory control and its relation to physical exercise and EEG theta waves.

MSC APPLIED COGNITIVE PSYCHOLOGY

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Does exercise improve cognitive abilities? An inquiry into EEG theta waves and their relation to exercise and inhibitory control.

by
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Abstract

Objective: Physical exercise is shown to increase cognitive control. However, only few studies consider the underlying cognitive mechanism that defines this relation. The aim of the present study is to a correlational design to determine the connections between inhibitory control, physical exercise and theta power using a correlational design. Furthermore, the secondary aim of the study is to compare theta power in successful and unsuccessful inhibitions.

Participants and methods: Using a counterbalanced and multi-method research design, 30 healthy adults (67% female, mean age = 25 years) completed an EEG measurement while conducting a stop-signal task (SST). Before the experiment, participants filled in the International Physical Assessment Questionnaire (IPAQ), measuring the self-reported weekly time of vigorous and moderate physical activity. A correlational analysis was conducted to establish the relationships between average theta power in successful and in unsuccessful stops, physical exercise levels, and SSRT, both in visual and auditory conditions. A repeated measures ANOVA was conducted to determine the difference in theta power in successful and failed inhibitions.

Results: No significant correlations were found theta power and SSRT ($r = -0.242$, $p = 0.189$), vigorous and moderate exercise and SSRT ($r = -0.131$, $p = 0.484$), or theta power and vigorous and moderate exercise ($r = 0.227$, $p = 0.220$). The findings from the repeated measures ANOVA suggested that theta power values differed significantly across successful and failed inhibitions, indicating that stop outcome significantly affected the amount of theta power in the brain ($F(1, 30) = 6.400$, $p = 0.017$).

Conclusion: The findings suggest that theta power is a significant predictor for inhibitory control. Therefore, the results provide a valuable window into the intricate interplay between neural oscillations, physical exercise, and cognitive control. As no significant correlations are found, future research is encouraged to further investigate the relationships.

Keywords: Theta oscillations, vigorous and moderate physical exercise, stop signal task, EEG.

Introduction

One is continuously required to inhibit emotions, behaviour, and thoughts in daily life. Inhibitory control is crucial in physical exercise because one needs to push themselves beyond discomfort to achieve a desired outcome. Physical exercise has been found to have a positive impact on cognitive control, as research has shown that engaging in regular physical exercise can enhance cognitive control and strengthen neural networks associated with self-regulation, leading to better mental discipline in various contexts (Tomporowski & Ellis, 1986; Etnier et al., 1997; Bailey et al., 2014; Loprinzi & Kane, 2015; Olson et al., 2016; Bergelt et al., 2020; Xiong et al., 2021). One of these fundamental mechanisms of cognitive control to regulate reactions is inhibitory control, or the capacity to suppress an ongoing response (Kenemans, 2015). Research has shown a positive link between physical exercise and inhibitory control (Olson, 2016; Kao et al., 2017; Amatriain-Fernández et al., 2021; Dhir et al., 2021). However, the exact neural mechanisms that underlie this relationship remain unclear and significantly less explored.

As mentioned, *inhibitory control* is defined as the ability to stop oneself from doing something already in progress – it, therefore, captures the ability of the brain to control cognitive and motor functions. Inhibitory control is part of the brain's complex cognitive abilities called executive functions, which aim to appropriately distribute cognitive or processing resources to the demands at hand (Eysenck & Keane, 2010; Barenberg et al., 2011; Munakata et al., 2011). Cognitive control processes allow us to "change our behaviour in response to present goals" (Ahumada-Méndez et al., 2022, p. 1). These functions are much more comprehensive than inhibitory control, including a variety of tasks such as switching attention, allocating attention selectively, inhibitory control, working memory, and more (Smith & Jonides, 1999; Barenberg et al., 2011; Ahumada-Méndez et al., 2022). Response inhibition – and inhibitory control at large – is an essential ability of the brain and a crucial part of executive functioning (Aron, 2007; Jaffard et al., 2008; Verbruggen & Logan, 2009), and is generally thought to be driven by the prefrontal cortex (Eysenck & Keane, 2005; Aron, 2007).

A distinction is made between two types of inhibitory response control processes: reactive and proactive inhibition (Kenemans, 2015; Levin et al., 2021). Effective inhibitory control combines both processes (Aron, 2011; Braver et al., 2007). Reactive response inhibition is a bottom-up activation of neurological systems that seeks to halt an ongoing motor response. Proactive inhibition, conversely, is a pre-emptive process that aims to stop a response even before it has been initiated (Kenemans, 2015; Meyer & Bucci, 2016). There are more critical differences between the dual mechanisms of inhibitory control. Proactive inhibitory control is first and foremost focused on a relevant stopping goal, whether reactive inhibition is purely activated after an imperative stimulus (Braver et al., 2007; Meyer & Bucci, 2016). Moreover, proactive inhibitory control is initiated by both endogenous and exogenous factors (Aron, 2011; Meyer & Bucci, 2016). Proactive control is future-oriented and focuses on preparatory attention. In contrast, reactive control focuses on the past and is generally characterised as

a late correction of action and, therefore, can only be triggered by an exogenous signal (Braver et al., 2007; Jaffard et al., 2008). Lastly, both proactive and reactive inhibition have commonly been studied using a stop-signal task (SST) – with proactive inhibition generally studied using a modified version of the SST), which provides a precise measure for the efficiency of response inhibition by measuring stop-signal reaction time (SSRT). A shorter SSRT, therefore, a faster response to the stimulus, is associated with better reactive inhibitory control (Aron et al., 2004; Meyer & Bucci, 2016).

A long history of research links physical exercise to cognitive functioning, including inhibitory control. Although the outcomes of individual empirical studies have varied, narrative reviewers have found that acute exercise positively impacts cognitive performance. (Etnier et al., 1997; Sibley & Etnier, 2003; Chang et al., 2012; Basso & Suzuki, 2017; Giles et al., 2013). Physical activity is defined as "any muscular movement requiring substantial energy expenditure" (Barenberg et al., 2011, p. 210). *Physical exercise* is defined in this paper as purposefully investing time to enhance physical activity and ability. As well as significant positive effects for prevention and decreasing the progression of various diseases and illnesses, physical exercise is also linked to a small yet significant positive effect on cognitive functioning. This positive effect ranges from increasing cognitive processing speed (Pindus et al., 2019) to increased performance in cognitive tasks dependent on the prefrontal cortex-dependent, mood improvements, and a decrease in overall stress levels (Basso & Suzuki, 2017).

In relation to inhibitory control, studies suggest a positive effect yet again. Previous research indicates that physical exercise has a positive effect on enhancing cognitive processes, including inhibitory control. A study by Padilla et al. (2013) found that active participants were more efficient in response inhibition, suggesting that physical activity is positively associated with cognitive control. According to Gejl et al. (2018), performing brief bursts of aerobic exercise may be a time-effective way to improve general cognitive abilities needed to complete activities that modify inhibitory control demands. Moreover, acute aerobic exercise has been shown to improve performance on tasks involving the upregulation of inhibitory control (Kamijo et al., 2007, 2009). Specifically, people who exercise habitually exhibit higher task anticipation and preparation (Stroth et al., 2009; Giles et al., 2013). Moreover, physical exercise significantly improves reactive inhibitory control in patients with Parkinson's disease (Wang et al., 2022). However, proactive inhibitory control showed no significant difference in this study. Lastly, athletes showed significantly greater inhibitory control than non-athletes in a study comparing table tennis players to non-athletes (Zhu et al., 2022).

Studies that inquire into the neural processes behind inhibitory control are generally studied with methods such as electroencephalogram imagery (EEG) recording, frequently yielding the researcher insights into precise measures of particular brainwaves before or after an event occurs (Ahumada-Méndez et al., 2022). EEG's primary objective is to identify neurophysiological processes and neural activity across different brain regions involved in a particular task with high temporal accuracy (Teplan, 2002).

The theta frequency band, or theta power, is a brain oscillation ranging from 4 to 8 Hz.[1] Studies have linked to inhibitory control in the past (Kenemans, 2015; Farbiash & Berger, 2016) as "mid frontal theta oscillations are usually seen in tasks of cognitive control and are considered a neural marker of medial prefrontal cortex (mPFC) engagement to support goal-directed control" (Ahumada-Méndez et al., 2022, p. 4), providing a connecting with inhibitory control. Even though studies specifically relating theta power to inhibitory control are only a few, this aforementioned link is demonstrated by Cavanagh et al. (2009). In their paper, they argue that increased theta-band synchronisation exists between the medial prefrontal cortex and the lateral prefrontal cortex in tasks that require the individual to exercise inhibitory control. Precisely, the strength of this synchronisation corresponds to the effectiveness of error correction, emphasising theta power's role in facilitating behavioural adjustments (Cavanagh et al., 2009). More specifically, according to Cooper et al. (2015), theta oscillations are significantly correlated to proactive control processes of inhibitory control. Moreover, theta power is observed to increase successful response inhibitions in stop stimuli (Nigbur et al., 2011). They find that theta power increases with cognitive conflicts, such as situations with competing responses or information, inhibiting an ongoing response. Theta power is modulated by various factors, including task difficulty (Brier et al., 2010), resting state activity (Pscherer et al., 2022), conflicts (Nigbur et al., 2010; Huster et al., 2013) and making mistakes (Dippel et al., 2015). Still, theta oscillations have received relatively little attention in scientific research studying inhibitory control (Cooper et al., 2015).

However, the link between physical exercise and theta oscillations still needs to be clarified in academic literature. A study by Luchsinger et al. (2016) presented evidence that biathletes had significantly higher levels of frontal theta activity than cross-country skiers; they do not provide any evidence suggesting the inhibitory control of the biathletes was any higher. Two other studies confirmed that theta power was increased in more physically active rats (Li et al., 2014; Li et al., 2021). Therefore, the research gap addressed in this study is the lack of studies demonstrating a connection between theta power and physical activity that specifically studied inhibitory control. This knowledge gap emphasises the necessity of empirical study to comprehend the effects of exercise on theta power. The current work offers new insights into how physical and brain oscillatory activity interact by filling this gap and concentrating on theta power.

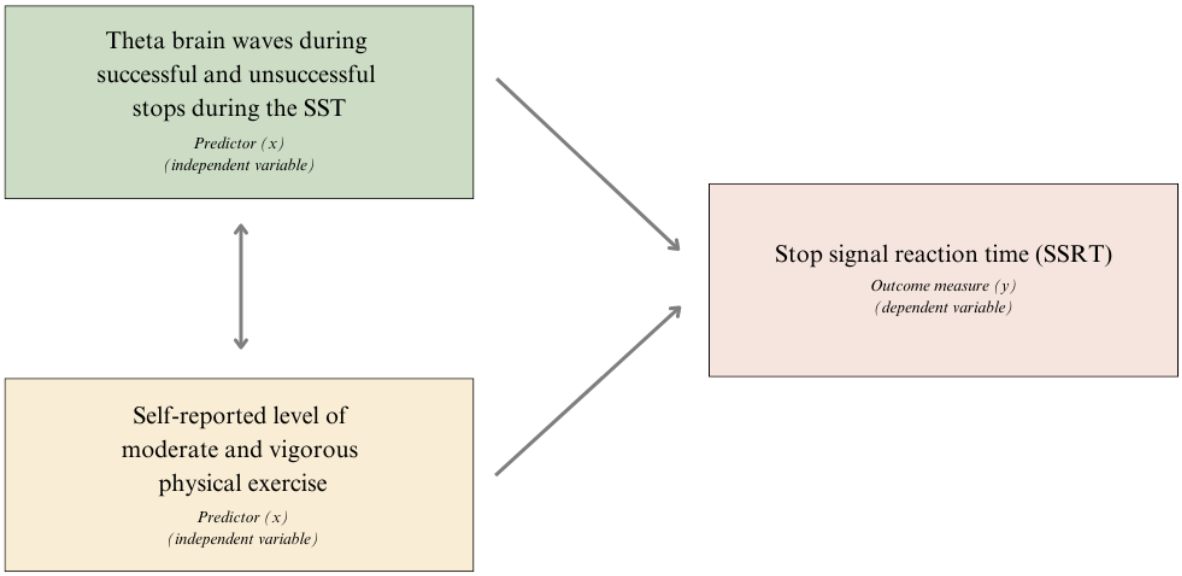
The present study employs a correlational design to determine the connections between inhibitory control, physical exercise and theta power. As no previous research studies these exact variables, this study adheres to an exploratory design. Therefore, data and statistical analysis will primarily focus on defining these relations. The study design is illustrated in Figure 1. Therefore, this paper will attempt to answer the following research question: "Is there a relationship between self-

[1] This frequency band is debated in academia, as some studies argue for a different frequency, such as Cooper et al., 2015 who characterise the theta band between 4-7 Hz.

reported vigorous and moderate physical exercise levels and theta oscillations observed during successful and failed stops in a stop signal task, and their association with inhibitory control in healthy adults?" This study's central hypothesis is that a significant association exists between self-reported vigorous and moderate physical exercise levels, theta oscillations during successful and failed stops in a stop signal task, and inhibitory control in healthy adults. Based on existing literature, it is expected that physical exercise has a positive effect on response inhibition. Additional to the primary research question, several sub-questions will be used to guide the research to determine the relations illustrated in Figure 1. This includes the relationship between physical fitness and SST performance, exercise and theta wave activity. Lastly, research by Kenemans (2015) inspired the hypothesis that theta power is higher in successful inhibitions compared to failed inhibitions. Therefore, this is the second aim of this research paper.

Figure 1

The relations between the three main variables that this study aims to explore and define.



This paper is expected to make substantial contributions to currently conducted academic research. First, this work addresses a critical gap in the literature by examining the link between self-reported levels of vigorous and moderate physical activity, theta oscillations during successful and unsuccessful inhibitions in a stop signal task, and inhibitory control in healthy individuals. However, no study has been found that investigates the participants' positive knowledge of their health and lifestyle regarding physical exercise and the underlying mechanisms. Secondly, the results of this study will help gain insights into the underlying mechanisms of how physical exercise affects cognitive control. This could aid the development of interventions and strategies to increase inhibitory control, potentially extending to psychopathology. Lastly, theta oscillations preceding successful and

failed inhibitory responses can be precisely and objectively measured using EEG recordings, providing a valuable window into the cognitive and neural processes that underly inhibitory control.

This study will start by discussing the methodology. Participants, research design and data analysis plan, will be presented. This includes survey methodology, experimental procedure and statical analysis plans. Secondly, the results chapter presents findings on survey exercise levels, stop-signal performance, and EEG theta waves. Thirdly, results are critically analysed in the discussion, considering their alignment with previous research and theoretical and practical implications. Lastly, the conclusion summarises key findings and research significance, highlighting contributions to the field and suggesting areas for future research.

Methods

In this chapter, the methodology of this paper will be discussed. Three specific data were collected: (1) the Physical Activity Questionnaire (PAQ) survey to measure self-reported levels of physical activity, (2) the SST, and (3) an EEG measurement. The IPAQ survey offers an academically verified tool for measuring participants' physical activity levels and providing information on their regular exercise routines. The SST is a widely used task for studying response inhibition (Verbruggen et al., 2019). Finally, EEG recordings documented brain activity patterns during the SST.

Participants

Out of 58 recruited participants, the final sample for this study consisted of 30 healthy adults (33% male, 67% female) between the ages 18 and 65 living in the Netherlands. The participants were recruited through convenient sampling from the student population at the Utrecht University Campus in the Netherlands and the researchers' networks. The mean age was 25 years (SD = 5, range 20-51, median = 24). Of these participants, 37% were bachelor students, and 53% were master students. There were no exclusion criteria based on nationality, gender, educational experience, level of physical activity, or language (Patino & Ferreira, 2018). Participants with significant vision or hearing problems or epilepsy patients were excluded. Secondly, participants with whom contact was lost during recruitment or did not complete the EEG or survey were not considered. Furthermore, participants were encouraged not to drink coffee or use any drugs or other stimulants starting at 22.00 the night before the experiment and not to use hair or skin products on the day of the experiment to limit noise in the EEG signal.

Before the start of the experiment, participants signed an informed consent written per the requirements and authorisation by the Ethics Review Board of the Faculty of Social & Behavioural Sciences of Utrecht University. For their voluntary participation, researchers rewarded participants with €20.- or 2.5 PPU upon completing the study. The PPU are part of the social and behavioural sciences research participation system for psychology bachelor students at Utrecht University.

Research design

Survey

Before completing the experiment in the lab, participants are asked to complete a survey consisting of six questionnaires. Next to demographic information, this survey measures various topics, including dietary habits, lifestyle beliefs and physical activity. Only the International Physical Activity Questionnaire (IPAQ) gathers relevant data for this thesis project. The IPAQ survey offers an academically validated tool for measuring individuals' levels of physical activity in their lifestyle to provide information on their habitual exercise patterns, although the survey has its limitations (Craig et al., 2003; Rosenberg et al., 2008;

Alomari et al., 2011). For this study, the questions have been uploaded into the Qualtrics browser software, which allows researchers to share the survey with participants and extract data easily. The questions used for this study be found in Appendix A.

The IPAQ distinguishes between four levels of exercise: vigorous, moderate, light, and inactive. Each has specific questions about how much time the participant engages in a particular physical activity, separated by days per week and hours per day. This questionnaire defines *vigorous physical activities* as "running, aerobics, sports, heavy yard work" (IPAQ, 2015). *Moderate physical activity* is defined as "brisk walking, bicycling at a regular pace, vacuuming, gardening, (…) [and] carrying light loads, sweeping, washing windows, and raking in the garden or yard" (IPAQ, 2015). Light exercise includes walking to get from place to place and for leisure. Lastly, questions about a sedentary lifestyle focus on travelling in a motor vehicle and time spent sitting. As mentioned, each question specifies the situation and the level of physical activity, allowing the researcher to analyse the data for every type of exercise. For this paper, the analysis will focus on vigorous and moderate physical exercise.

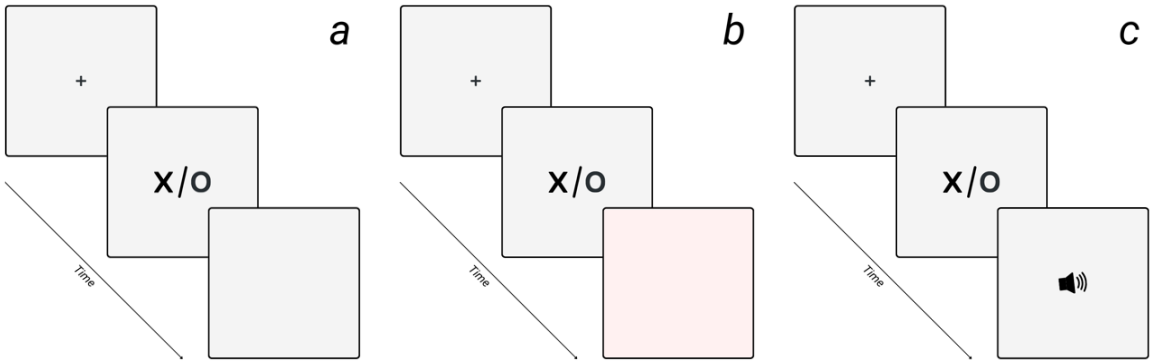
Experimental procedure

After completing the survey online, participants were requested to book a time for the EEG lab experiment and SST. During the lab experiment, participants were seated in a dimly lit, sound-attenuated room after signing the informed consent form. The participants were seated with their heads on a chinrest ±55 cm from the computer screen, during which the researchers placed the EEG cap and six external electrodes. Following, they were connected to the 64-electrode configuration of the EEG equipment and the equipment's signal was tested.

First, a baseline or resting state measurement was performed. Participants were directed to look at a fixation cross for 5 minutes before sitting motionless with their eyes closed for another 2 minutes. After the EEG resting state measurements have concluded, the SST starts. During the stop-signal exercise, subjects were instructed to respond to 'go' stimuli (an X or O on screen) as quickly and precisely as possible but to hold their ongoing reaction when a stop signal was delivered. The stop signal was presented in a minority of the trials, either the 'go' stimulus followed by a visual – a red flash on the screen for 150 ms – or an auditory signal – hearing a noise in the headphones. Participants were instructed to respond quickly and accurately to the 'go' and the 'stop' signals. After each block – experimental and practice – the computer compared the number of successful reactions on 'go' trials and effective inhibition to achieve roughly 50% unsuccessful inhibitions. Therefore, participants were instructed to react slower or quicker if the proportion of successful inhibitions was less than 40% or greater than 60%. The SST is visually illustrated in Figure 2. Furthermore, the full experimental procedure protocol has been added in Appendix H.

Figure 2

A graphic representation of the SST task.

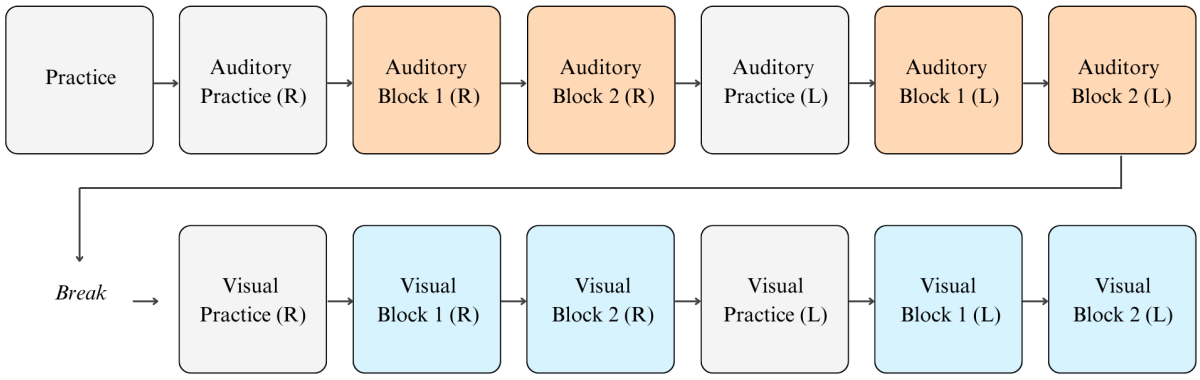


Note: Image a) shows a go stimulus, image b) shows a visual stop stimulus, and c) shows an auditory stop stimulus.

The experiment lasted 13 blocks total, of which five blocks were practice blocks. Participants were given a five-minute break after seven blocks, roughly in the middle of the experiment. The SST was divided into eight conditions, which were counterbalanced across participants by changing the order of auditory-visual is and the buttons they needed to press to indicate a go-trial. Figure 3 gives a visual representation of the experimental procedure of the lab experiment. Practice blocks are colour-coded in the light grey. All eight conditions can be found in Appendix B.

Figure 3

A visual representation of the experimental blocks of the SST.



Note: Condition 1 has been chosen as an example. R and L refer to the button corresponding to the stimulus X. Blocks with auditory stop signals are colour-coded orange, blocks with visual stop signals are colour-coded light blue.

EEG measurement

Using the BioSemi ActiveTwo EEG system (Biosemi, Amsterdam, The Netherlands), 64 scalp electrodes were used to record electroencephalography improved with conducting electrolyte gel. A BioSemi EEG amplifier was used to record the EEG signals. Recording electrodes were placed according to the 10/20 system. Six external electrodes were placed on the participant's head, four facial electrodes to record and correct for electrical activity brought on by the polarization of the eyes, and two attached on the left and the right mastoid. The facial electrodes were placed above the left eye, below the left eye, left to the left eye, and right to the left eye. The electrodes were attached in line with the pupil. Placing the facial electrodes allows eye movement to be captured in any direction. In other words, they were capturing the horizontal and the vertical electrooculogram. EEG signals were online referenced to the Common Mode Sense (CMS) / Driven Right Leg (DRL) electrode.

Data analysis

Survey analysis

Analysis for the IPAQ survey data will occur in Microsoft Excel 2019. Several steps will be taken with clear order and intention. Firstly, empty or incomplete datasets were removed from the analysis. Secondly, the data is ordered according to the numerical order of the participant number. Thirdly, the main output of the IPAQ is the number of days and the hours or minutes per day, as per the IPAQ scoring protocol (IPAQ Research Committee, 2004). All outputs will be converted into days per week and minutes per day to create consistency between the data. Maximum values and extreme outliers were excluded.

Moreover, vigorous, moderate, and light exercise values were truncated to a maximum of 240 minutes of 4 hours. Responses of less than 10 minutes were recorded as zero (IPAQ Research Committee, 2004). Fourthly, data quality is checked by identifying unclear responses. The percentage of unclear responses is calculated for each survey question to identify weaknesses and limitations. The average of the two numbers was taken for answers that included a range of time (e.g., "2-3 hours"). In Qualitrics, participants were free to choose a unit of time. Therefore, for questions about hours or minutes, answers like "1" or "2" were assumed to be hours and adjusted accordingly. If a number was higher than 24 hours, indicating that the subject misinterpreted the question and answered the total number of hours per week, this number was divided by the number of days in question. Answers that were altogether unclear such as "more than 14", were excluded. Lastly, extreme values – more than three standard deviations from the mean – were excluded from the analysis to enhance the reliability of the data.

This thesis decided not to utilise the official scoring calculations. Instead, it took a more straightforward approach. Total weekly minutes were calculated to indicate habitual exercise for every type of exercise. For the primary analysis, this study only considered vigorous and moderate exercise.

Stop-signal task performance analysis

SSRT is the most common way to measure response inhibition, directly measuring the latency to inhibit a prepotent response (Logan & Cowan, 1984; Bedard et al., 2002; Lipszyc & Schachar, 2010; Skippen et al., 2019). Therefore, this study will solely focus on SSRT as a measure for inhibitory control and SST performance. The results were measured for each experimental block that the participant completed. Therefore, the SSRTs will be averaged for each participant into three numbers: the average for the auditory modality, the average for the visual modality, and lastly, the average overall. These numbers are analysed statistically, with average overall SSRT as the primary variable. In the analysis, only experimental blocks are considered.

EEG theta waves analysis

EEG pre-processing

Brain Vision Analyzer software Version 2.1 (Brain Products, Munich, Germany) was used for the pre-processing steps. This study focuses on 950 ms before and 50 ms after the stop stimulus. First, practice blocks were removed using the export and import functionality. Selected channels were referenced to external electrodes placed on the left and right mastoids, and the sampling rate was reduced to 64 Hz. At 0.5 Hz, a low cut-off filter was used.

Consequently, data were separated into auditory and visual segments to perform separate analyses using reference markers placed in the task log files. For each modality, data was further segmented into successful and unsuccessful inhibitions. An artefact rejection algorithm was used for each modality (successful auditory, failed auditory, successful visual, and failed visual, abbreviated AS, AF, VS, and VF). The maximum allowed voltage was set to 50 μV/ms, with a minimum amplitude of -200 μV and a maximum amplitude of 200 μV. Similarly, the ocular correction was applied for all channels using a built-in algorithm. A second artefact rejection occurred, after which the total number of segments for each modality could be counted. Appendix C contains all details of the entire data processing method from Brain Vision Analyser software.

Data quality

Each participant had a different number of correct inhibitions during the SST. However, for analysis, it is integral that theta power was averaged across the same number of segments. Therefore, trials have been randomly selected to equalise the number of successful and failed inhibitions segments.

Secondly, it is crucial to retain as much quality data as possible. For this reason, datasets were left out if there were fewer than 60 remaining segments after artefact rejection and segment equalisation for either visual, auditory, or both. This limit was imposed to preserve approximately

two-thirds of the available data and to provide enough data points for a dependable sample to base statistical analysis.

2.3.4. Statistical analysis

The answers to the main research question were defined using statistical analysis in IBM SPSS Statistics software version 28.0.1.0 and JASP (University of Amsterdam, Amsterdam, the Netherlands). Two main methods were used in the statistical analysis of this thesis to explore and determine the relationships and variations between the variables of interest.

Correlations and Regression Analyses

A comprehensive correlation analysis was conducted using JASP software to examine the relationships between variables. Specifically, the analysis investigated the associations between self-reported exercise levels, including vigorous, moderate, light, sedentary, total average and the average of vigorous of moderate exercise per participant, and various aspects of theta power, namely auditory failed, auditory successful, visual failed, visual successful, and average theta power. Furthermore, the correlations between these exercise levels and SSRT values were examined to see if these were statistically significant ($p < 0.05$). This rigorous analysis provided precise insights into the strength of these relationships. In addition, two separate regression analyses were performed in SPSS to assess the predictive power of self-reported exercise levels on inhibitory control and the predictive power of theta power on SSRT.

ANOVA

To investigate the impact of modality (auditory vs visual) and stop outcome (successful vs failed inhibitions) on theta power, a meticulous repeated measures analysis of variance (ANOVA) was employed. This analysis aimed to ascertain whether statistically significant differences existed in theta power between the auditory and visual stop stimuli. The study rigorously examined the role of theta oscillations in both successful and failed inhibitions by utilising the ANOVA approach, which accounts for within-subject factors. The precise nature of this analysis enabled a nuanced understanding of the specific dynamics underlying inhibitory control.

Results

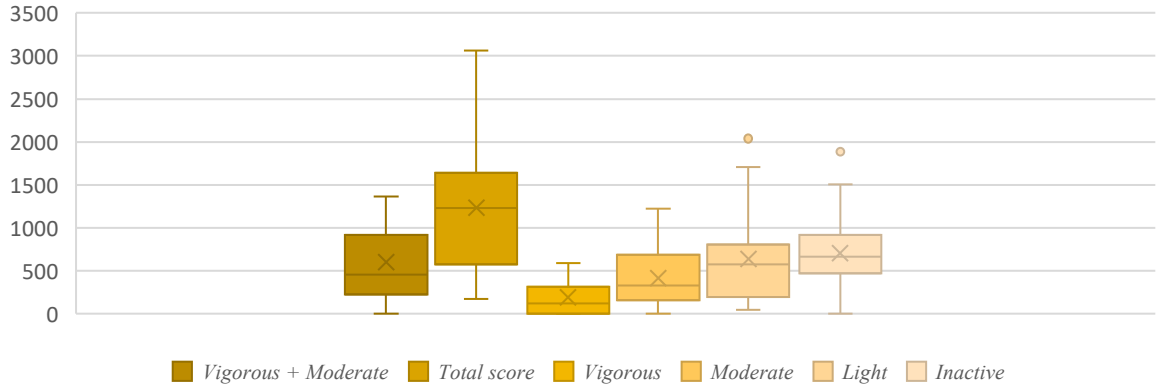
For various reasons, 28 datasets (48%) had to be excluded from the analysis. Two participants did not complete the survey, and the datasets of four participants were in the extremes of the IPAQ or SSRT data. The data from fifteen participants did not pass the 60 segments criteria for the EEG recording after processing. Lastly, seven datasets were lost due to human error on the researchers' part. This chapter discusses the results in the context of the two research questions.

Survey exercise levels

The IPAQ included self-reported measures of participants' time engaging in physical exercise. Appendix D shows the results of the IPAQ survey data after data cleaning, which are visualised in Figure 4. Inactivity had the highest minute average (mean = 701, SD = 371, range = 0-1884). Secondly, on average, participants spent the most time doing light exercise, with an average of 637 minutes per week, or approximately 10.5 hours (mean = 637, SD = 757, range = 40-2040). Moderate exercise, thirdly, was reported with an average time of 411 minutes per week (mean = 411, SD = 336, range = 0-1220). Lastly, vigorous exercise was reported with the lowest average, range, mean and standard deviation. This indicates that participants spent the least amount of time doing exercise with a vigorous intensity (mean = 188, SD = 183, range = 0-585). Accumulatively, the scores were added to give the participant two total exercise scores. Firstly, a total score was explored. However, due to the high number of light physical activity (which also included walking to and from work), these numbers turned out unreasonably high, with a maximum of 3060 minutes per week or approximately 51 hours a week (mean = 1235, SD = 707, range = 170-3060). As mentioned, this paper focuses only on vigorous and moderate exercise. This gave more promising results, with an average of 598 minutes per week (mean = 598, SD = 416, range = 0-1365).

Figure 4

Boxplot of vigorous and moderate exercise, total exercise, vigorous exercise, moderate exercise, light exercise and sedentary lifestyle.

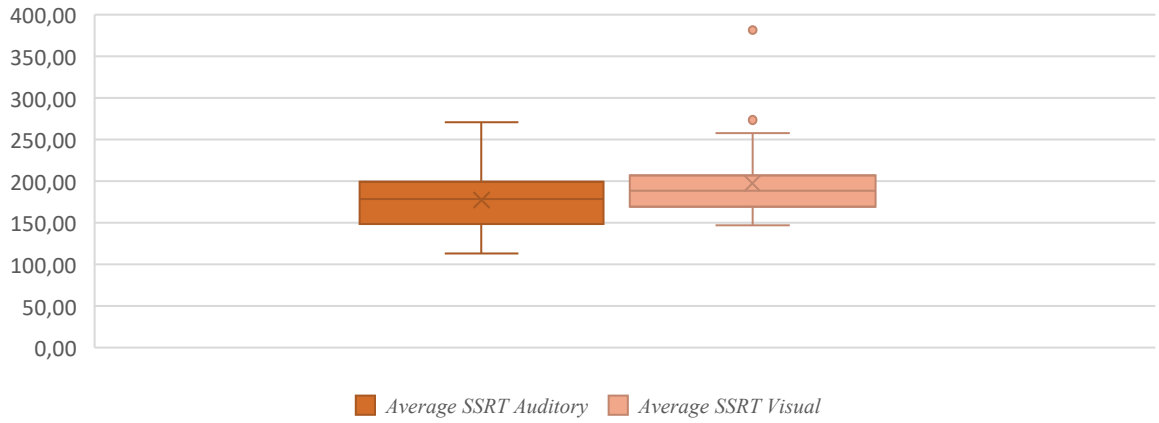


Stop-signal performance

The data shows that participants responded quickly, with a mean SSRT of 186,62ms across the population (SD = 74, range = 38-952). All numbers are in milliseconds. Generally, participants' response time decreased during the experiment, both for 'go' trials and 'stop' trials (meanRT_go: mean = 617.56, SD = 126.17; range = 343-1053; meanRT_stop: mean = 530.75, SD = 103.38, range = 353-796). Results indicate that SSRT in the auditory blocks was lower (mean = 177.25; SD = 36,71, range = 113-270) than in the visual blocks (mean = 194,27, SD = 45,16, range = 146-381). Data distribution is visualised in Figure 5. Although there is a difference between SSRT of the visual and auditory modalities, this correlation was not statistically significant (r = 0.293, p = 0.110). The difference is further highlighted in the repeated measures ANOVA.

Figure 5

Boxplot of average SSRT.

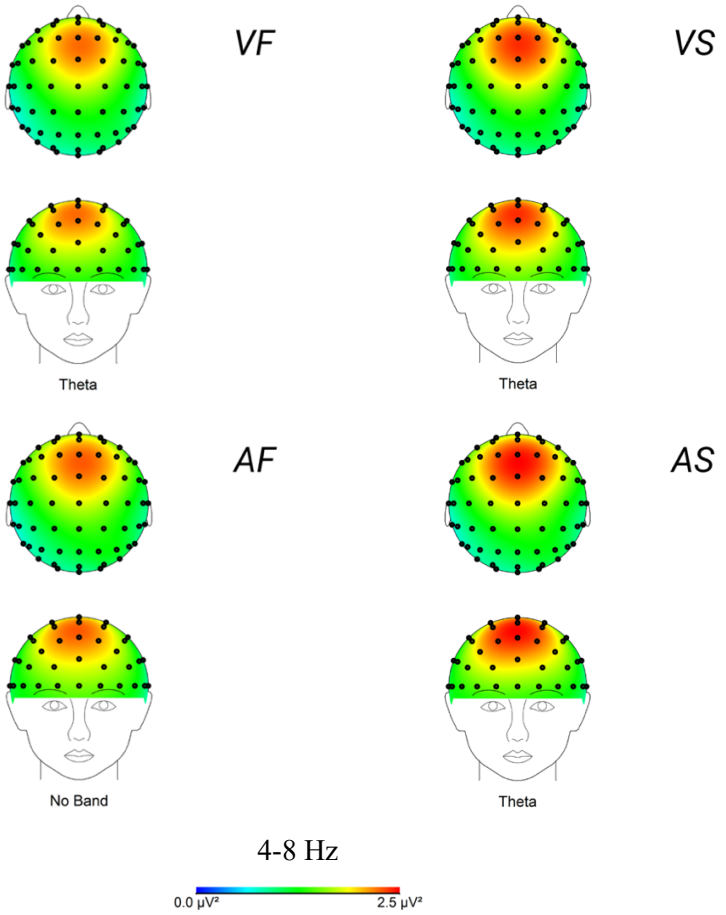


EEG theta waves

Theta power was averaged for each participant using electrodes Cz and FCz, as evidence indicates that theta power is most potent in these locations. The highest average theta power was found in the auditory condition with successful inhibitions (AvAS) with a mean of 2.392 (SD = 0.973, range = 0.735-4.290). This was followed by average theta power successful inhibitions in the visual condition (AvVS) (mean = 2.311, SD = 0.905, range = 0.916-4.993). Therefore, theta power with successful inhibitions was highest in both conditions. Out of the failed inhibitions, the average theta power in the auditory condition (AvAF) (mean = 2.270, SD = 0.795, range = 0.816-3.658) was higher than the average theta power in the visual condition (AvVF) (mean = 2.190, SD = 0.795, range = 0.909-4.250). Each of these conditions is visually illustrated in Figure 6, which visualises the differences in theta power in the auditory and visual conditions. Overall, the theta power of failed inhibitions in the visual conditions was the lowest. All these values combined per participant gave an average theta power with a mean of 2.291 (SD = 0.819, range = 0.845-4.298). Theta power data is visualised in boxplots in Figure 7.

Figure 6

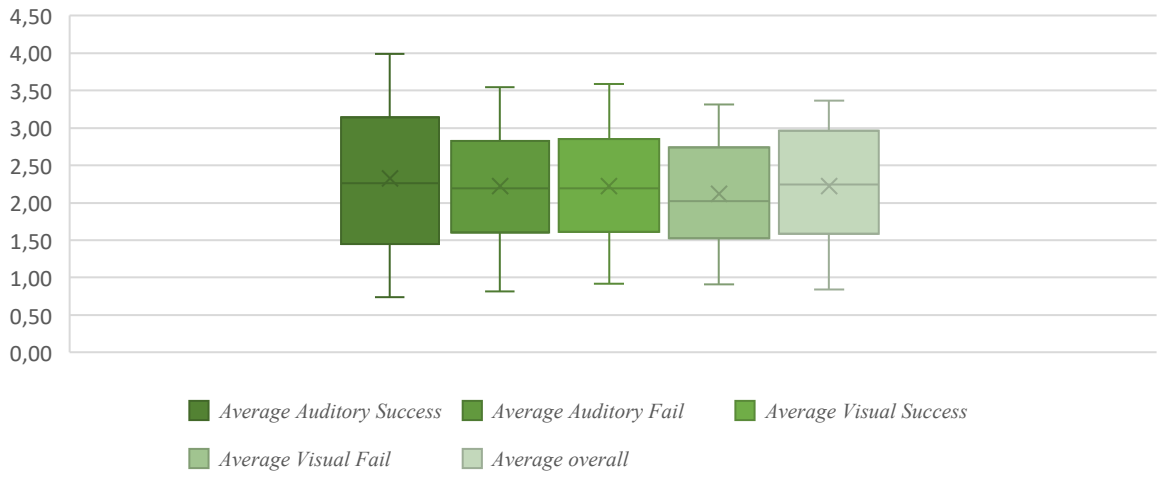
Topographical view of theta oscillations between 950 ms before and 50 ms before the stop signal.



Note: The top images show visual failed and visual successful. Lastly, the bottom images show the differences between the total average of failed and successful inhibitions. The images clearly show the differences between theta activity, as theta power is significantly higher in successful inhibitions.

Figure 7

Boxplot of theta power.



Correlations

This study utilised a correlational approach to assess whether average theta power and the total weekly time that the participant engaged in vigorous and moderate physical exercise could be predictors for SSRT; all variables were tested against one another for correlations. All outcomes are reported in Appendix E.

The results of the correlation analysis examining the relationships between the main variables of the study are presented in Figure 8. The analysis revealed no statistically significant correlations between theta power, self-reported vigorous and moderate exercise, and SSRT. Exercise and SSRT were found to be negatively correlated, as were theta power and SSRT, but these correlations are not statistically significant (see Fig. 8). These findings underscore the limited explanatory power of theta power and physical exercise in predicting individual differences in SSRT.

Figure 8

Correlations between the independent variables and the dependent variable of this paper.

Variable		Theta_Average	Exercise_Score_VM	SSRT_Average
1. Theta_Average	Pearson's r	—		
	p-value	—		
2. Exercise_Score_VM	Pearson's r	0.227	—	
	p-value	0.220	—	
3. SSRT_Average	Pearson's r	-0.242	-0.131	—
	p-value	0.189	0.484	—

Note: None of the correlations are statistically significant ($p < 0.05$).

However, several other statistically significant correlations were discovered (see Fig. 9). Most correlations were between minor variables within the same variable, such as theta AvAS and theta AvAF. These correlations were discovered between the minor variables in all central variables, theta, exercise, and SSRT. The positive correlations between Theta_AvAS and Light_Exercise are the most notable, though the relationship is weak (p =.029). Theta_AvAS also had a weak positive correlation with Exercise_Score (p =.035). Finally, age was correlated with both average SSRT in the visual condition (p = 0.001) and average SSRT (p = 0.001), indicating a positive relationship in both cases. All statistically significant correlations are shown in Figure 9.

Figure 9

Statistically significant correlations found between the minor variables of this study

Variable 1		*Variable 2*	*Pearsons's r*		*p-value*
Theta_AvAS	-	Theta_AvAF	0.892	***	< .001
Theta_AvAS	-	Theta_AvVS	0.839	***	< .001
Theta_AvAS	-	Theta_AvVF	0.810	***	< .001
Theta_AvAS	-	Theta_Average	0.942	***	< .001
Theta_AvAS	-	Light_Exercise	0.392	*	0.029
Theta_AvAS	-	Exercise_Score	0.381	*	0.035
Theta_AvAF	-	Theta_AvVS	0.860	***	< .001
Theta_AvAF	-	Theta_AvVF	0.793	***	< .001
Theta_AvAF	-	Theta_Average	0.938	***	< .001
Theta_AvVS	-	Theta_AvVF	0.939	***	< .001
Theta_AvVS	-	Theta_Average	0.962	***	< .001
Theta_AvVF	-	Theta_Average	0.935	***	< .001
Vigorous_Exercise	-	Moderate_Exercise	0.433	*	0.015
Vigorous_Exercise	-	Exercise_Score_VM	0.715	***	< .001
Moderate_Exercise	-	Exercise_Score	0.775	***	< .001
Moderate_Exercise	-	Exercise_Score_VM	0.939	***	< .001
Light_Exercise	-	Inactive_Exercise	-0.378	*	0.036
Light_Exercise	-	Exercise_Score	0.694	***	< .001
Exercise_Score	-	Exercise_Score_VM	0.743	***	< .001
SSRT_AvAud	-	SSRT_Average	0.756	***	< .001
SSRT_AvVis	-	SSRT_Average	0.847	***	< .001
SSRT_AvVis	-	Age	0.760	***	< .001
SSRT_Average	-	Age	0.609	***	< .001

*Note: * p < .05, ** p < .01, *** p < .001*

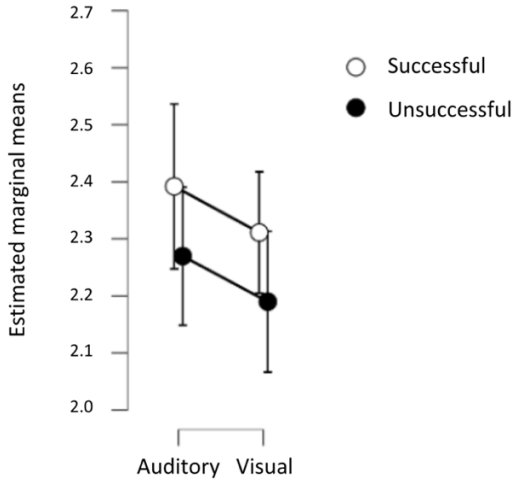
Repeated Measures ANOVA

A repeated measures ANOVA was performed to compare the effect of successful and unsuccessful inhibitions on theta power. The results showed that theta power values differed significantly across successful and failed inhibitions, suggesting that stop outcome significantly affected the amount of theta power in the brain ($F(1, 30) = 6.400$, $p = 0.017$). Results indicate no significant interaction between the stop outcome and the modality ($F(1, 30) = 1.224*10\text{-}4$, $p = 0.991$). Moreover, the results indicate that neither the visual nor the auditory modality has a significant main effect ($F(1, 30) = 1.016$, $p = 0.322$), even though there is a clear difference between theta power in

both conditions, as seen in Figure 10. These findings suggest that – rather than determined by the visual or the auditory condition – the difference in theta power is primarily determined by stop outcome, be it successful or failed inhibitions. Lastly, the repeated measures ANOVA revealed that, most likely, no statistically significant between-subjects effects exist ($F(30) = 2.684$, $p > 0.05$). Full repeated measures ANOVA results have been added to appendix F.

Figure 10

Profile plot of estimated marginal means.



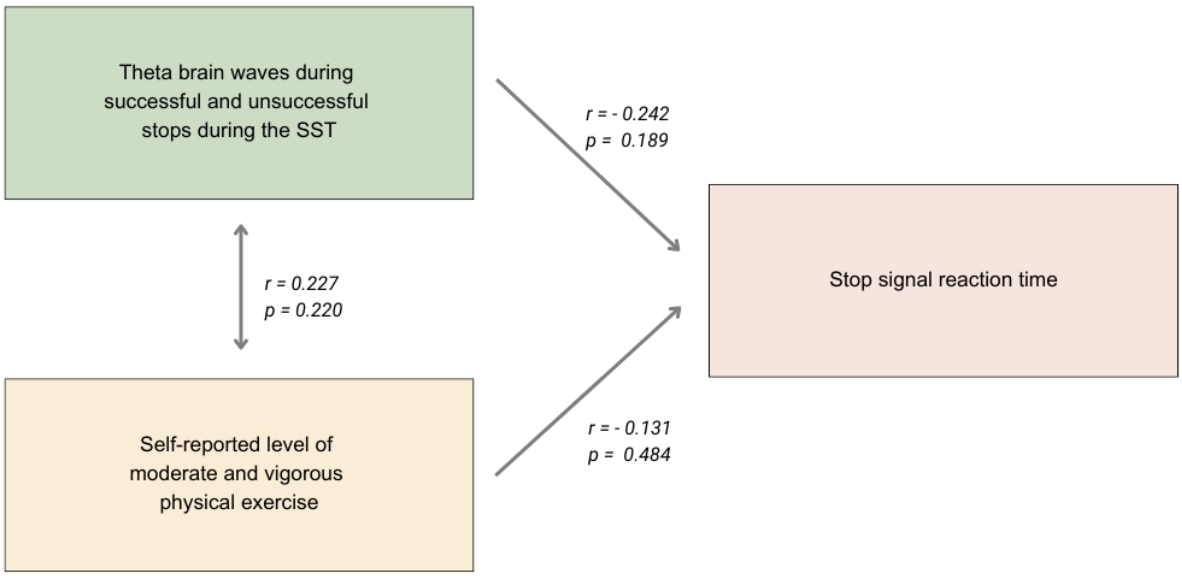
Note: clearly visible is that theta power in successful inhibitions is higher than in unsuccessful inhibitions in both modalities.

Discussion

The study aimed to explore the intricate relationship between theta power in successful and failed inhibitions, physical exercise, and SSRT. This study also aimed to investigate some underlying neural mechanisms that govern proactive inhibitory control, exploring the potential influence of physical exercise on this cognitive mechanism. Unfortunately, the findings indicate no statistically significant correlations between the main variables (see Fig. 11). No significant correlation was found between physical exercise and SSRT, between theta power and SSRT, and between theta power and physical exercise. It is important to note, however, that two significant correlations were found between physical exercise and theta power, suggesting that a weak positive relationship between the variables does exist, even if findings indicate the overall relationship is nonsignificant and weak. The results provide valuable insights into the complex interplay between neural oscillations, physical activity, and cognitive control. This contributes to our understanding of relevant factors impacting inhibitory control processes.

Figure 11

The theoretical model of this study with results of the correlation analysis.



Firstly, the positive relationship between exercise and cognitive control has been confirmed in numerous studies, and this is the primary trend in the academic literature (Tomporowski & Ellis, 1986; Etnier et al., 1997; Bailey et al., 2014; Drollette et al., 2014; Loprinzi & Kane, 2015; Olson et al., 2016; Bergelt et al., 2020; Xiong et al., 2021). Therefore, it was expected that a significant positive relationship would be found between physical exercise and SSRT, thereby indicating that inhibitory control improves with physical exercise. However, the results contradict the central hypothesis of the study, as the correlation analysis revealed no significant correlation between

physical exercise and SSRT. These findings suggest that, at least within the scope of this study, the self-reported physical exercise levels did not exert a discernible effect on inhibitory control.

Several potential explanations exist for the lack of a significant relationship between physical exercise and inhibitory control. First, the limitations of the international physical activity questionnaire (IPAQ) should be acknowledged. The IPAQ is a questionnaire based on self-reporting of the amount of time a participant has exercised; hence it is vulnerable to inaccurate information. The most important is a tendency for over-estimation, potentially due to the social desirability bias and difficulty in accurately recalling physical activity over the previous week. This limitation may explain the high levels of physical activity observed in this study, consistent with previous IPAQ-based studies that found high levels of self-reported physical activity (Bauman et al., 2009; Yates et al., 2010). Secondly, it is crucial to consider the limitations caused by the data cleaning process. Namely, 7.65% of the data gathered in Qualitrics was unclear and required review. Moreover, 17 of the 37 questions had 10% or more unclear answers. After data cleaning and review procedures, described in the methodology chapter, this number was reduced to 0.62% and zero questions with 10% or more unclear answers. Even though this was necessary to ensure data quality, unintended biases may have been introduced during this process.

Furthermore, previous studies examining the relationship between physical activity and cognitive control used an alternative approach to the IPAQ. With the exception of Li et al. (2021), who did utilise the IPAQ to measure physical exercise, the academic studies reviewed for this paper used either an exercise intervention (Giles et al., 2013; Bailey et al., 2021; Xiong et al., 2021) or studied the effects of an acute bout of exercise, which is a very brief period of physical activity as part of the research project itself (Etnier et al., 1997; Hillman et al., 2003; Tomporowski, 2003; Davranche & McMorris, 2008; Lambourne & Tomporowski, 2010; Drollette et al., 2014; Loprinzi & Kane, 2015; Basso & Suzuki, 2017; Olson et al., 2016; Kao et al., 2017; Tsukamoto et al., 2017; Gejl et al., 2018; Bergelt et al., 2020; Levin et al., 2021). This indicates a fundamental limitation in the literature regarding this topic, as the methodology suffers from considerable inconsistency (Tomporowski & Ellis, 1986; Chang et al., 2012). For this reason, it can be debated whether the findings between this study and previous literature can be compared. This study employs an entirely distinctive methodology compared to other studies examining the same relationships. Because the methods are different and thus not comparable, the fact that the results point to a different conclusion is a scientific conclusion. This reduces the study's scientific relevance. As a result, future studies ought to add to existing data by employing the IPAQ to measure physical activity to increase the validity of this paper's findings.

Contextual factors may also play a role. First, Chang et al. (2012) identified four factors that moderate the effects of physical exercise on cognitive ability: 1) duration, 2) intensity, 3) type of cognitive performance assessed, and 4) participant fitness. The IPAQ only considers the previous week's duration and intensity of exercise. Studies suggest that more factors that may play a role are

sleep quality and sleep efficiency, which mediate the relationship between physical exercise and inhibitory control among university students (Li et al., 2021), a population similar to this study's sample.

Even though most relationships tested in the correlation analysis found conclusive proof that a significant relationship exists, a surprising result was the significant correlations between theta power and physical exercise. Even though the relationship between the two dependent variables is insignificant, the association between Theta_AvAS and light_exercise ($p = 0.029$) and Theta_AvAS and the total exercise score ($p = 0.035$) is. Furthermore, the theta power-to-exercise relationship is this study's only positive – nonsignificant – relationship. This relationship has barely been studied in academic literature; most relevant studies focus on theta power in rats after physical exercise (Kuo et al., 2010; Li et al., 2014; Li et al., 2021). The relationship has not been replicated in humans (Chaire et al., 2020). Since no significant correlation has been found, these findings stand alone and need further research and evidence.

Finally, age was found to have significant correlations with both average SSRT measured in the visual condition ($p = 0.001$) and average SSRT ($p = 0.001$). This strong positive relationship indicates that as age increases, so does SSRT. This finding is in line with the literature. Studies have found that "the ability to inhibit prepotent responses improved throughout childhood and then diminished slightly throughout adulthood" (Williams et al., 1999, p. 211). Moreover, physical exercise is found to affect the relationship significantly. Older adults who engage in more physical exercise are shown to have faster reaction times compared to those who don't (Huang et al., 2014). Due to the fact that this study's population is primarily around the mean age of 25, no conclusions can be drawn about whether the statistically significant correlation also applies to other age groups.

This study adds to the existing literature by exploring the role of the underlying neural mechanisms between SSRT and physical exercise. Theta power is, namely, an element which only a few scholarly studies consider. This study has focused on theta power because it has previously been demonstrated to indicate proactive inhibitory control (Kenemans, 2015; Farbiash & Berger, 2016; Ahumada-Méndez et al., 2022). The integration of EEG recordings provides this thesis with objective and precise measurements of theta oscillations during the SST, providing valuable insights into the cognitive and neural processes that underlie inhibitory control. However, the relationship here – similar to physical exercise and SSRT – is also found to be statistically insignificant according to the results of this study.

The repeated measures ANOVA findings showed a statistically significant main effect of stop outcome, indicating that theta power before a stop signal differed significantly between successful and failed inhibitions. This finding confirms the second hypothesis and thereby accomplishes the secondary aim of this paper. This finding is congruent with academic literature (Nigbur et al., 2011; Huster et al., 2013; Dippel et al., 2015; Pscherer et al., 2019; Pscherer et al., 2022). Furthermore, the finding that theta power is higher in successful inhibitions is found in both the visual and auditory

conditions. Interestingly, even though this finding is consistent when comparing theta power in the auditory and the visual condition in successful and unsuccessful inhibitions, there is no significant difference between the two modalities ($p = 0.332$).

Although the findings shed light on brain activity connected to inhibitory control, it remains unclear how exactly theta band activity promotes cognitive control. One plausible explanation states that theta band power reflects the synchronisation of neural activity in the brain, particularly in regions involved in cognitive control. The response inhibition mechanism is engaged whenever one needs to suppress a prepotent or automatic response, such as avoiding pressing a button following a stop stimulus. Higher theta power found preceding successful inhibitions may indicate higher engagement of these cognitive control mechanisms. Likewise, this would suggest that the cognitive control mechanism is less engaged preceding failed inhibitions. This may explain both why theta power might be lower preceding unsuccessful inhibitions and why that inhibition attempt might have failed. Another possibility is that since one has to deal with conflicting information, this is the reason for increased theta power. Theta power, namely, is found to increase with conflicting information and or situations in which inhibitory control is required (Nigbur et al., 2011; Huster et al., 2013; Dippel et al., 2015; Pscherer et al., 2019; Pscherer et al., 2022). Lastly, studies suggest that theta band activity is more potent when people make impulsive errors (Nigbur et al., 2011; Cavanagh et al., 2009). Theta power is therefore marked as a marker for cognitive control. However, it is essential to remember that the research linking theta power to inhibitory control remains limited. In brief, the findings of this study confirm that theta power appears to play a significant role in facilitating successful inhibitory response control. By extension, it appears to facilitate cognitive control more generally.

This study has theoretical and practical significance, but some limitations must be taken into account when interpreting its results. First, the IPAQ survey's limitations and the data's overestimation have already been discussed. Secondly, the study observes limited generalisability. The sample population consisted of a relatively small number of healthy adults recruited through convenient sampling from the student population of Utrecht University. The specific demographic characteristics of this population may restrict the generalisability of findings to the broader population because the findings may not be representative of other age groups, cultural backgrounds, educational backgrounds, or groups with other habits surrounding physical exercise. Additionally, the study excluded a sizable portion of the data (48%) to ensure data quality. These factors have a negative effect on the external validity of the study. Moreover, two-thirds of the population was female (66%). The physiological differences between men and women regarding physical exercise is a highly controversial and charged topic. However, this study does recognise the importance of having a balanced population sample regarding sex, as a gender-unbalanced set of subjects is a threat to the external validity of any study (Holverstott et al., 2002; Roig-Maimó & Mas-Sansó, 2019).

Another limitation of this study is the utilisation of potentially confounding variables. Despite efforts to control for confounding variables, there may still be unaccounted factors that have

influenced the study's outcome. For instance, the participants' sleep patterns, eating habits, fatigue and stress levels, medication use, or other factors could potentially impact the performance on the SST task or have influenced the EEG measurements. Several participants admitted they had not slept well the night before and felt fatigued. This may have influenced the results of their data sets.

Even though many limitations can be identified, three strengths of the study and its methodology should be recognised. Firstly, the thesis utilises a very comprehensive data collection process. Several academically validated methodologies have been combined into a single study, including a validated questionnaire, the stop-signal task frequently used in studies on this topic, and EEG measurements. This allows for a comprehensive investigation of the research topic. Secondly, participant selection criteria were set clearly, thereby increasing the internal validity of the study and allowing the results to be applicable to the student population of Utrecht University. Lastly, it can be argued that the EEG recordings offer the most valid data of this study since this data underwent the highest level of rigorous data pre-processing and quality control. Similar to the IPAQ data, many steps have been taken to guarantee high-quality data. This procedure included artefact rejection, segment equalisation, and setting criteria for retaining high-quality data. By taking these measures, the reliability and validity of EEG analysis have been increased, and the data can be utilised for future studies in the field.

Now that the research methodology has been viewed critically, recommendations for future research must be made. Firstly, the population's selection can be improved. In this study, even though a wide age range was defined, due to convenient sampling using the researchers' networks, the study included primarily students with bachelor's and master's degrees. However, study findings might be more significant when a randomised population is recruited. This can take the shape of an equal ratio of males to females or compare athletes and non-athletes. The randomisation would help create generalisability and a clear distinction between two groups that could be easily compared with one another.

Secondly, it has been noted that the IPAQ survey has significant weaknesses, particularly an overestimation due to self-reporting. Future research could improve on this by using a longitudinal study that more accurately tracks the physical exercise of participants to determine the long-term effects of physical exercise on inhibitory control. The longitudinal setup would give rise to more excellent reliability. Alternatively, future studies can utilise the IPAQ to measure physical activity to build out the available literature and findings based on this methodology, considering the IPAQ is widely used in studies that concern inhibitory control. Adding to this body of literature is valuable because it increases the academic relevance of this study, in addition, to understand the relationship more deeply between inhibitory control, physical exercise and theta power.

In conclusion, this study found no significant relationships between physical exercise, theta power, and SSRT, rejecting the main hypothesis. However, repeated measures ANOVA results suggested that a significant difference in theta power exists between theta power in successful

inhibitions and theta power in failed inhibitions. The results provide a valuable window into the intricate interplay between neural oscillations, physical exercise, and cognitive control. The relationship is complex and highlights the need for future research. The present study's outcomes must be interpreted in the context of its research methodology and the specific characteristics of the participant sample, which includes clear limitations. Future research is encouraged to employ the IPAQ survey to build out literature about the relationship between cognitive control and physical exercise and to be inspired by the methodological rigour that this study has followed.

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Appendices

Appendix A: Survey questions

Question number	***exercise type***	***Question***
Q2.2	-	What is your age?
Q2.3	-	What gender do you identify as?
Q2.4	-	What is the highest degree or level of education you have completed or are currently enrolled in?
Q6.1	-	Do you currently have a job or do any unpaid work outside your home?
Q6.3	Vigorous	During the last 7 days, on how many days did you do **vigorous** physical activities like heavy lifting, digging, heavy construction, or climbing up stairs as part of your work? Think about only those physical activities that you did for at least 10 minutes at a time. - Selected Choice
Q6.3_1_TEXT	Vigorous	During the last 7 days, on how many days did you do **vigorous** physical activities like heavy lifting, digging, heavy construction, or climbing up stairs as part of your work? Think about only those physical activities that you did for at least 10 minutes at a time. - How many days a week? - Text
Q6.4	Vigorous	How much time did you usually spend on one of those days doing **vigorous** physical activities as part of your work? Specify hours, minutes if possible.
Q6.5	Moderate	Again, think about only those physical activities that you did for at least 10 minutes at a time. During the last 7 days, on how many days did you do **moderate** physical activities like carrying light loads as part of your work? Please do not include walking. - Selected Choice
Q6.5_1_TEXT	Moderate	Again, think about only those physical activities that you did for at least 10 minutes at a time. During the last 7 days, on how many days did you do **moderate** physical activities like carrying light loads as part of your work? Please do not include walking. - How many days a week? - Text
Q6.6	Moderate	How much time did you usually spend on one of those days doing **moderate** physical activities as part of your work? Specify hours, minutes if possible.

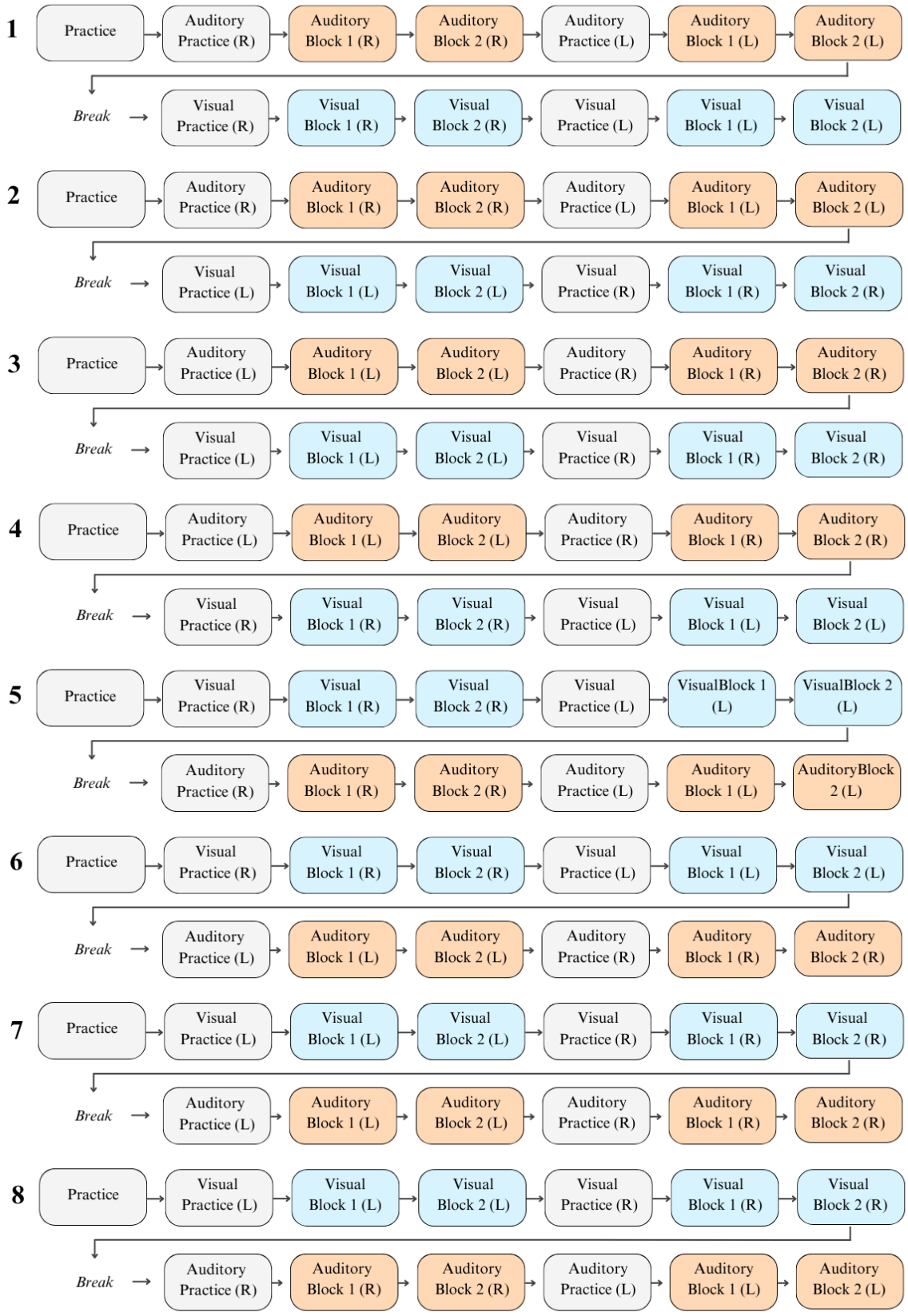
Q6.7	Light	During the last 7 days, on how many days did you **walk** for at least 10 minutes at a time as part of your work? Please do not count any walking you did to travel to or from work. - Selected Choice
Q6.7_1_TEXT	Light	During the last 7 days, on how many days did you **walk** for at least 10 minutes at a time as part of your work? Please do not count any walking you did to travel to or from work. - How many days a week? - Text
Q6.8	Light	How much time did you usually spend on one of those days **walking** as part of your work? Specify hours, minutes if possible.
Q6.10	Inactive	During the last 7 days, on how many days did you **travel in a motor vehicle** like a train, bus, car, or tram? - Selected Choice
Q6.10_1_TEXT	Inactive	During the last 7 days, on how many days did you **travel in a motor vehicle** like a train, bus, car, or tram? - How many days a week? - Text
Q6.11	Inactive	How much time did you usually spend on one of those days **traveling in a train, bus, car, tram, or other kind of motor vehicle**? Specify hours, minutes if possible.
Q6.13	Moderate	During the last 7 days, on how many days did you **bicycle** for at least 10 minutes at a time to go from place to place? - Selected Choice
Q6.13_1_TEXT	Moderate	During the last 7 days, on how many days did you **bicycle** for at least 10 minutes at a time to go from place to place? - How many days a week? - Text
Q6.14	Moderate	How much time did you usually spend on one of those days to **bicycle** from place to place? Specify hours, minutes if possible.
Q6.15	Light	During the last 7 days, on how many days did you **walk** for at least 10 minutes at a time to go from place to place? - Selected Choice
Q6.15_1_TEXT	Light	During the last 7 days, on how many days did you **walk** for at least 10 minutes at a time to go from place to place? - How many days a week? - Text
Q6.16	Light	How much time did you usually spend on one of those days **walking** from place to place? Specify hours, minutes if possible.
Q6.18	Vigorous	Think about only those physical activities that you did for at least 10 minutes at a time. During the last 7 days, on how many days did you do **vigorous** physical activities like heavy lifting, chopping wood, shoveling snow, or digging in the garden or yard? - Selected Choice

Q6.18_1_TEXT	Vigorous	Think about only those physical activities that you did for at least 10 minutes at a time. During the last 7 days, on how many days did you do **vigorous** physical activities like heavy lifting, chopping wood, shoveling snow, or digging in the garden or yard? - How many days a week? - Text
Q6.19	Vigorous	How much time did you usually spend on one of those days doing **vigorous** physical activities in the garden or yard? Specify hours, minutes if possible.
Q6.20	Moderate	Again, think about only those physical activities that you did for at least 10 minutes at a time. During the last 7 days, on how many days did you do **moderate** activities like carrying light loads, sweeping, washing windows, and raking in the garden or yard? - Selected Choice
Q6.20_1_TEXT	Moderate	Again, think about only those physical activities that you did for at least 10 minutes at a time. During the last 7 days, on how many days did you do **moderate** activities like carrying light loads, sweeping, washing windows, and raking in the garden or yard? - How many days per week? - Text
Q6.21	Moderate	How much time did you usually spend on one of those days doing **moderate** physical activities in the garden or yard? Specify hours, minutes if possible
Q6.22	Moderate	How much time did you usually spend on one of those days doing **moderate** physical activities in the garden or yard? Specify hours, minutes if possible
Q6.22_1_TEXT	Moderate	Once again, think about only those physical activities that you did for at least 10 minutes at a time. During the last 7 days, on how many days did you do **moderate** activities like carrying light loads, washing windows, scrubbing floors and sweeping inside your home? - Selected Choice
Q6.23	Moderate	How much time did you usually spend on one of those days doing **moderate** physical activities inside your home? Specify hours, minutes if possible.
Q6.25	Light	Not counting any walking you have already mentioned, during the last 7 days, on how many days did you **walk** for at least 10 minutes at a time in your leisure time? - Selected Choice

Q6.25_1_TEXT	Light	Not counting any walking you have already mentioned, during the last 7 days, on how many days did you **walk** for at least 10 minutes at a time in your leisure time? - How many days per week? - Text
Q6.26	Light	How much time did you usually spend on one of those days **walking** in your leisure time? Specify hours, minutes if possible.
Q6.27	Vigorous	Think about only those physical activities that you did for at least 10 minutes at a time. During the last 7 days, on how many days did you do **vigorous** physical activities like aerobics, running, fast bicycling, or fast swimming in your leisure time? - Selected Choice
Q6.27_1_TEXT	Vigorous	Think about only those physical activities that you did for at least 10 minutes at a time. During the last 7 days, on how many days did you do **vigorous** physical activities like aerobics, running, fast bicycling, or fast swimming in your leisure time? - How many days per week? - Text
Q6.28	Vigorous	How much time did you usually spend on one of those days doing **vigorous** physical activities in your leisure time? Specify hours, minutes if possible.
Q6.29	Moderate	Again, think about only those physical activities that you did for at least 10 minutes at a time. During the last 7 days, on how many days did you do **moderate** physical activities like bicycling at a regular pace, swimming at a regular pace, and doubles tennis in your leisure time? - Selected Choice
Q6.29_1_TEXT	Moderate	Again, think about only those physical activities that you did for at least 10 minutes at a time. During the last 7 days, on how many days did you do **moderate** physical activities like bicycling at a regular pace, swimming at a regular pace, and doubles tennis in your leisure time? - How many days per week? - Text
Q6.30	Moderate	How much time did you usually spend on one of those days doing **moderate** physical activities in your leisure time? Specify hours, minutes if possible.
Q6.32	Inaction	During the last 7 days, how much time did you usually spend **sitting** on a weekday? Specify hours, minutes if possible.
Q6.33	Inaction	During the last 7 days, how much time did you usually spend **sitting** on a weekend day? Specify hours, minutes if possible.

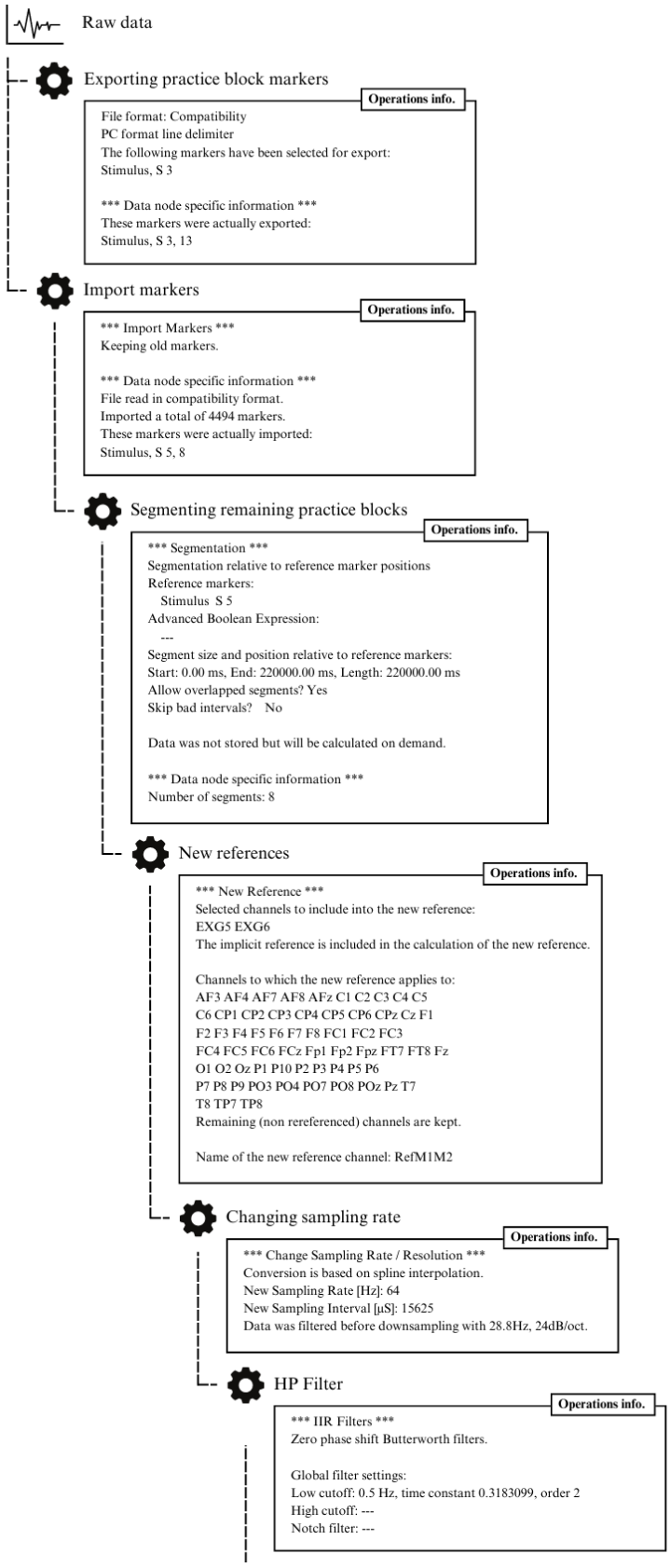
Appendix B: Conditions and counterbalancing

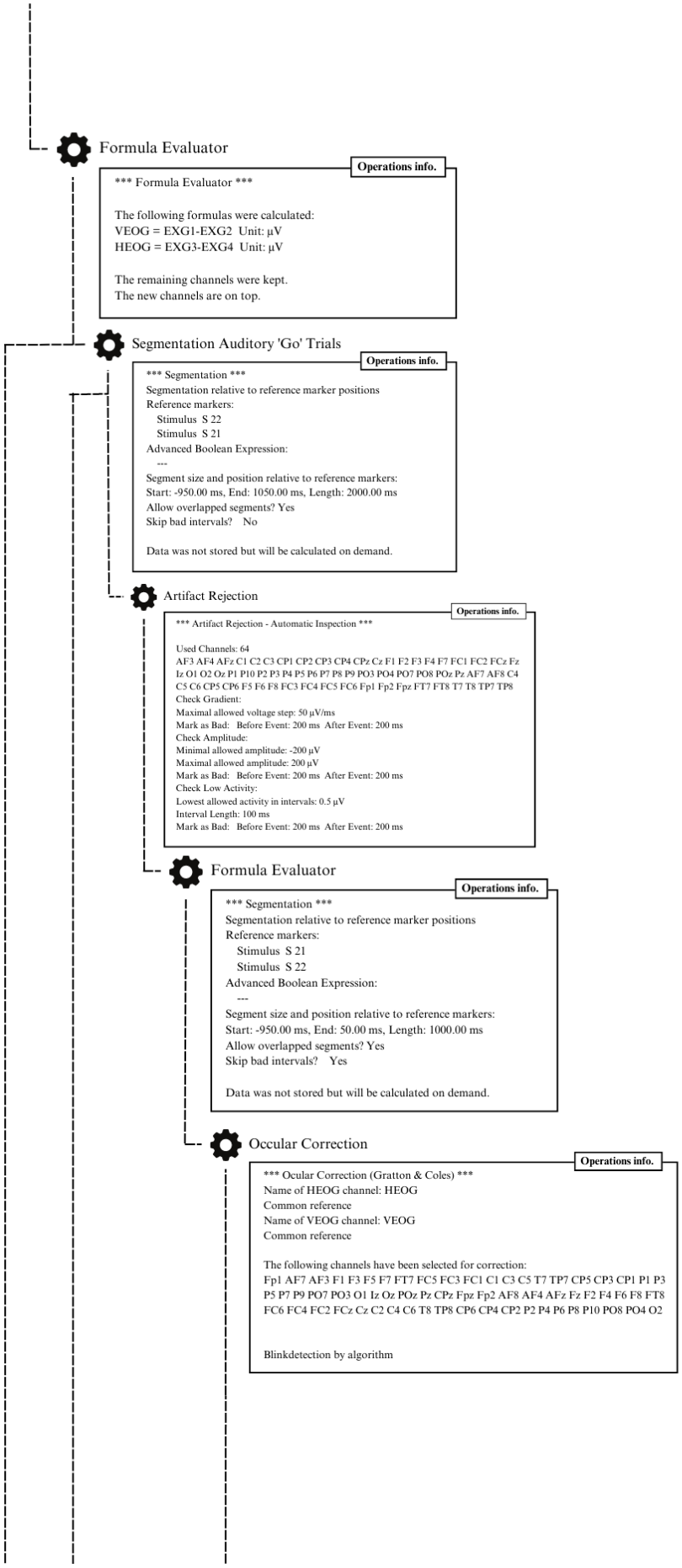
Visual to represent the experimental setup with the 8 conditions. Note that both the left and right changes, as well as the auditory and visual conditions are switched.



Appendix C. BrainVision Analyzer History Tree

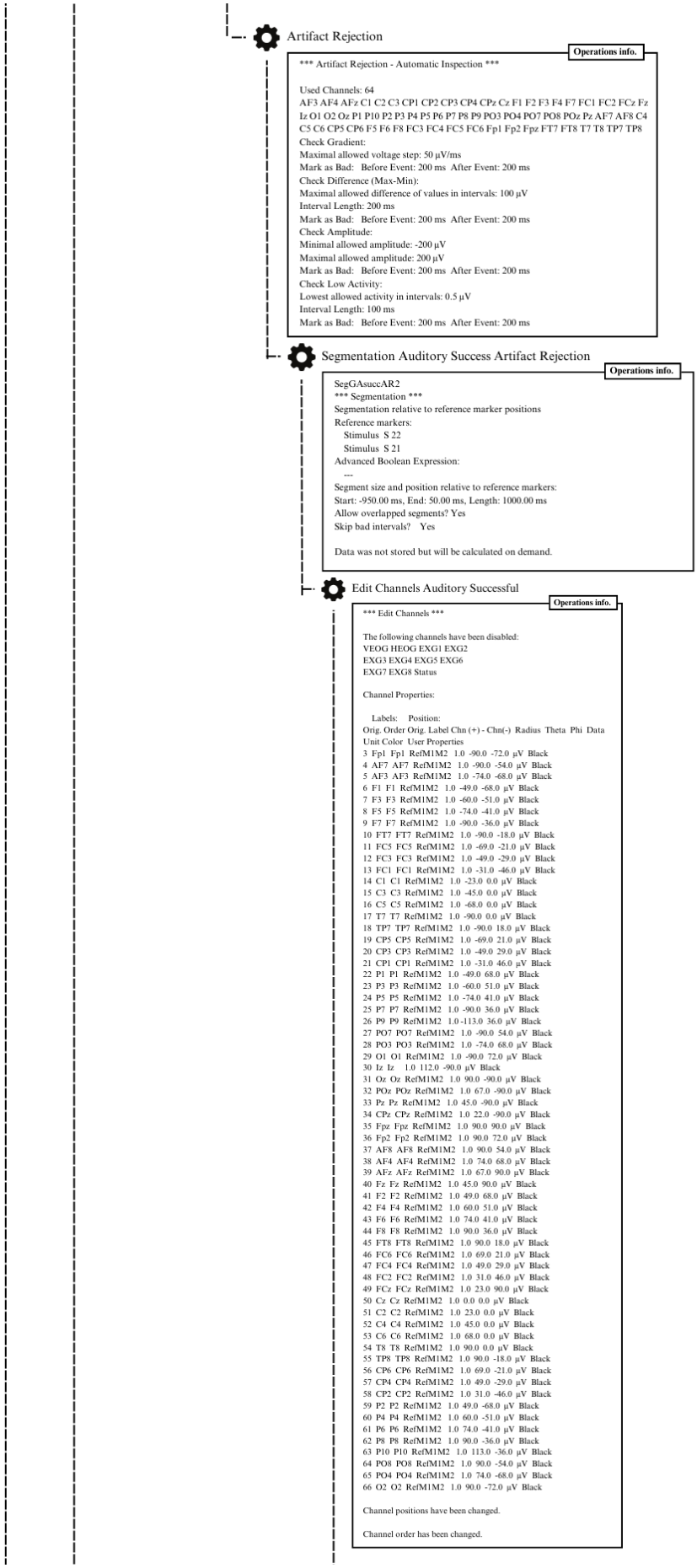
(S21 and S22 inferred auditory, S31 and S32 inferred visual)



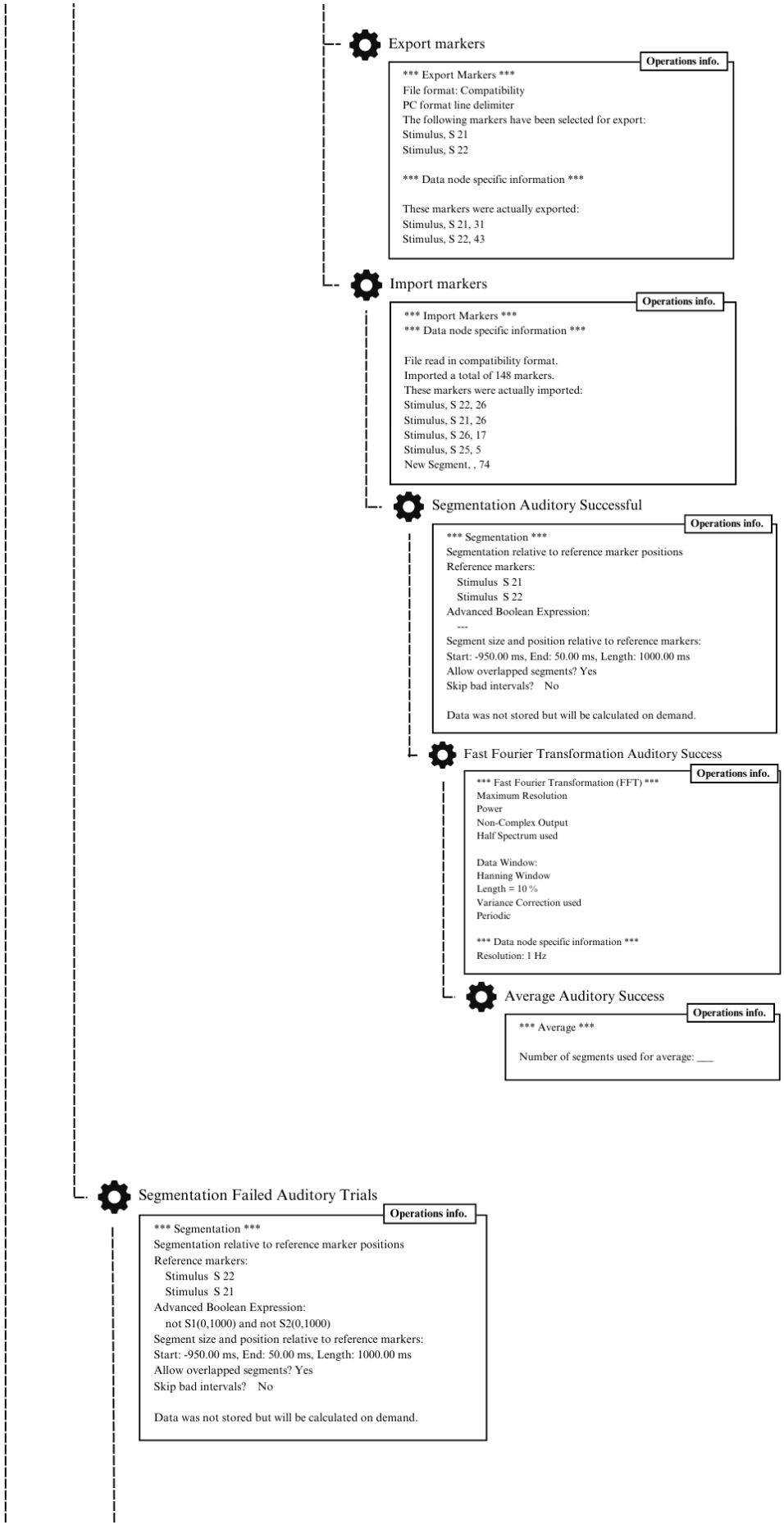

Formula Evaluator
Operations info.
*** Formula Evaluator ***
The following formulas were calculated:
VEOG = EXG1-EXG2 Unit: µV
HEOG = EXG3-EXG4 Unit: µV
The remaining channels were kept.
The new channels are on top.
Segmentation Auditory 'Go' Trials
Operations info.
*** Segmentation ***
Segmentation relative to reference marker positions
Reference markers:
Stimulus S 22
Stimulus S 21
Advanced Boolean Expression:

Segment size and position relative to reference markers:
Start: -950.00 ms, End: 1050.00 ms, Length: 2000.00 ms
Allow overlapped segments? Yes
Skip bad intervals? No
Data was not stored but will be calculated on demand.
Artifact Rejection
Operations info.
*** Artifact Rejection - Automatic Inspection ***
Used Channels: 64
AF3 AF4 AFz C1 C2 C3 CP1 CP2 CP3 CP4 CPz Cz F1 F2 F3 F4 F7 FC1 FC2 FCz Fz Iz O1 O2 Oz P1 P10 P2 P3 P4 P5 P6 P7 P8 P9 PO3 PO4 PO7 PO8 POz Pz AF7 AF8 C4 C5 C6 CP5 CP6 F5 F6 F8 FC3 FC4 FC5 FC6 Fp1 Fp2 Fpz FT7 FT8 T7 T8 TP7 TP8
Check Gradient:
Maximal allowed voltage step: 50 µV/ms
Mark as Bad: Before Event: 200 ms After Event: 200 ms
Check Amplitude:
Minimal allowed amplitude: -200 µV
Maximal allowed amplitude: 200 µV
Mark as Bad: Before Event: 200 ms After Event: 200 ms
Check Low Activity:
Lowest allowed activity in intervals: 0.5 µV
Interval Length: 100 ms
Mark as Bad: Before Event: 200 ms After Event: 200 ms
Formula Evaluator
Operations info.
*** Segmentation ***
Segmentation relative to reference marker positions
Reference markers:
Stimulus S 21
Stimulus S 22
Advanced Boolean Expression:

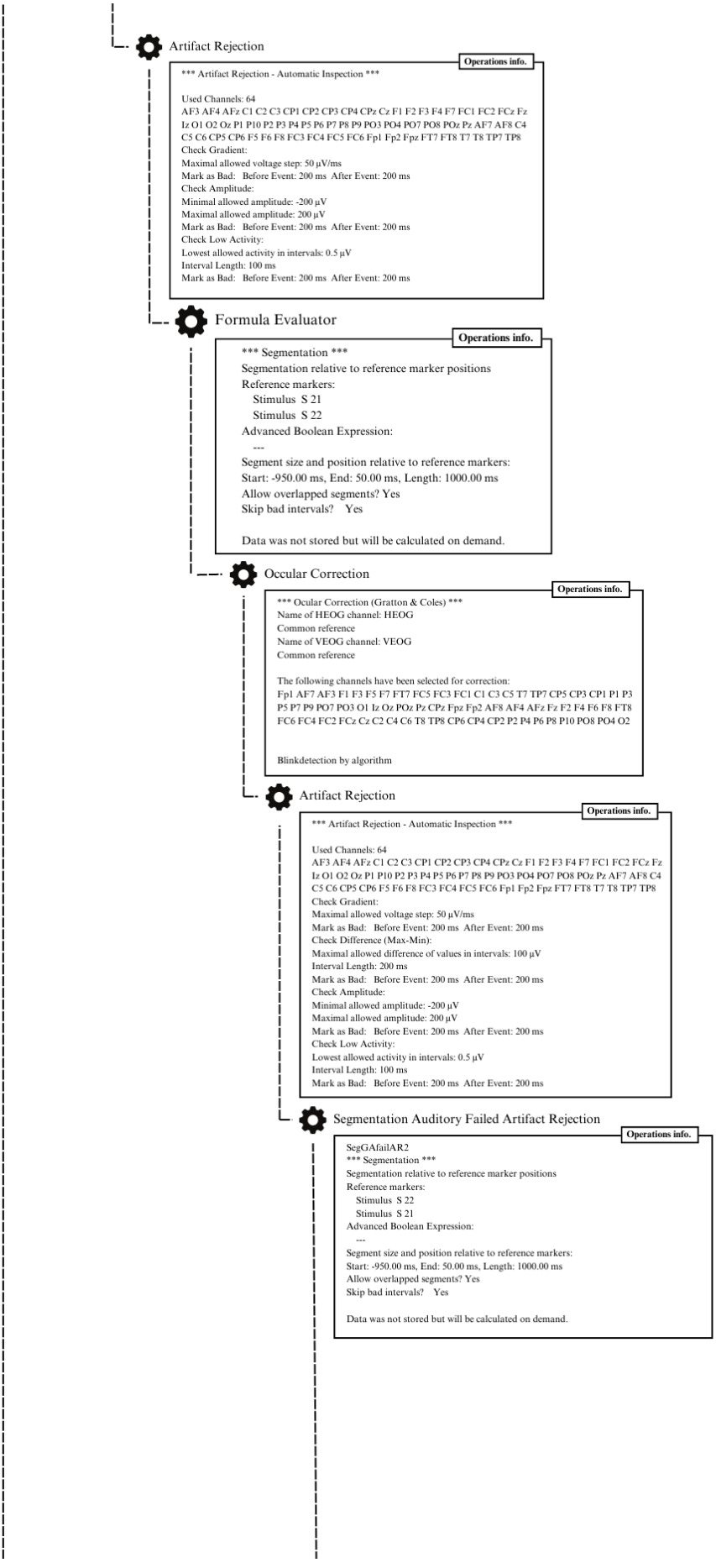
Segment size and position relative to reference markers:
Start: -950.00 ms, End: 50.00 ms, Length: 1000.00 ms
Allow overlapped segments? Yes
Skip bad intervals? Yes
Data was not stored but will be calculated on demand.
Occular Correction
Operations info.
*** Ocular Correction (Gratton & Coles) ***
Name of HEOG channel: HEOG
Common reference
Name of VEOG channel: VEOG
Common reference
The following channels have been selected for correction:
Fp1 AF7 AF3 F1 F3 F5 F7 FT7 FC5 FC3 FC1 C1 C3 C5 T7 TP7 CP5 CP3 CP1 P1 P3 P5 P7 P9 PO7 PO3 O1 Iz Oz POz Pz CPz Fpz Fp2 AF8 AF4 AFz Fz F2 F4 F6 F8 FT8 FC6 FC4 FC2 FCz Cz C2 C4 C6 T8 TP8 CP6 CP4 CP2 P2 P4 P6 P8 P10 PO8 PO4 O2
Blinkdetection by algorithm


Artifact Rejection
Operations info.
*** Artifact Rejection - Automatic Inspection ***
Used Channels: 64
AF3 AF4 AFz C1 C2 C3 CP1 CP2 CP3 CP4 CPz Cz F1 F2 F3 F4 F7 FC1 FC2 FCz Fz Iz O1 O2 Oz P1 P10 P2 P3 P4 P5 P6 P7 P8 P9 PO3 PO4 PO7 PO8 POz Pz AF7 AF8 C4 C5 C6 CP5 CP6 F5 F6 F8 FC3 FC4 FC5 FC6 Fp1 Fp2 Fpz FT7 FT8 T7 T8 TP7 TP8
Check Gradient:
Maximal allowed voltage step: 50 µV/ms
Mark as Bad: Before Event: 200 ms After Event: 200 ms
Check Difference (Max-Min):
Maximal allowed difference of values in intervals: 100 µV
Interval Length: 200 ms
Mark as Bad: Before Event: 200 ms After Event: 200 ms
Check Amplitude:
Minimal allowed amplitude: -200 µV
Maximal allowed amplitude: 200 µV
Mark as Bad: Before Event: 200 ms After Event: 200 ms
Check Low Activity:
Lowest allowed activity in intervals: 0.5 µV
Interval Length: 100 ms
Mark as Bad: Before Event: 200 ms After Event: 200 ms
Segmentation Auditory Success Artifact Rejection
Operations info.
SegGAsuccAR2
*** Segmentation ***
Segmentation relative to reference marker positions
Reference markers:
Stimulus S 22
Stimulus S 21
Advanced Boolean Expression:

Segment size and position relative to reference markers:
Start: -950.00 ms, End: 50.00 ms, Length: 1000.00 ms
Allow overlapped segments? Yes
Skip bad intervals? Yes
Data was not stored but will be calculated on demand.
Edit Channels Auditory Successful
Operations info.
*** Edit Channels ***
The following channels have been disabled:
VEOG HEOG EXG1 EXG2
EXG3 EXG4 EXG5 EXG6
EXG7 EXG8 Status
Channel Properties:
Labels: Position:
Orig. Order Orig. Label Chn (+) - Chn(-) Radius Theta Phi Data Unit Color User Properties
3 Fp1 Fp1 RefM1M2 1.0 -90.0 -72.0 µV Black
4 AF7 AF7 RefM1M2 1.0 -90.0 -54.0 µV Black
5 AF3 AF3 RefM1M2 1.0 -74.0 -68.0 µV Black
6 F1 F1 RefM1M2 1.0 -49.0 -68.0 µV Black
7 F3 F3 RefM1M2 1.0 -60.0 -51.0 µV Black
8 F5 F5 RefM1M2 1.0 -74.0 -41.0 µV Black
9 F7 F7 RefM1M2 1.0 -90.0 -36.0 µV Black
10 FT7 FT7 RefM1M2 1.0 -90.0 -18.0 µV Black
11 FC5 FC5 RefM1M2 1.0 -69.0 -21.0 µV Black
12 FC3 FC3 RefM1M2 1.0 -49.0 -29.0 µV Black
13 FC1 FC1 RefM1M2 1.0 -31.0 -46.0 µV Black
14 C1 C1 RefM1M2 1.0 -23.0 0.0 µV Black
15 C3 C3 RefM1M2 1.0 -45.0 0.0 µV Black
16 C5 C5 RefM1M2 1.0 -68.0 0.0 µV Black
17 T7 T7 RefM1M2 1.0 -90.0 0.0 µV Black
18 TP7 TP7 RefM1M2 1.0 -90.0 18.0 µV Black
19 CP5 CP5 RefM1M2 1.0 -69.0 21.0 µV Black
20 CP3 CP3 RefM1M2 1.0 -49.0 29.0 µV Black
21 CP1 CP1 RefM1M2 1.0 -31.0 46.0 µV Black
22 P1 P1 RefM1M2 1.0 -49.0 68.0 µV Black
23 P3 P3 RefM1M2 1.0 -60.0 51.0 µV Black
24 P5 P5 RefM1M2 1.0 -74.0 41.0 µV Black
25 P7 P7 RefM1M2 1.0 -90.0 36.0 µV Black
26 P9 P9 RefM1M2 1.0 -113.0 36.0 µV Black
27 PO7 PO7 RefM1M2 1.0 -90.0 54.0 µV Black
28 PO3 PO3 RefM1M2 1.0 -74.0 68.0 µV Black
29 O1 O1 RefM1M2 1.0 -90.0 72.0 µV Black
30 Iz Iz 1.0 112.0 -90.0 µV Black
31 Oz Oz RefM1M2 1.0 90.0 -90.0 µV Black
32 POz POz RefM1M2 1.0 67.0 -90.0 µV Black
33 Pz Pz RefM1M2 1.0 45.0 -90.0 µV Black
34 CPz CPz RefM1M2 1.0 22.0 -90.0 µV Black
35 Fpz Fpz RefM1M2 1.0 90.0 90.0 µV Black
36 Fp2 Fp2 RefM1M2 1.0 90.0 72.0 µV Black
37 AF8 AF8 RefM1M2 1.0 90.0 54.0 µV Black
38 AF4 AF4 RefM1M2 1.0 74.0 68.0 µV Black
39 AFz AFz RefM1M2 1.0 67.0 90.0 µV Black
40 Fz Fz RefM1M2 1.0 45.0 90.0 µV Black
41 F2 F2 RefM1M2 1.0 49.0 68.0 µV Black
42 F4 F4 RefM1M2 1.0 60.0 51.0 µV Black
43 F6 F6 RefM1M2 1.0 74.0 41.0 µV Black
44 F8 F8 RefM1M2 1.0 90.0 36.0 µV Black
45 FT8 FT8 RefM1M2 1.0 90.0 18.0 µV Black
46 FC6 FC6 RefM1M2 1.0 69.0 21.0 µV Black
47 FC4 FC4 RefM1M2 1.0 49.0 29.0 µV Black
48 FC2 FC2 RefM1M2 1.0 31.0 46.0 µV Black
49 FCz FCz RefM1M2 1.0 23.0 90.0 µV Black
50 Cz Cz RefM1M2 1.0 0.0 0.0 µV Black
51 C2 C2 RefM1M2 1.0 23.0 0.0 µV Black
52 C4 C4 RefM1M2 1.0 45.0 0.0 µV Black
53 C6 C6 RefM1M2 1.0 68.0 0.0 µV Black
54 T8 T8 RefM1M2 1.0 90.0 0.0 µV Black
55 TP8 TP8 RefM1M2 1.0 90.0 -18.0 µV Black
56 CP6 CP6 RefM1M2 1.0 69.0 -21.0 µV Black
57 CP4 CP4 RefM1M2 1.0 49.0 -29.0 µV Black
58 CP2 CP2 RefM1M2 1.0 31.0 -46.0 µV Black
59 P2 P2 RefM1M2 1.0 49.0 -68.0 µV Black
60 P4 P4 RefM1M2 1.0 60.0 -51.0 µV Black
61 P6 P6 RefM1M2 1.0 74.0 -41.0 µV Black
62 P8 P8 RefM1M2 1.0 90.0 -36.0 µV Black
63 P10 P10 RefM1M2 1.0 113.0 -36.0 µV Black
64 PO8 PO8 RefM1M2 1.0 90.0 -54.0 µV Black
65 PO4 PO4 RefM1M2 1.0 74.0 -68.0 µV Black
66 O2 O2 RefM1M2 1.0 90.0 -72.0 µV Black
Channel positions have been changed.
Channel order has been changed.

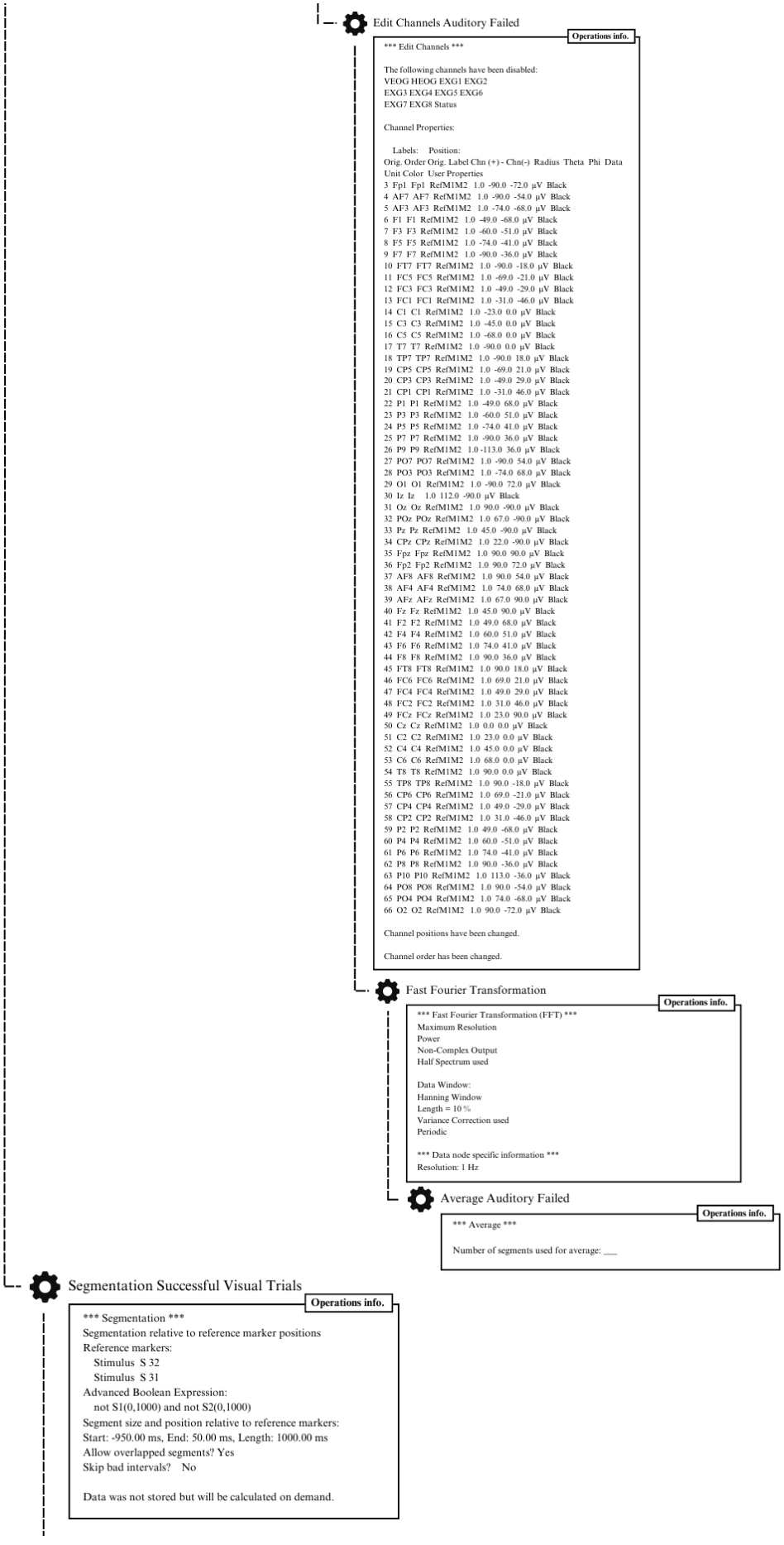

Export markers
Operations info.
*** Export Markers ***
File format: Compatibility
PC format line delimiter
The following markers have been selected for export:
Stimulus, S 21
Stimulus, S 22
*** Data node specific information ***
These markers were actually exported:
Stimulus, S 21, 31
Stimulus, S 22, 43
Import markers
Operations info.
*** Import Markers ***
*** Data node specific information ***
File read in compatibility format.
Imported a total of 148 markers.
These markers were actually imported:
Stimulus, S 22, 26
Stimulus, S 21, 26
Stimulus, S 26, 17
Stimulus, S 25, 5
New Segment, , 74
Segmentation Auditory Successful
Operations info.
*** Segmentation ***
Segmentation relative to reference marker positions
Reference markers:
Stimulus S 21
Stimulus S 22
Advanced Boolean Expression:

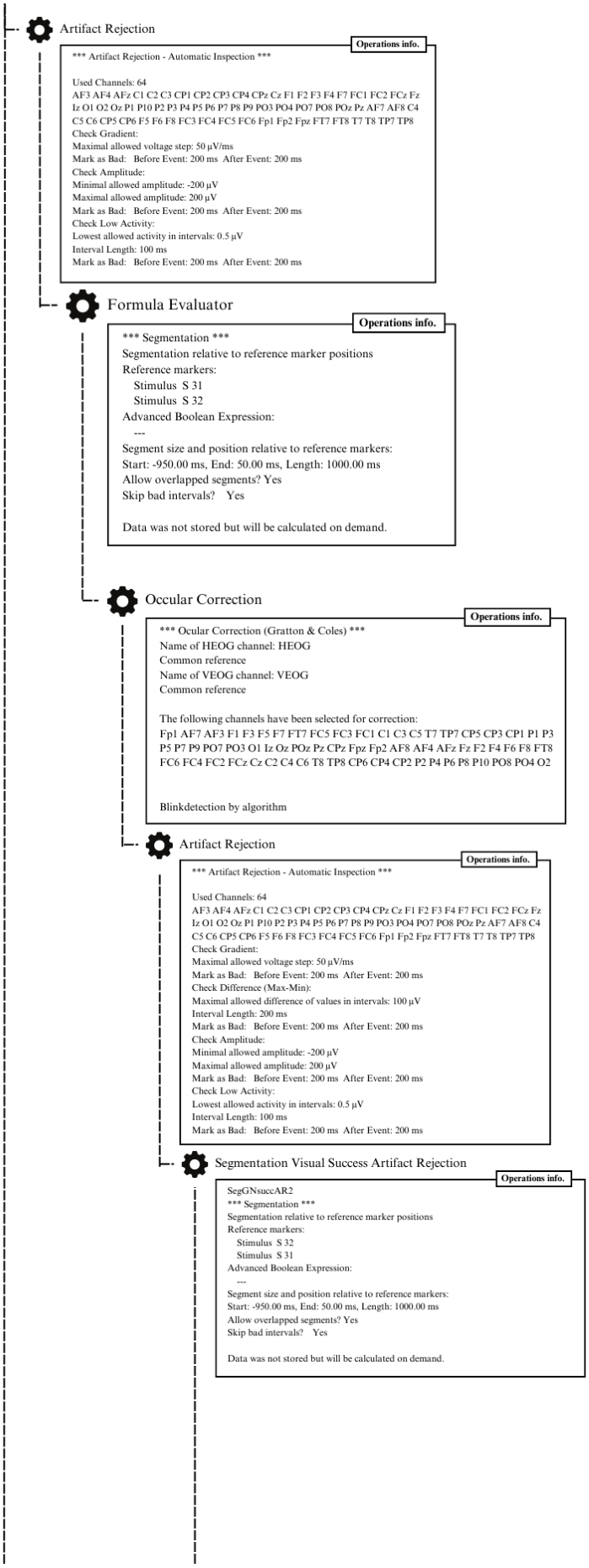
Segment size and position relative to reference markers:
Start: -950.00 ms, End: 50.00 ms, Length: 1000.00 ms
Allow overlapped segments? Yes
Skip bad intervals? No
Data was not stored but will be calculated on demand.
Fast Fourier Transformation Auditory Success
Operations info.
*** Fast Fourier Transformation (FFT) ***
Maximum Resolution
Power
Non-Complex Output
Half Spectrum used
Data Window:
Hanning Window
Length = 10 %
Variance Correction used
Periodic
*** Data node specific information ***
Resolution: 1 Hz
Average Auditory Success
Operations info.
*** Average ***
Number of segments used for average: ___
Segmentation Failed Auditory Trials
Operations info.
*** Segmentation ***
Segmentation relative to reference marker positions
Reference markers:
Stimulus S 22
Stimulus S 21
Advanced Boolean Expression:
not S1(0,1000) and not S2(0,1000)
Segment size and position relative to reference markers:
Start: -950.00 ms, End: 50.00 ms, Length: 1000.00 ms
Allow overlapped segments? Yes
Skip bad intervals? No
Data was not stored but will be calculated on demand.


Artifact Rejection
Operations info.
*** Artifact Rejection - Automatic Inspection ***
Used Channels: 64
AF3 AF4 AFz C1 C2 C3 CP1 CP2 CP3 CP4 CPz Cz F1 F2 F3 F4 F7 FC1 FC2 FCz Fz Iz O1 O2 Oz P1 P10 P2 P3 P4 P5 P6 P7 P8 P9 PO3 PO4 PO7 PO8 POz Pz AF7 AF8 C4 C5 C6 CP5 CP6 F5 F6 F8 FC3 FC4 FC5 FC6 Fp1 Fp2 Fpz FT7 FT8 T7 T8 TP7 TP8
Check Gradient:
Maximal allowed voltage step: 50 µV/ms
Mark as Bad: Before Event: 200 ms After Event: 200 ms
Check Amplitude:
Minimal allowed amplitude: -200 µV
Maximal allowed amplitude: 200 µV
Mark as Bad: Before Event: 200 ms After Event: 200 ms
Check Low Activity:
Lowest allowed activity in intervals: 0.5 µV
Interval Length: 100 ms
Mark as Bad: Before Event: 200 ms After Event: 200 ms
Formula Evaluator
Operations info.
*** Segmentation ***
Segmentation relative to reference marker positions
Reference markers:
Stimulus S 21
Stimulus S 22
Advanced Boolean Expression:

Segment size and position relative to reference markers:
Start: -950.00 ms, End: 50.00 ms, Length: 1000.00 ms
Allow overlapped segments? Yes
Skip bad intervals? Yes
Data was not stored but will be calculated on demand.
Occular Correction
Operations info.
*** Ocular Correction (Gratton & Coles) ***
Name of HEOG channel: HEOG
Common reference
Name of VEOG channel: VEOG
Common reference
The following channels have been selected for correction:
Fp1 AF7 AF3 F1 F3 F5 F7 FT7 FC5 FC3 FC1 C1 C3 C5 T7 TP7 CP5 CP3 CP1 P1 P3 P5 P7 P9 PO7 PO3 O1 Iz Oz POz Pz CPz Fpz Fp2 AF8 AF4 AFz Fz F2 F4 F6 F8 FT8 FC6 FC4 FC2 FCz Cz C2 C4 C6 T8 TP8 CP6 CP4 CP2 P2 P4 P6 P8 P10 PO8 PO4 O2
Blinkdetection by algorithm
Artifact Rejection
Operations info.
*** Artifact Rejection - Automatic Inspection ***
Used Channels: 64
AF3 AF4 AFz C1 C2 C3 CP1 CP2 CP3 CP4 CPz Cz F1 F2 F3 F4 F7 FC1 FC2 FCz Fz Iz O1 O2 Oz P1 P10 P2 P3 P4 P5 P6 P7 P8 P9 PO3 PO4 PO7 PO8 POz Pz AF7 AF8 C4 C5 C6 CP5 CP6 F5 F6 F8 FC3 FC4 FC5 FC6 Fp1 Fp2 Fpz FT7 FT8 T7 T8 TP7 TP8
Check Gradient:
Maximal allowed voltage step: 50 µV/ms
Mark as Bad: Before Event: 200 ms After Event: 200 ms
Check Difference (Max-Min):
Maximal allowed difference of values in intervals: 100 µV
Interval Length: 200 ms
Mark as Bad: Before Event: 200 ms After Event: 200 ms
Check Amplitude:
Minimal allowed amplitude: -200 µV
Maximal allowed amplitude: 200 µV
Mark as Bad: Before Event: 200 ms After Event: 200 ms
Check Low Activity:
Lowest allowed activity in intervals: 0.5 µV
Interval Length: 100 ms
Mark as Bad: Before Event: 200 ms After Event: 200 ms
Segmentation Auditory Failed Artifact Rejection
Operations info.
SegGAfailAR2
*** Segmentation ***
Segmentation relative to reference marker positions
Reference markers:
Stimulus S 22
Stimulus S 21
Advanced Boolean Expression:

Segment size and position relative to reference markers:
Start: -950.00 ms, End: 50.00 ms, Length: 1000.00 ms
Allow overlapped segments? Yes
Skip bad intervals? Yes
Data was not stored but will be calculated on demand.


Edit Channels Auditory Failed
Operations info.
*** Edit Channels ***
The following channels have been disabled:
VEOG HEOG EXG1 EXG2
EXG3 EXG4 EXG5 EXG6
EXG7 EXG8 Status
Channel Properties:
Labels: Position:
Orig. Order Orig. Label Chn (+) - Chn(-) Radius Theta Phi Data Unit Color User Properties
3 Fp1 Fp1 RefM1M2 1.0 -90.0 -72.0 µV Black
4 AF7 AF7 RefM1M2 1.0 -90.0 -54.0 µV Black
5 AF3 AF3 RefM1M2 1.0 -74.0 -68.0 µV Black
6 F1 F1 RefM1M2 1.0 -49.0 -68.0 µV Black
7 F3 F3 RefM1M2 1.0 -60.0 -51.0 µV Black
8 F5 F5 RefM1M2 1.0 -74.0 -41.0 µV Black
9 F7 F7 RefM1M2 1.0 -90.0 -36.0 µV Black
10 FT7 FT7 RefM1M2 1.0 -90.0 -18.0 µV Black
11 FC5 FC5 RefM1M2 1.0 -69.0 -21.0 µV Black
12 FC3 FC3 RefM1M2 1.0 -49.0 -29.0 µV Black
13 FC1 FC1 RefM1M2 1.0 -31.0 -46.0 µV Black
14 C1 C1 RefM1M2 1.0 -23.0 0.0 µV Black
15 C3 C3 RefM1M2 1.0 -45.0 0.0 µV Black
16 C5 C5 RefM1M2 1.0 -68.0 0.0 µV Black
17 T7 T7 RefM1M2 1.0 -90.0 0.0 µV Black
18 TP7 TP7 RefM1M2 1.0 -90.0 18.0 µV Black
19 CP5 CP5 RefM1M2 1.0 -69.0 21.0 µV Black
20 CP3 CP3 RefM1M2 1.0 -49.0 29.0 µV Black
21 CP1 CP1 RefM1M2 1.0 -31.0 46.0 µV Black
22 P1 P1 RefM1M2 1.0 -49.0 68.0 µV Black
23 P3 P3 RefM1M2 1.0 -60.0 51.0 µV Black
24 P5 P5 RefM1M2 1.0 -74.0 41.0 µV Black
25 P7 P7 RefM1M2 1.0 -90.0 36.0 µV Black
26 P9 P9 RefM1M2 1.0 -113.0 36.0 µV Black
27 PO7 PO7 RefM1M2 1.0 -90.0 54.0 µV Black
28 PO3 PO3 RefM1M2 1.0 -74.0 68.0 µV Black
29 O1 O1 RefM1M2 1.0 -90.0 72.0 µV Black
30 Iz Iz 1.0 112.0 -90.0 µV Black
31 Oz Oz RefM1M2 1.0 90.0 -90.0 µV Black
32 POz POz RefM1M2 1.0 67.0 -90.0 µV Black
33 Pz Pz RefM1M2 1.0 45.0 -90.0 µV Black
34 CPz CPz RefM1M2 1.0 22.0 -90.0 µV Black
35 Fpz Fpz RefM1M2 1.0 90.0 90.0 µV Black
36 Fp2 Fp2 RefM1M2 1.0 90.0 72.0 µV Black
37 AF8 AF8 RefM1M2 1.0 90.0 54.0 µV Black
38 AF4 AF4 RefM1M2 1.0 74.0 68.0 µV Black
39 AFz AFz RefM1M2 1.0 67.0 90.0 µV Black
40 Fz Fz RefM1M2 1.0 45.0 90.0 µV Black
41 F2 F2 RefM1M2 1.0 49.0 68.0 µV Black
42 F4 F4 RefM1M2 1.0 60.0 51.0 µV Black
43 F6 F6 RefM1M2 1.0 74.0 41.0 µV Black
44 F8 F8 RefM1M2 1.0 90.0 36.0 µV Black
45 FT8 FT8 RefM1M2 1.0 90.0 18.0 µV Black
46 FC6 FC6 RefM1M2 1.0 69.0 21.0 µV Black
47 FC4 FC4 RefM1M2 1.0 49.0 29.0 µV Black
48 FC2 FC2 RefM1M2 1.0 31.0 46.0 µV Black
49 FCz FCz RefM1M2 1.0 23.0 90.0 µV Black
50 Cz Cz RefM1M2 1.0 0.0 0.0 µV Black
51 C2 C2 RefM1M2 1.0 23.0 0.0 µV Black
52 C4 C4 RefM1M2 1.0 45.0 0.0 µV Black
53 C6 C6 RefM1M2 1.0 68.0 0.0 µV Black
54 T8 T8 RefM1M2 1.0 90.0 0.0 µV Black
55 TP8 TP8 RefM1M2 1.0 90.0 -18.0 µV Black
56 CP6 CP6 RefM1M2 1.0 69.0 -21.0 µV Black
57 CP4 CP4 RefM1M2 1.0 49.0 -29.0 µV Black
58 CP2 CP2 RefM1M2 1.0 31.0 -46.0 µV Black
59 P2 P2 RefM1M2 1.0 49.0 -68.0 µV Black
60 P4 P4 RefM1M2 1.0 60.0 -51.0 µV Black
61 P6 P6 RefM1M2 1.0 74.0 -41.0 µV Black
62 P8 P8 RefM1M2 1.0 90.0 -36.0 µV Black
63 P10 P10 RefM1M2 1.0 113.0 -36.0 µV Black
64 PO8 PO8 RefM1M2 1.0 90.0 -54.0 µV Black
65 PO4 PO4 RefM1M2 1.0 74.0 -68.0 µV Black
66 O2 O2 RefM1M2 1.0 90.0 -72.0 µV Black
Channel positions have been changed.
Channel order has been changed.
Fast Fourier Transformation
Operations info.
*** Fast Fourier Transformation (FFT) ***
Maximum Resolution
Power
Non-Complex Output
Half Spectrum used
Data Window:
Hanning Window
Length = 10 %
Variance Correction used
Periodic
*** Data node specific information ***
Resolution: 1 Hz
Average Auditory Failed
Operations info.
*** Average ***
Number of segments used for average: ___
Segmentation Successful Visual Trials
Operations info.
*** Segmentation ***
Segmentation relative to reference marker positions
Reference markers:
Stimulus S 32
Stimulus S 31
Advanced Boolean Expression:
not S1(0,1000) and not S2(0,1000)
Segment size and position relative to reference markers:
Start: -950.00 ms, End: 50.00 ms, Length: 1000.00 ms
Allow overlapped segments? Yes
Skip bad intervals? No
Data was not stored but will be calculated on demand.


Artifact Rejection
Operations info.
*** Artifact Rejection - Automatic Inspection ***
Used Channels: 64
AF3 AF4 AFz C1 C2 C3 CP1 CP2 CP3 CP4 CPz Cz F1 F2 F3 F4 F7 FC1 FC2 FCz Fz Iz O1 O2 Oz P1 P10 P2 P3 P4 P5 P6 P7 P8 P9 PO3 PO4 PO7 PO8 POz Pz AF7 AF8 C4 C5 C6 CP5 CP6 F5 F6 F8 FC3 FC4 FC5 FC6 Fp1 Fp2 Fpz FT7 FT8 T7 T8 TP7 TP8
Check Gradient:
Maximal allowed voltage step: 50 µV/ms
Mark as Bad: Before Event: 200 ms After Event: 200 ms
Check Amplitude:
Minimal allowed amplitude: -200 µV
Maximal allowed amplitude: 200 µV
Mark as Bad: Before Event: 200 ms After Event: 200 ms
Check Low Activity:
Lowest allowed activity in intervals: 0.5 µV
Interval Length: 100 ms
Mark as Bad: Before Event: 200 ms After Event: 200 ms
Formula Evaluator
Operations info.
*** Segmentation ***
Segmentation relative to reference marker positions
Reference markers:
Stimulus S 31
Stimulus S 32
Advanced Boolean Expression:

Segment size and position relative to reference markers:
Start: -950.00 ms, End: 50.00 ms, Length: 1000.00 ms
Allow overlapped segments? Yes
Skip bad intervals? Yes
Data was not stored but will be calculated on demand.
Occular Correction
Operations info.
*** Ocular Correction (Gratton & Coles) ***
Name of HEOG channel: HEOG
Common reference
Name of VEOG channel: VEOG
Common reference
The following channels have been selected for correction:
Fp1 AF7 AF3 F1 F3 F5 F7 FT7 FC5 FC3 FC1 C1 C3 C5 T7 TP7 CP5 CP3 CP1 P1 P3 P5 P7 P9 PO7 PO3 O1 Iz Oz POz Pz CPz Fpz Fp2 AF8 AF4 AFz Fz F2 F4 F6 F8 FT8 FC6 FC4 FC2 FCz Cz C2 C4 C6 T8 TP8 CP6 CP4 CP2 P2 P4 P6 P8 P10 PO8 PO4 O2
Blinkdetection by algorithm
Artifact Rejection
Operations info.
*** Artifact Rejection - Automatic Inspection ***
Used Channels: 64
AF3 AF4 AFz C1 C2 C3 CP1 CP2 CP3 CP4 CPz Cz F1 F2 F3 F4 F7 FC1 FC2 FCz Fz Iz O1 O2 Oz P1 P10 P2 P3 P4 P5 P6 P7 P8 P9 PO3 PO4 PO7 PO8 POz Pz AF7 AF8 C4 C5 C6 CP5 CP6 F5 F6 F8 FC3 FC4 FC5 FC6 Fp1 Fp2 Fpz FT7 FT8 T7 T8 TP7 TP8
Check Gradient:
Maximal allowed voltage step: 50 µV/ms
Mark as Bad: Before Event: 200 ms After Event: 200 ms
Check Difference (Max-Min):
Maximal allowed difference of values in intervals: 100 µV
Interval Length: 200 ms
Mark as Bad: Before Event: 200 ms After Event: 200 ms
Check Amplitude:
Minimal allowed amplitude: -200 µV
Maximal allowed amplitude: 200 µV
Mark as Bad: Before Event: 200 ms After Event: 200 ms
Check Low Activity:
Lowest allowed activity in intervals: 0.5 µV
Interval Length: 100 ms
Mark as Bad: Before Event: 200 ms After Event: 200 ms
Segmentation Visual Success Artifact Rejection
Operations info.
SegGNsuccAR2
*** Segmentation ***
Segmentation relative to reference marker positions
Reference markers:
Stimulus S 32
Stimulus S 31
Advanced Boolean Expression:

Segment size and position relative to reference markers:
Start: -950.00 ms, End: 50.00 ms, Length: 1000.00 ms
Allow overlapped segments? Yes
Skip bad intervals? Yes
Data was not stored but will be calculated on demand.

Edit Channels Visual Success

Operations info.

*** Edit Channels ***

The following channels have been disabled:
VEOG HEOG EXG1 EXG2
EXG3 EXG4 EXG5 EXG6
EXG7 EXG8 Status

Channel Properties:

Labels: Position:
Orig. Order Orig. Label Chn (+) - Chn(-) Radius Theta Phi Data Unit Color User Properties
3 Fp1 Fp1 RefM1M2 1.0 -90.0 -72.0 µV Black
4 AF7 AF7 RefM1M2 1.0 -90.0 -54.0 µV Black
5 AF3 AF3 RefM1M2 1.0 -74.0 -68.0 µV Black
6 F1 F1 RefM1M2 1.0 -49.0 -68.0 µV Black
7 F3 F3 RefM1M2 1.0 -60.0 -51.0 µV Black
8 F5 F5 RefM1M2 1.0 -74.0 -41.0 µV Black
9 F7 F7 RefM1M2 1.0 -90.0 -36.0 µV Black
10 FT7 FT7 RefM1M2 1.0 -90.0 -18.0 µV Black
11 FC5 FC5 RefM1M2 1.0 -69.0 -21.0 µV Black
12 FC3 FC3 RefM1M2 1.0 -49.0 -29.0 µV Black
13 FC1 FC1 RefM1M2 1.0 -31.0 -46.0 µV Black
14 C1 C1 RefM1M2 1.0 -23.0 0.0 µV Black
15 C3 C3 RefM1M2 1.0 -45.0 0.0 µV Black
16 C5 C5 RefM1M2 1.0 -68.0 0.0 µV Black
17 T7 T7 RefM1M2 1.0 -90.0 0.0 µV Black
18 TP7 TP7 RefM1M2 1.0 -90.0 18.0 µV Black
19 CP5 CP5 RefM1M2 1.0 -69.0 21.0 µV Black
20 CP3 CP3 RefM1M2 1.0 -49.0 29.0 µV Black
21 CP1 CP1 RefM1M2 1.0 -31.0 46.0 µV Black
22 P1 P1 RefM1M2 1.0 -49.0 68.0 µV Black
23 P3 P3 RefM1M2 1.0 -60.0 51.0 µV Black
24 P5 P5 RefM1M2 1.0 -74.0 41.0 µV Black
25 P7 P7 RefM1M2 1.0 -90.0 36.0 µV Black
26 P9 P9 RefM1M2 1.0 -113.0 36.0 µV Black
27 PO7 PO7 RefM1M2 1.0 -90.0 54.0 µV Black
28 PO3 PO3 RefM1M2 1.0 -74.0 68.0 µV Black
29 O1 O1 RefM1M2 1.0 -90.0 72.0 µV Black
30 Iz Iz 1.0 112.0 -90.0 µV Black
31 Oz Oz RefM1M2 1.0 90.0 -90.0 µV Black
32 POz POz RefM1M2 1.0 67.0 -90.0 µV Black
33 Pz Pz RefM1M2 1.0 45.0 -90.0 µV Black
34 CPz CPz RefM1M2 1.0 22.0 -90.0 µV Black
35 Fpz Fpz RefM1M2 1.0 90.0 90.0 µV Black
36 Fp2 Fp2 RefM1M2 1.0 90.0 72.0 µV Black
37 AF8 AF8 RefM1M2 1.0 90.0 54.0 µV Black
38 AF4 AF4 RefM1M2 1.0 74.0 68.0 µV Black
39 AFz AFz RefM1M2 1.0 67.0 90.0 µV Black
40 Fz Fz RefM1M2 1.0 45.0 90.0 µV Black
41 F2 F2 RefM1M2 1.0 49.0 68.0 µV Black
42 F4 F4 RefM1M2 1.0 60.0 51.0 µV Black
43 F6 F6 RefM1M2 1.0 74.0 41.0 µV Black
44 F8 F8 RefM1M2 1.0 90.0 36.0 µV Black
45 FT8 FT8 RefM1M2 1.0 90.0 18.0 µV Black
46 FC6 FC6 RefM1M2 1.0 69.0 21.0 µV Black
47 FC4 FC4 RefM1M2 1.0 49.0 29.0 µV Black
48 FC2 FC2 RefM1M2 1.0 31.0 46.0 µV Black
49 FCz FCz RefM1M2 1.0 23.0 90.0 µV Black
50 Cz Cz RefM1M2 1.0 0.0 0.0 µV Black
51 C2 C2 RefM1M2 1.0 23.0 0.0 µV Black
52 C4 C4 RefM1M2 1.0 45.0 0.0 µV Black
53 C6 C6 RefM1M2 1.0 68.0 0.0 µV Black
54 T8 T8 RefM1M2 1.0 90.0 0.0 µV Black
55 TP8 TP8 RefM1M2 1.0 90.0 -18.0 µV Black
56 CP6 CP6 RefM1M2 1.0 69.0 -21.0 µV Black
57 CP4 CP4 RefM1M2 1.0 49.0 -29.0 µV Black
58 CP2 CP2 RefM1M2 1.0 31.0 -46.0 µV Black
59 P2 P2 RefM1M2 1.0 49.0 -68.0 µV Black
60 P4 P4 RefM1M2 1.0 60.0 -51.0 µV Black
61 P6 P6 RefM1M2 1.0 74.0 -41.0 µV Black
62 P8 P8 RefM1M2 1.0 90.0 -36.0 µV Black
63 P10 P10 RefM1M2 1.0 113.0 -36.0 µV Black
64 PO8 PO8 RefM1M2 1.0 90.0 -54.0 µV Black
65 PO4 PO4 RefM1M2 1.0 74.0 -68.0 µV Black
66 O2 O2 RefM1M2 1.0 90.0 -72.0 µV Black

Channel positions have been changed.

Channel order has been changed.

Export markers

Operations info.

*** Export Markers ***
File format: Compatibility
PC format line delimiter
The following markers have been selected for export:
Stimulus, S 31
Stimulus, S 32

*** Data node specific information ***

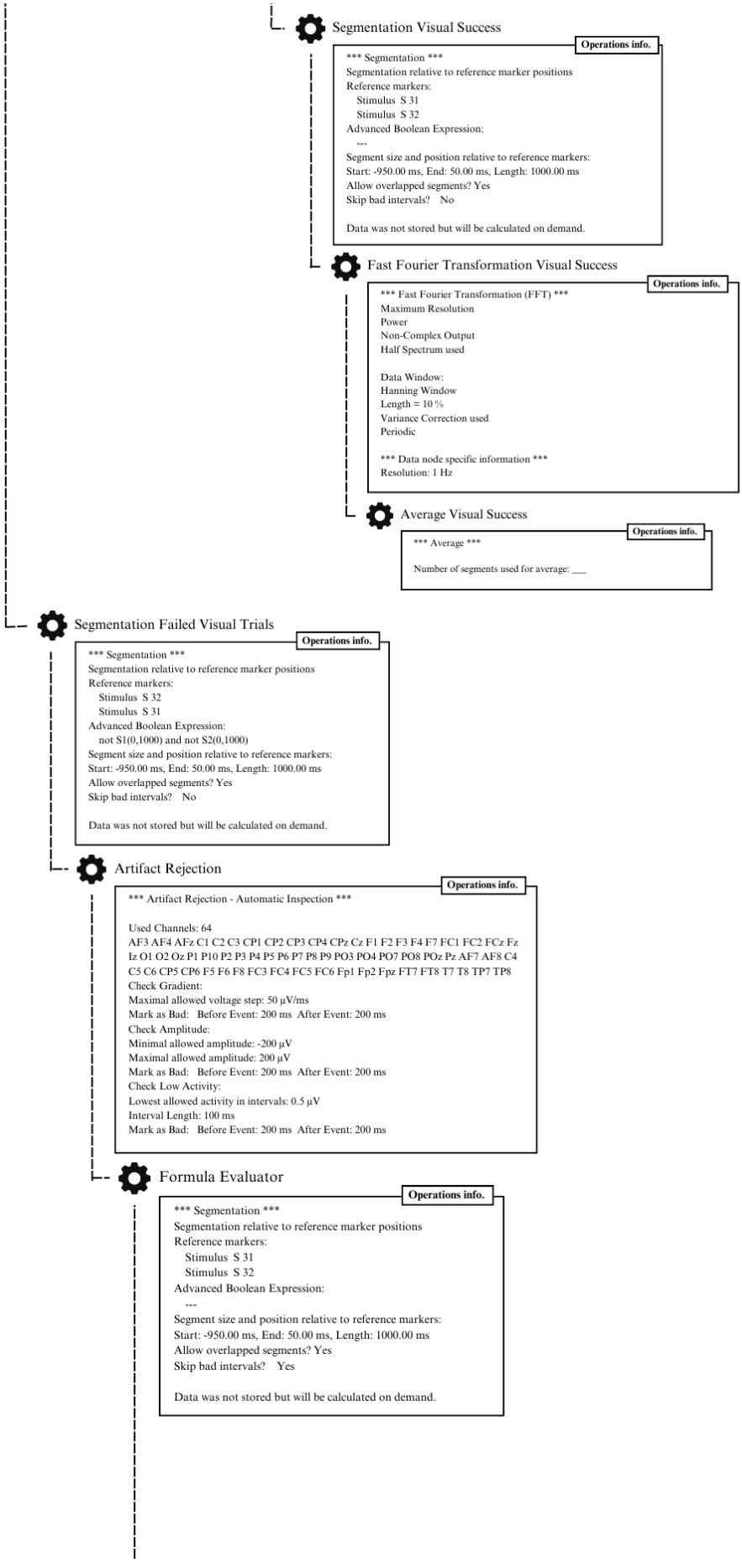
These markers were actually exported:
Stimulus, S 31, 31
Stimulus, S 32, 43

Import markers

Operations info.

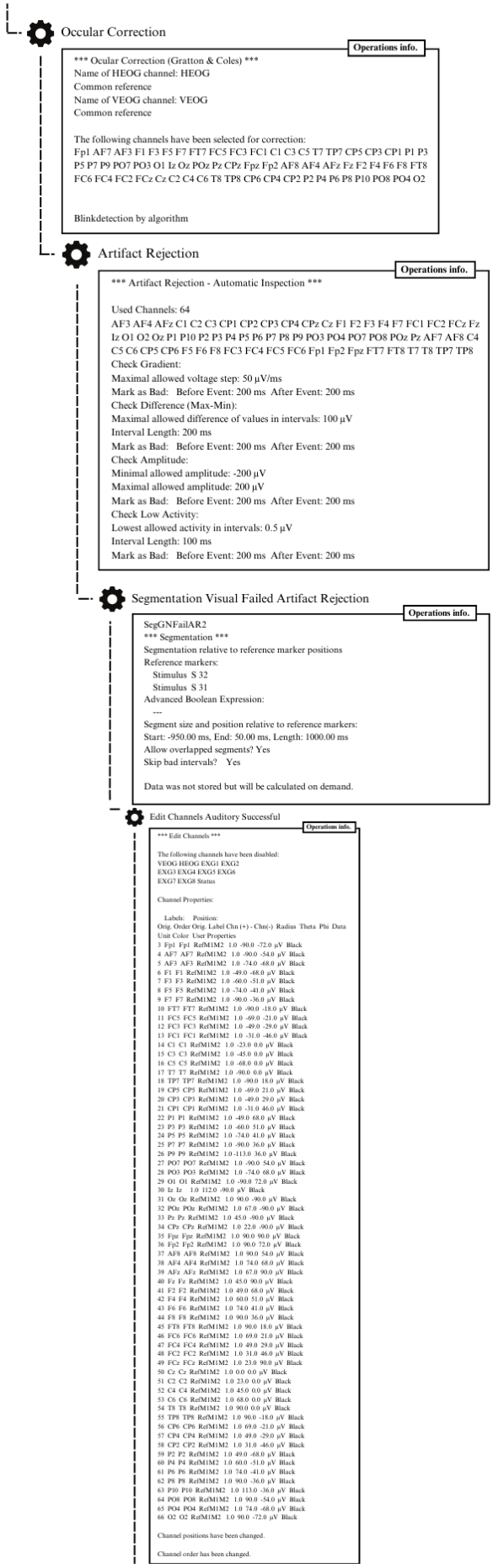
*** Import Markers ***
*** Data node specific information ***

File read in compatibility format.
Imported a total of 148 markers.
These markers were actually imported:
Stimulus, S 32, 26
Stimulus, S 31, 26
Stimulus, S 36, 17
Stimulus, S 35, 5
New Segment, , 74

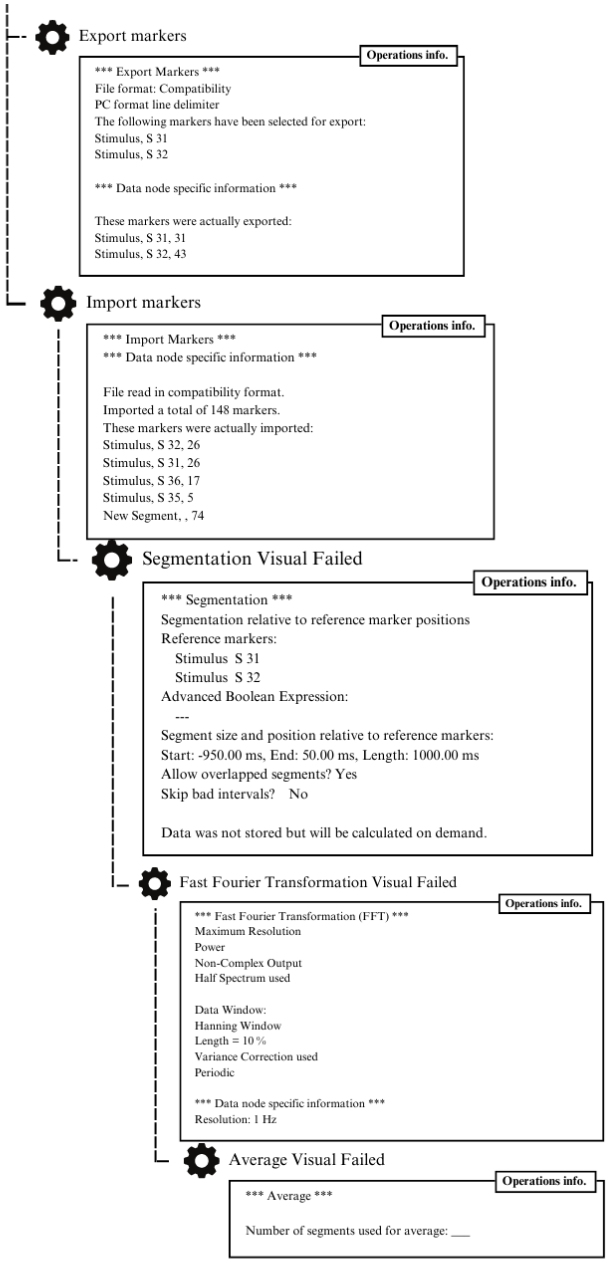

Segmentation Visual Success
Operations info.
*** Segmentation ***
Segmentation relative to reference marker positions
Reference markers:
Stimulus S 31
Stimulus S 32
Advanced Boolean Expression:

Segment size and position relative to reference markers:
Start: -950.00 ms, End: 50.00 ms, Length: 1000.00 ms
Allow overlapped segments? Yes
Skip bad intervals? No
Data was not stored but will be calculated on demand.
Fast Fourier Transformation Visual Success
Operations info.
*** Fast Fourier Transformation (FFT) ***
Maximum Resolution
Power
Non-Complex Output
Half Spectrum used
Data Window:
Hanning Window
Length = 10 %
Variance Correction used
Periodic
*** Data node specific information ***
Resolution: 1 Hz
Average Visual Success
Operations info.
*** Average ***
Number of segments used for average: ___
Segmentation Failed Visual Trials
Operations info.
*** Segmentation ***
Segmentation relative to reference marker positions
Reference markers:
Stimulus S 32
Stimulus S 31
Advanced Boolean Expression:
not S1(0,1000) and not S2(0,1000)
Segment size and position relative to reference markers:
Start: -950.00 ms, End: 50.00 ms, Length: 1000.00 ms
Allow overlapped segments? Yes
Skip bad intervals? No
Data was not stored but will be calculated on demand.
Artifact Rejection
Operations info.
*** Artifact Rejection - Automatic Inspection ***
Used Channels: 64
AF3 AF4 AFz C1 C2 C3 CP1 CP2 CP3 CP4 CPz Cz F1 F2 F3 F4 F7 FC1 FC2 FCz Fz
Iz O1 O2 Oz P1 P10 P2 P3 P4 P5 P6 P7 P8 P9 PO3 PO4 PO7 PO8 POz Pz AF7 AF8 C4
C5 C6 CP5 CP6 F5 F6 F8 FC3 FC4 FC5 FC6 Fp1 Fp2 Fpz FT7 FT8 T7 T8 TP7 TP8
Check Gradient:
Maximal allowed voltage step: 50 µV/ms
Mark as Bad: Before Event: 200 ms After Event: 200 ms
Check Amplitude:
Minimal allowed amplitude: -200 µV
Maximal allowed amplitude: 200 µV
Mark as Bad: Before Event: 200 ms After Event: 200 ms
Check Low Activity:
Lowest allowed activity in intervals: 0.5 µV
Interval Length: 100 ms
Mark as Bad: Before Event: 200 ms After Event: 200 ms
Formula Evaluator
Operations info.
*** Segmentation ***
Segmentation relative to reference marker positions
Reference markers:
Stimulus S 31
Stimulus S 32
Advanced Boolean Expression:

Segment size and position relative to reference markers:
Start: -950.00 ms, End: 50.00 ms, Length: 1000.00 ms
Allow overlapped segments? Yes
Skip bad intervals? Yes
Data was not stored but will be calculated on demand.


Occular Correction
Operations info.
*** Ocular Correction (Gratton & Coles) ***
Name of HEOG channel: HEOG
Common reference
Name of VEOG channel: VEOG
Common reference
The following channels have been selected for correction:
Fp1 AF7 AF3 F1 F3 F5 F7 FT7 FC5 FC3 FC1 C1 C3 C5 T7 TP7 CP5 CP3 CP1 P1 P3 P5 P7 P9 PO7 PO3 O1 Iz Oz POz Pz CPz Fpz Fp2 AF8 AF4 AFz Fz F2 F4 F6 F8 FT8 FC6 FC4 FC2 FCz Cz C2 C4 C6 T8 TP8 CP6 CP4 CP2 P2 P4 P6 P8 P10 PO8 PO4 O2
Blinkdetection by algorithm
Artifact Rejection
Operations info.
*** Artifact Rejection - Automatic Inspection ***
Used Channels: 64
AF3 AF4 AFz C1 C2 C3 CP1 CP2 CP3 CP4 CPz Cz F1 F2 F3 F4 F7 FC1 FC2 FCz Fz Iz O1 O2 Oz P1 P10 P2 P3 P4 P5 P6 P7 P8 P9 PO3 PO4 PO7 PO8 POz Pz AF7 AF8 C4 C5 C6 CP5 CP6 F5 F6 F8 FC3 FC4 FC5 FC6 Fp1 Fp2 Fpz FT7 FT8 T7 T8 TP7 TP8
Check Gradient:
Maximal allowed voltage step: 50 µV/ms
Mark as Bad: Before Event: 200 ms After Event: 200 ms
Check Difference (Max-Min):
Maximal allowed difference of values in intervals: 100 µV
Interval Length: 200 ms
Mark as Bad: Before Event: 200 ms After Event: 200 ms
Check Amplitude:
Minimal allowed amplitude: -200 µV
Maximal allowed amplitude: 200 µV
Mark as Bad: Before Event: 200 ms After Event: 200 ms
Check Low Activity:
Lowest allowed activity in intervals: 0.5 µV
Interval Length: 100 ms
Mark as Bad: Before Event: 200 ms After Event: 200 ms
Segmentation Visual Failed Artifact Rejection
Operations info.
SegGNFailAR2
*** Segmentation ***
Segmentation relative to reference marker positions
Reference markers:
Stimulus S 32
Stimulus S 31
Advanced Boolean Expression:

Segment size and position relative to reference markers:
Start: -950.00 ms, End: 50.00 ms, Length: 1000.00 ms
Allow overlapped segments? Yes
Skip bad intervals? Yes
Data was not stored but will be calculated on demand.
Edit Channels Auditory Successful
Operations info.
*** Edit Channels ***
The following channels have been disabled:
VEOG HEOG EXG1 EXG2
EXG3 EXG4 EXG5 EXG6
EXG7 EXG8 Status
Channel Properties:
Labels: Position:
Orig. Order Orig. Label Chn (+) - Chn(-) Radius Theta Phi Data Unit Color User Properties
3 Fp1 Fp1 RefM1M2 1.0 -90.0 -72.0 µV Black
4 AF7 AF7 RefM1M2 1.0 -90.0 -54.0 µV Black
5 AF3 AF3 RefM1M2 1.0 -74.0 -68.0 µV Black
6 F1 F1 RefM1M2 1.0 -49.0 -68.0 µV Black
7 F3 F3 RefM1M2 1.0 -60.0 -51.0 µV Black
8 F5 F5 RefM1M2 1.0 -74.0 -41.0 µV Black
9 F7 F7 RefM1M2 1.0 -90.0 -36.0 µV Black
10 FT7 FT7 RefM1M2 1.0 -90.0 -18.0 µV Black
11 FC5 FC5 RefM1M2 1.0 -69.0 -21.0 µV Black
12 FC3 FC3 RefM1M2 1.0 -49.0 -29.0 µV Black
13 FC1 FC1 RefM1M2 1.0 -31.0 -46.0 µV Black
14 C1 C1 RefM1M2 1.0 -23.0 0.0 µV Black
15 C3 C3 RefM1M2 1.0 -45.0 0.0 µV Black
16 C5 C5 RefM1M2 1.0 -68.0 0.0 µV Black
17 T7 T7 RefM1M2 1.0 -90.0 0.0 µV Black
18 TP7 TP7 RefM1M2 1.0 -90.0 18.0 µV Black
19 CP5 CP5 RefM1M2 1.0 -69.0 21.0 µV Black
20 CP3 CP3 RefM1M2 1.0 -49.0 29.0 µV Black
21 CP1 CP1 RefM1M2 1.0 -31.0 46.0 µV Black
22 P1 P1 RefM1M2 1.0 -49.0 68.0 µV Black
23 P3 P3 RefM1M2 1.0 -60.0 51.0 µV Black
24 P5 P5 RefM1M2 1.0 -74.0 41.0 µV Black
25 P7 P7 RefM1M2 1.0 -90.0 36.0 µV Black
26 P9 P9 RefM1M2 1.0 -113.0 36.0 µV Black
27 PO7 PO7 RefM1M2 1.0 -90.0 54.0 µV Black
28 PO3 PO3 RefM1M2 1.0 -74.0 68.0 µV Black
29 O1 O1 RefM1M2 1.0 -90.0 72.0 µV Black
30 Iz Iz 1.0 112.0 -90.0 µV Black
31 Oz Oz RefM1M2 1.0 90.0 -90.0 µV Black
32 POz POz RefM1M2 1.0 67.0 -90.0 µV Black
33 Pz Pz RefM1M2 1.0 45.0 -90.0 µV Black
34 CPz CPz RefM1M2 1.0 22.0 -90.0 µV Black
35 Fpz Fpz RefM1M2 1.0 90.0 90.0 µV Black
36 Fp2 Fp2 RefM1M2 1.0 90.0 72.0 µV Black
37 AF8 AF8 RefM1M2 1.0 90.0 54.0 µV Black
38 AF4 AF4 RefM1M2 1.0 74.0 68.0 µV Black
39 AFz AFz RefM1M2 1.0 67.0 90.0 µV Black
40 Fz Fz RefM1M2 1.0 45.0 90.0 µV Black
41 F2 F2 RefM1M2 1.0 49.0 68.0 µV Black
42 F4 F4 RefM1M2 1.0 60.0 51.0 µV Black
43 F6 F6 RefM1M2 1.0 74.0 41.0 µV Black
44 F8 F8 RefM1M2 1.0 90.0 36.0 µV Black
45 FT8 FT8 RefM1M2 1.0 90.0 18.0 µV Black
46 FC6 FC6 RefM1M2 1.0 69.0 21.0 µV Black
47 FC4 FC4 RefM1M2 1.0 49.0 29.0 µV Black
48 FC2 FC2 RefM1M2 1.0 31.0 46.0 µV Black
49 FCz FCz RefM1M2 1.0 23.0 90.0 µV Black
50 Cz Cz RefM1M2 1.0 0.0 0.0 µV Black
51 C2 C2 RefM1M2 1.0 23.0 0.0 µV Black
52 C4 C4 RefM1M2 1.0 45.0 0.0 µV Black
53 C6 C6 RefM1M2 1.0 68.0 0.0 µV Black
54 T8 T8 RefM1M2 1.0 90.0 0.0 µV Black
55 TP8 TP8 RefM1M2 1.0 90.0 -18.0 µV Black
56 CP6 CP6 RefM1M2 1.0 69.0 -21.0 µV Black
57 CP4 CP4 RefM1M2 1.0 49.0 -29.0 µV Black
58 CP2 CP2 RefM1M2 1.0 31.0 -46.0 µV Black
59 P2 P2 RefM1M2 1.0 49.0 -68.0 µV Black
60 P4 P4 RefM1M2 1.0 60.0 -51.0 µV Black
61 P6 P6 RefM1M2 1.0 74.0 -41.0 µV Black
62 P8 P8 RefM1M2 1.0 90.0 -36.0 µV Black
63 P10 P10 RefM1M2 1.0 113.0 -36.0 µV Black
64 PO8 PO8 RefM1M2 1.0 90.0 -54.0 µV Black
65 PO4 PO4 RefM1M2 1.0 74.0 -68.0 µV Black
66 O2 O2 RefM1M2 1.0 90.0 -72.0 µV Black
Channel positions have been changed.
Channel order has been changed.


Export markers
Operations info.
*** Export Markers ***
File format: Compatibility
PC format line delimiter
The following markers have been selected for export:
Stimulus, S 31
Stimulus, S 32
*** Data node specific information ***
These markers were actually exported:
Stimulus, S 31, 31
Stimulus, S 32, 43
Import markers
Operations info.
*** Import Markers ***
*** Data node specific information ***
File read in compatibility format.
Imported a total of 148 markers.
These markers were actually imported:
Stimulus, S 32, 26
Stimulus, S 31, 26
Stimulus, S 36, 17
Stimulus, S 35, 5
New Segment, , 74
Segmentation Visual Failed
Operations info.
*** Segmentation ***
Segmentation relative to reference marker positions
Reference markers:
Stimulus S 31
Stimulus S 32
Advanced Boolean Expression:

Segment size and position relative to reference markers:
Start: -950.00 ms, End: 50.00 ms, Length: 1000.00 ms
Allow overlapped segments? Yes
Skip bad intervals? No
Data was not stored but will be calculated on demand.
Fast Fourier Transformation Visual Failed
Operations info.
*** Fast Fourier Transformation (FFT) ***
Maximum Resolution
Power
Non-Complex Output
Half Spectrum used
Data Window:
Hanning Window
Length = 10 %
Variance Correction used
Periodic
*** Data node specific information ***
Resolution: 1 Hz
Average Visual Failed
Operations info.
*** Average ***
Number of segments used for average: ___

Appendix D: IPAQ Survey Data

Participant ID	*V+M*	*Total score*	*Vigorous*	*Moderate*	*Light*	*Inactive*
PP02	660	1230	300	360	570	1884
PP03	1355	2355	585	770	1000	420
PP04	900	1560	240	660	660	395
PP06	420	480	360	60	60	787
PP07	200	530	0	200	330	965
PP09	960	1680	75	885	720	420
PP10	230	320	120	110	90	547
PP11	130	170	30	100	40	784
PP15	160	730	30	130	570	780
PP18	960	1545	360	600	585	602
PP22	535	1370	120	415	835	931
PP32	60	240	0	60	180	845
PP37	620	820	300	320	200	487
PP41	1350	3060	300	1050	1710	547
PP46	900	1380	0	900	480	818
PP47	210	525	0	210	315	1054
PP48	600	1230	90	510	630	607
PP53	205	715	30	175	510	720
PP54	885	1360	540	345	475	907
PP55	435	585	420	15	150	1506
PP57	415	515	240	175	100	501
PP58	310	910	140	170	600	0
PP61	0	2040	0	0	2040	4
PP67	1365	1535	480	885	170	420
PP71	1220	2330	0	1220	1110	482
PP73	300	1090	0	300	790	783
PP81	1315	2110	450	865	795	930
PP82	450	2070	120	330	1620	423
PP86	340	1630	0	340	1290	543
PP87	460	940	300	160	480	967

All values are in minutes per week.

Appendix E: Correlations

Pearson's Correlations

		Pearson's r	p
Theta_AvAS	- Theta_AvAF	0.892***	< .001
Theta_AvAS	- Theta_AvVS	0.839***	< .001
Theta_AvAS	- Theta_AvVF	0.810***	< .001
Theta_AvAS	- Theta_Average	0.942***	< .001
Theta_AvAS	- Vigorous_Exercise	-0.147	0.430
Theta_AvAS	- Moderate_Exercise	0.284	0.121
Theta_AvAS	- Light_Exercise	0.392*	0.029
Theta_AvAS	- Inactive_Exercise	-0.091	0.626
Theta_AvAS	- Exercise_Score	0.381*	0.035
Theta_AvAS	- Exercise_Score_VM	0.164	0.377
Theta_AvAS	- SSRT_AvAud	-0.129	0.490
Theta_AvAS	- SSRT_AvVis	-0.251	0.173
Theta_AvAS	- SSRT_Average	-0.244	0.187
Theta_AvAS	- Age	-0.078	0.676
Theta_AvAF	- Theta_AvVS	0.860***	< .001
Theta_AvAF	- Theta_AvVF	0.793***	< .001
Theta_AvAF	- Theta_Average	0.938***	< .001
Theta_AvAF	- Vigorous_Exercise	-0.118	0.526
Theta_AvAF	- Moderate_Exercise	0.321	0.078
Theta_AvAF	- Light_Exercise	0.235	0.203
Theta_AvAF	- Inactive_Exercise	0.036	0.849
Theta_AvAF	- Exercise_Score	0.304	0.096
Theta_AvAF	- Exercise_Score_VM	0.204	0.272
Theta_AvAF	- SSRT_AvAud	-0.167	0.371
Theta_AvAF	- SSRT_AvVis	-0.214	0.249
Theta_AvAF	- SSRT_Average	-0.239	0.196
Theta_AvAF	- Age	0.015	0.936
Theta_AvVS	- Theta_AvVF	0.939***	< .001
Theta_AvVS	- Theta_Average	0.962***	< .001
Theta_AvVS	- Vigorous_Exercise	-0.034	0.856
Theta_AvVS	- Moderate_Exercise	0.412*	0.021

Pearson's Correlations

		Pearson's r	p
Theta_AvVS	- Light_Exercise	0.205	0.270
Theta_AvVS	- Inactive_Exercise	-0.135	0.467
Theta_AvVS	- Exercise_Score	0.358 *	0.048
Theta_AvVS	- Exercise_Score_VM	0.307	0.093
Theta_AvVS	- SSRT_AvAud	0.023	0.901
Theta_AvVS	- SSRT_AvVis	-0.308	0.092
Theta_AvVS	- SSRT_Average	-0.198	0.286
Theta_AvVS	- Age	-0.176	0.343
Theta_AvVF	- Theta_Average	0.935 ***	< .001
Theta_AvVF	- Vigorous_Exercise	-0.182	0.326
Theta_AvVF	- Moderate_Exercise	0.322	0.077
Theta_AvVF	- Light_Exercise	0.216	0.243
Theta_AvVF	- Inactive_Exercise	-0.262	0.155
Theta_AvVF	- Exercise_Score	0.275	0.134
Theta_AvVF	- Exercise_Score_VM	0.181	0.331
Theta_AvVF	- SSRT_AvAud	-0.046	0.808
Theta_AvVF	- SSRT_AvVis	-0.310	0.090
Theta_AvVF	- SSRT_Average	-0.237	0.199
Theta_AvVF	- Age	-0.233	0.207
Theta_Average	- Vigorous_Exercise	-0.126	0.499
Theta_Average	- Moderate_Exercise	0.354	0.050
Theta_Average	- Light_Exercise	0.282	0.124
Theta_Average	- Inactive_Exercise	-0.119	0.523
Theta_Average	- Exercise_Score	0.353	0.052
Theta_Average	**- Exercise_Score_VM**	**0.227**	**0.220**
Theta_Average	- SSRT_AvAud	-0.083	0.656
Theta_Average	- SSRT_AvVis	-0.287	0.118
Theta_Average	**- SSRT_Average**	**-0.242**	**0.189**
Theta_Average	- Age	-0.125	0.503
Vigorous_Exercise	- Moderate_Exercise	0.433 *	0.015
Vigorous_Exercise	- Light_Exercise	-0.211	0.253
Vigorous_Exercise	- Inactive_Exercise	0.121	0.516

Pearson's Correlations

		Pearson's r	p
Vigorous_Exercise	- Exercise_Score	0.374 *	0.038
Vigorous_Exercise	- Exercise_Score_VM	0.715 ***	< .001
Vigorous_Exercise	- SSRT_AvAud	0.041	0.828
Vigorous_Exercise	- SSRT_AvVis	0.128	0.492
Vigorous_Exercise	- SSRT_Average	0.110	0.555
Vigorous_Exercise	- Age	0.083	0.655
Moderate_Exercise	- Light_Exercise	0.146	0.432
Moderate_Exercise	- Inactive_Exercise	-0.164	0.378
Moderate_Exercise	- Exercise_Score	0.775 ***	< .001
Moderate_Exercise	- Exercise_Score_VM	0.939 ***	< .001
Moderate_Exercise	- SSRT_AvAud	-0.203	0.273
Moderate_Exercise	- SSRT_AvVis	-0.160	0.389
Moderate_Exercise	- SSRT_Average	-0.223	0.229
Moderate_Exercise	- Age	-0.139	0.457
Light_Exercise	- Inactive_Exercise	-0.378 *	0.036
Light_Exercise	- Exercise_Score	0.694 ***	< .001
Light_Exercise	- Exercise_Score_VM	0.033	0.860
Light_Exercise	- SSRT_AvAud	0.036	0.847
Light_Exercise	- SSRT_AvVis	-0.292	0.111
Light_Exercise	- SSRT_Average	-0.180	0.333
Light_Exercise	- Age	-0.112	0.550
Inactive_Exercise	- Exercise_Score	-0.312	0.088
Inactive_Exercise	- Exercise_Score_VM	-0.081	0.665
Inactive_Exercise	- SSRT_AvAud	0.062	0.742
Inactive_Exercise	- SSRT_AvVis	-0.026	0.890
Inactive_Exercise	- SSRT_Average	0.016	0.930
Inactive_Exercise	- Age	0.037	0.842
Exercise_Score	- Exercise_Score_VM	0.743 ***	< .001
Exercise_Score	- SSRT_AvAud	-0.078	0.676
Exercise_Score	- SSRT_AvVis	-0.250	0.174
Exercise_Score	- SSRT_Average	-0.215	0.246
Exercise_Score	- Age	-0.129	0.488

Pearson's Correlations

		Pearson's r	p
Exercise_Score_VM	- SSRT_AvAud	-0.142	0.446
Exercise_Score_VM	- SSRT_AvVis	-0.076	0.686
Exercise_Score_VM	**- SSRT_Average**	**-0.131**	**0.484**
Exercise_Score_VM	- Age	-0.076	0.685
SSRT_AvAud	- SSRT_AvVis	0.293	0.110
SSRT_AvAud	- SSRT_Average	0.756***	< .001
SSRT_AvAud	- Age	0.161	0.388
SSRT_AvVis	- SSRT_Average	0.847***	< .001
SSRT_AvVis	- Age	0.760***	< .001
SSRT_Average	- Age	0.609***	< .001

* p < .05, ** p < .01, *** p < .001

Appendix F: Repeated Measures ANOVA

Within Subjects Effects

Cases	Sum of Squares	df	Mean Square	F	p
Stop	0.459	1	0.459	6.400	0.017
Residuals	2.154	30	0.072		
Modality	0.201	1	0.201	1.016	0.322
Residuals	5.927	30	0.198		
Stop ✻ Modality	9.422×10^{-6}	1	9.422×10^{-6}	1.224×10^{-4}	0.991
Residuals	2.309	30	0.077		

Note. Type III Sum of Squares

Between Subjects Effects

Cases	Sum of Squares	df	Mean Square	F	p
Residuals	80.509	30	2.684		

Note. Type III Sum of Squares

Appendix G: EEG Lab Protocol

Directly after sign-up:

Ask the participant to sign up through Calendly. They will receive an automatic email with all the information.

The inclusion criteria should be:

- 18-65 years old
- Healthy hearing and vision
- Able to travel to the lab in Utrecht

Day before the experiment

The participant will receive an automatic reminder email 24 hours before participation.

- 00:30 | Prepare the lab:

Aim to be present about 30 minutes before the first participant starts the experiment. Switch on the table lamp behind the participant's screen (black switch on the left of the tabletop) and the lamp in the control room.

Determine who is researcher 1 and who is researcher 2. In some cases, there is also a supporting researcher 3.

Researcher 1:	*Researcher 2:*
Guides and delivers instructions to the participant.	Takes care of all the technical set-up.

Switch on the two lights: behind the Presentation computer, and behind the EEG computer
Switch on all 3 screens: 1 participant screen, 2 screens in the control room
Switch on stimulus PC and EEG PC
Sanitise the chin rest and keyboard using a alcohol prep pad

Password of the computer: _____.

Check whether all the money is there (for the day of the experiment and the next day).

- 00:15 | EEG preparation

Check the electrode strands on breakages or faults, make sure to check whether all electrode tips are present, any residual gel, wire quality, no tangles, and remove all the stickers.

All good? Continue by attaching the stickers on the face electrodes (around the small electrode circle). Make sure that you use the big stickers on the electrodes that go under and above the eye (EXG1/EXG2).

Did something break? Please report it immediately to your supervising professor and send it to the student groups chat.

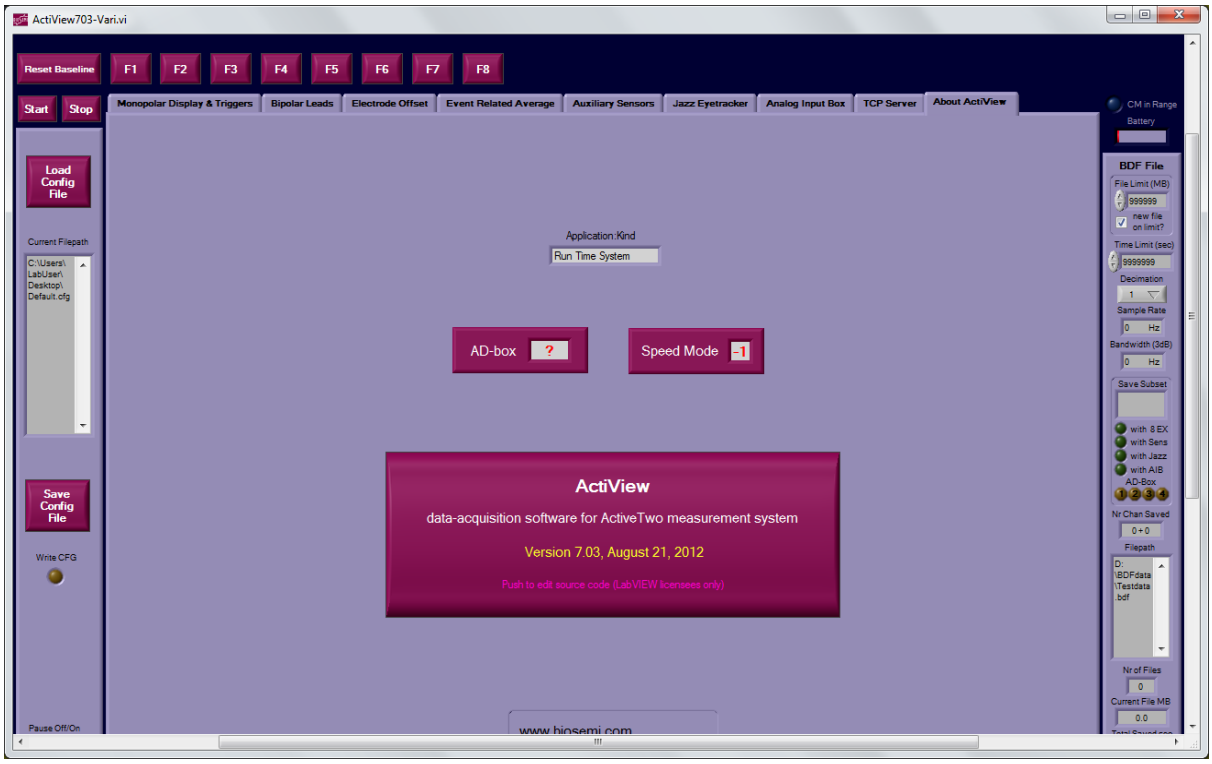
Next steps

1. Fill the syringes about halfway with conductive electrolyte gel about halfway.
2. Connect the biosemi amplifier to a fully charged battery, and place the other battery on the charger.
3. Connect them as shown in the picture below. You can attach the battery under the Biosemi Amplifier.
    1. Make sure (!) that the orange wire does not get caught in between the amplifier and the battery.
4. When the cables are connected, turn the amplifier on with the power button on the front, which is on the bottom left. Both power-LEDS are solid green, and the "CM in range"-LED should blink blue. You can leave the amplifier off until the participant is connected to the EEG equipment, to save battery.

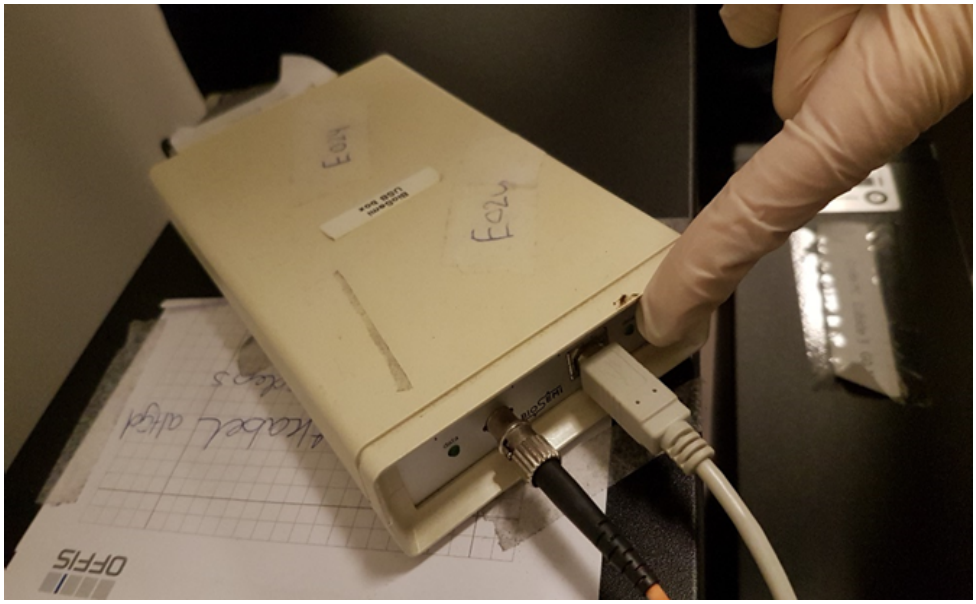
Start the Actiview programme on the EEG PC.

1. Look for the "ActiveView" program on the right on the task PC.

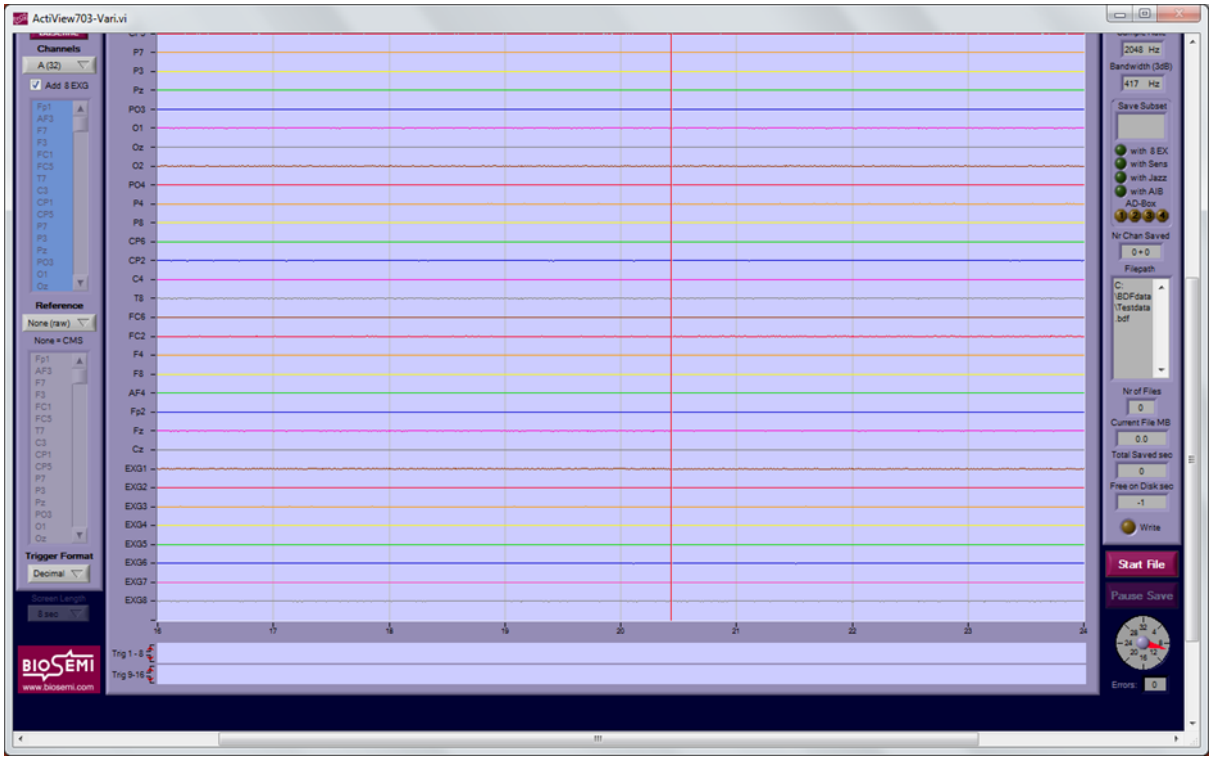
2. Switch to the "about Actiview" tab and press the "Load Config file" button in the left-hand column.
3. Go to the desktop → National Instruments → " configuring" folder, select the file "10-20system64+8.cfg" and press "ok".



4. Select the tab "Monopolar Display & Triggers" and check whether you can see flatlines in the screen if you press "start" at the top left.
    1. If you get an error message; "ADC-box is not powered on", click on 'ok' of the error message.
    2. How do you solve this error message? Take the grey square usb-cable out of the front of the ADC-box (on top of the stimulus pc), wait for 5 seconds, and plug it in again. Wait a moment again, and then press "start" in actiview.



5. Finally, at the bottom left of the Actiview screen, change the Trigger Format from "Analog" to "Decimal".



All software is now set to receive the participant.

Start Presentation of the Resting state EEG

1. Look for the "Presentation" program on the left task PC.
2. Click on the folder icon located in the top left corner of the screen.
3. Select 'Open Experiment' from the top menu.
4. Navigate to the RestingstateEEG folder.
5. Start the resting state EEG

Start Presentation of the Task PC.

1. Keep the "Presentation" program open on the left task PC.
2. Click on the folder icon located in the top left corner of the screen.
3. Select "Open Experiment" from the top menu.
4. Navigate to the SSTmodForLocationLaptop folder.
5. Select the "Taskfiles" subfolder.
6. From there, you will see 8 different task files labeled either "Vis_Aud" or 'Aud_Vis'.
7. Choose the task file that was predetermined for the specific participant. This is indicated in the "Tracking of participants" document found on Google Drive.

When the right task file has been opened

1. When the right task file is opened, you can select the boxes of the experiment blocks you want your participant to take ('Oef' in the file name means that it is a practice block).
2. Press "Run Scenario" for the task to start.
3. After each block a pop-up window will appear. Click "Continue" to start the next block.
4. !!! Don't click the "Cancel" button. It will stop the experiment !!!

00:00 | Arrival of the participant

Researcher 1 guides the participant from the waiting area at the counter to room E0.38.

- Do you still need to use the bathroom?
- Feel free to leave your jacket, bag, electronics in the control room. Could you please put your phone notifications on silent?
- You can now take a seat here.
- Did you sign the informed consent letter already? *If not: Use the printout in the lab.*
- Have you filled in the questionnaire online? *If not: let them fill in the questionnaire outside the lab.*

00:10 | Attaching sensors

Set-up

1. Adjust the participant's chair to a comfortable sitting height for him/her.
2. Roll the participant in the chair towards the desk, and raise the desk until the participant can rest his/her chin on the chinrest, and is able to relax completely. *For more comfort and hygiene, you can place a piece of paper on the chinrest.*
3. Make sure that the participant is in a relaxed position with no tension in the shoulders (and trapezius muscles). Check with the participant.
4. Adjust the keyboard in front of the participant, in a way the participant can comfortably reach it.
5. The keyboard has to be within the block (inside the taped lines). To make sure it is in the correct position, ask the participant to position their fingers on the left and right button. *The arms should rest comfortably on the desk, with no strain in the arms or neck.*

Make sure that:

- The point on the monitor closest to the bridge of the nose is in the exact centre of the monitor, the distance between nose bridge and screen centre should be approximately 40 centimeters.
- The response keyboard is always in the exact same location (tape-indicated). You can move the keyboard up and down, not sideways.
- The response fingers of both hands is continuously on the response key, in a relaxed manner, and the participant knows how to perform a decent response.
- (light conditions are as they should be, normally just one lamp behind the monitor)
- Prevent any noise from the control room during the task execution.

Attaching the cap and cleaning

1. Measure the circumference of the participant's head from the nasion to the inion, see which cap to use (when in doubt; a smaller cap is always better):

S	50-54 cm
S/M	52-56 cm
M	54-58 cm
M/L	56-60 cm
L	58-62 m

2. Clean the skin with an alcohol swab at the places where the face electrodes will be placed.
    1. **NOTE**: have the participant close his/her eyes when you are working with the alcohol swab in the proximity of the eyes. Wait for the alcohol vapour to evaporate (± 5s) before instructing the participant to open his eyes again.

External EEG electrodes

Clean participants face with an alcohol prep pad (be careful around their eyes)
Apply gel to the face electrodes and attach them in the following order (from the participant's perspective):

EXG1	Above the left eye (in line with the pupil; use a big sticker)
EXG2	Below the left eye (in line with pupil; use a big sticker)
EXG3	Left to the left eye (in line with pupil)
EXG4	Right to the right eye (in line with pupil)
EXG5 (7)	Left mastoid
EXG6 (8)	Right mastoid

It is important that the facial electrodes should be attached:

- As closely as possible to the eyes but avoiding discomfort
- As vertically/horizontally as possible
- Aligned to the pupil.

Switch on the measuring box and check that the blue light is lit steadily.

Earplugs

1. Place the earplugs in the ears of the participant. *You can ask if they would like to do it themselves. But explain what they should do:*
2. Roll the earplug until it is flat
3. Gently pull on the earlobe.
4. Carefully insert the flattened earplug.
5. Check with the participant if it's inserted correctly and that they are not uncomfortable.

EEG-cap and electrodes

NOTE: If the participant has long hair, let them wear their hair down. (no ponytails or braids)

1. Carefully put the cap on the participant. Never let them do this themselves. It works best if researcher 1 and researcher 2 work together in putting on the cap. Researcher 1 holds the front of the cap in place, so it does not mess up the electrode on the face. Researcher 2 puts the cap on towards the back of the head.
2. Measure whether Cz is exactly in the middle (from nasion to inion and from the left earlobe to the right earlobe).
3. Close the clasp, check with the participant if it is not too tight or irritating.
4. Don't forget to let the label hang out of the cap, it is located right underneath the lz electrode
5. Inject the gel into the electrode holes
    1. Note: better too little than too much, you can always add more. In case of thick hair, try to push the hair aside with the tip of the syringe so that the gel can touch the scalp. Ask the participant if the gel can be felt; this means that there is contact with the scalp.
6. Snap on the electrodes.
7. Then, clip the 32-electrode bundle into the measuring box (top, A). Repeat for the second 32-bundle, to B.
8. Check whether there is any tension on the wires of the electrodes (otherwise you can tape bundles or wires to the participant's clothing). Also ask if anything else is bothering the participant.

Is the cap comfortable? Please let us know if the cap is too tight, if something hurts or if it is too uncomfortable.

We will now close the clasp. Is the cap still comfortable?

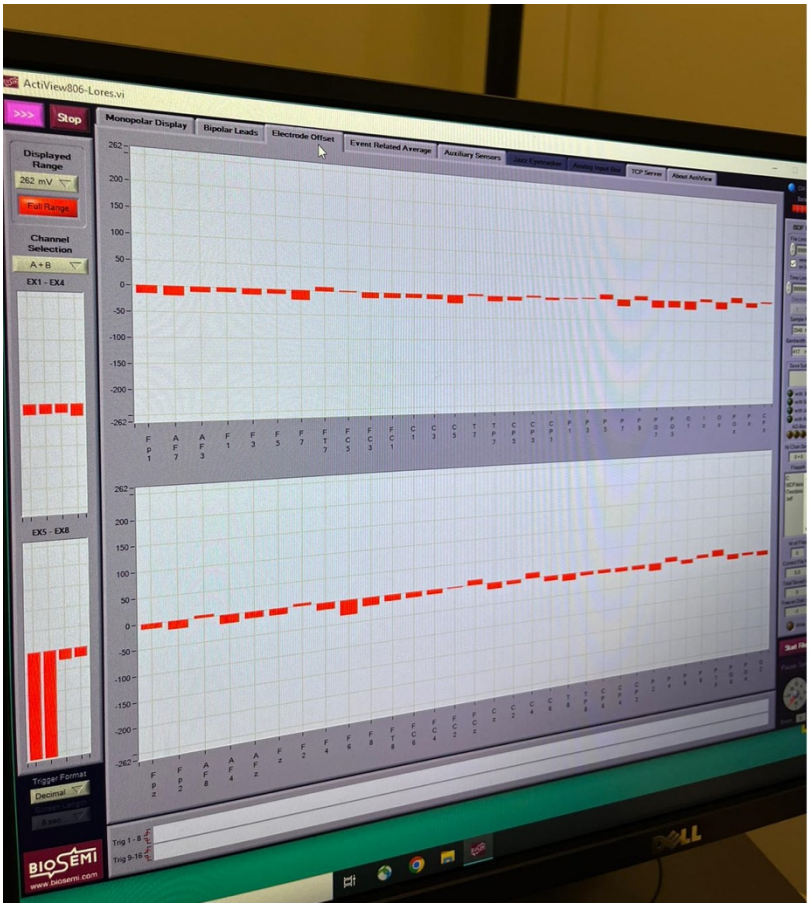
We finished up everything. Are you overall seated comfortably?

In order for the sensors to measure your brain activity, we will need to add a bit of conductive gel. This might mess up your hair a little bit, but there is a possibility to wash your hair when the experiment is over.

We will now start attaching the sensors. Can you feel the gel on your scalp?

Great! Everything is now connected. We will now just quickly check whether all the sensors are working properly.

**NOTE: Feel free to chat to the participant during this part. It's your job as a researcher to make them feel at ease.*



Electrode offset

These steps are for researcher 2.

1. ActiView should be set-up correctly and be ready for use (see previous steps).
2. Use EX01 and EX02 as the reference electrodes.
3. Go to 'Electrode offset' tab
4. The optimal offset should look similar to the picture below:
    1. The offsets of electrodes on the right should stay stable and between -50:50 level (-20:20 ideally)
    2. The offsets of reference electrodes on the left should stay stable at a low level. NOTE: We use only 6 facial electrodes, so 2 will look connected improperly (on the left of the screen).

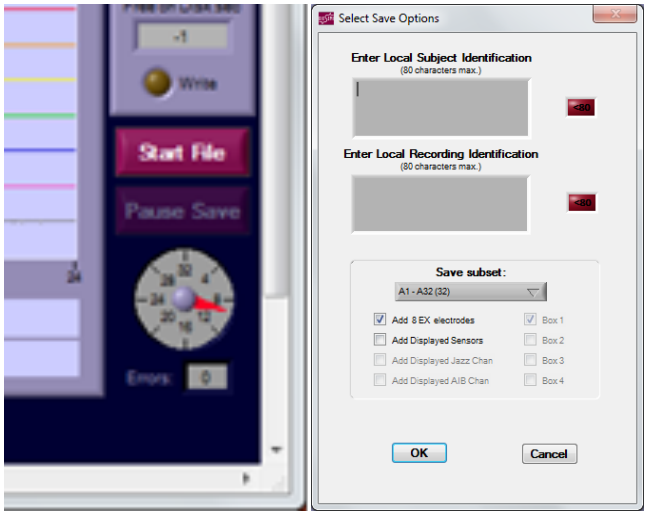
3. Might you find that it detects more electrodes than the 64 we have (in other words, it doesn't look like the below image, change the "channel selection" to "A+B").
4. Double check that the electrode names on the screen correspond with the electrode names on the cap. If not, please load the configuration file "10-20system64+8.cfg" again.

5. Make sure to check the "about actiview" tab and load the correct configuration: this is done by clicking load config file then pressing the configuration folder, following this select the 10-64 option then start the program to ensure that the electrodes are properly labelled in the program.

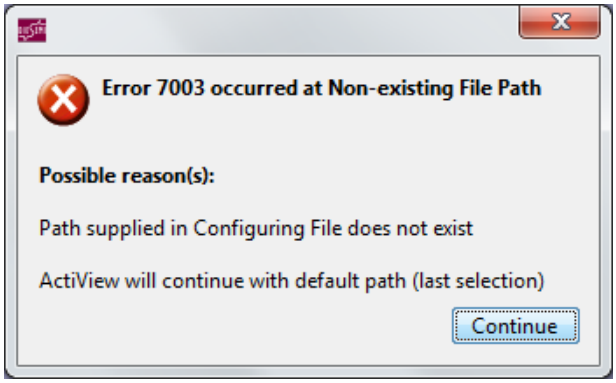
00:30 min | Start task

Data collection

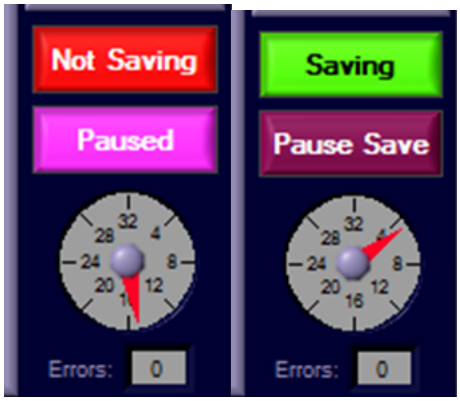
1. Start the data collection of the EEG signal.
    1. EEG PC: press "Start file", bottom right, and enter the participant code in "Local subject identification".



    b. Click "Continue" if the error message appears.



2. Choose the folder “DataFolder” >> “Predict_SST” as the location to save the files, and choose the participant code as the name. Participant code can be found in the ‘Tracking of participants’ document.
    1. File name: [participant ID from the ‘tracking of participants’ document in the Google Drive]_EEG → PP01_EEG.
    2. This name is for both computers.
3. Create a new file!
    1. Attention (!): Press “Paused” to change the “not recording” status to “recording”.
    2. **“Saving” button should be green when the data is being recorded.**
    3. The second picture is what is shown when the data is being recorded



Resting state

1. Instruct the participant about the resting state.

Before we start the experiment, we are going to measure a baseline consisting of 7 minutes. The first 5 minutes consist of looking at a fixation cross. The last two minutes will consist of sitting with your eyes closed. The on-screen instructions will prompt you to close your eyes and continue by pressing the spacebar. Please, sit still as much as possible. Don’t stare and just look at the screen normally, relax your muscles. I will re-enter the room when the resting state is finished.

2. Turn on the resting state on the task computer.
    1. Task codes: *8 - start eyes open, - start eyes closed*
3. The participant now presses the space bar.
4. Press stop on the EEG data collection computer when the experiment is finished.

Practice block

1. Instruct the participant that a practice block is done, to get acquainted with the task.

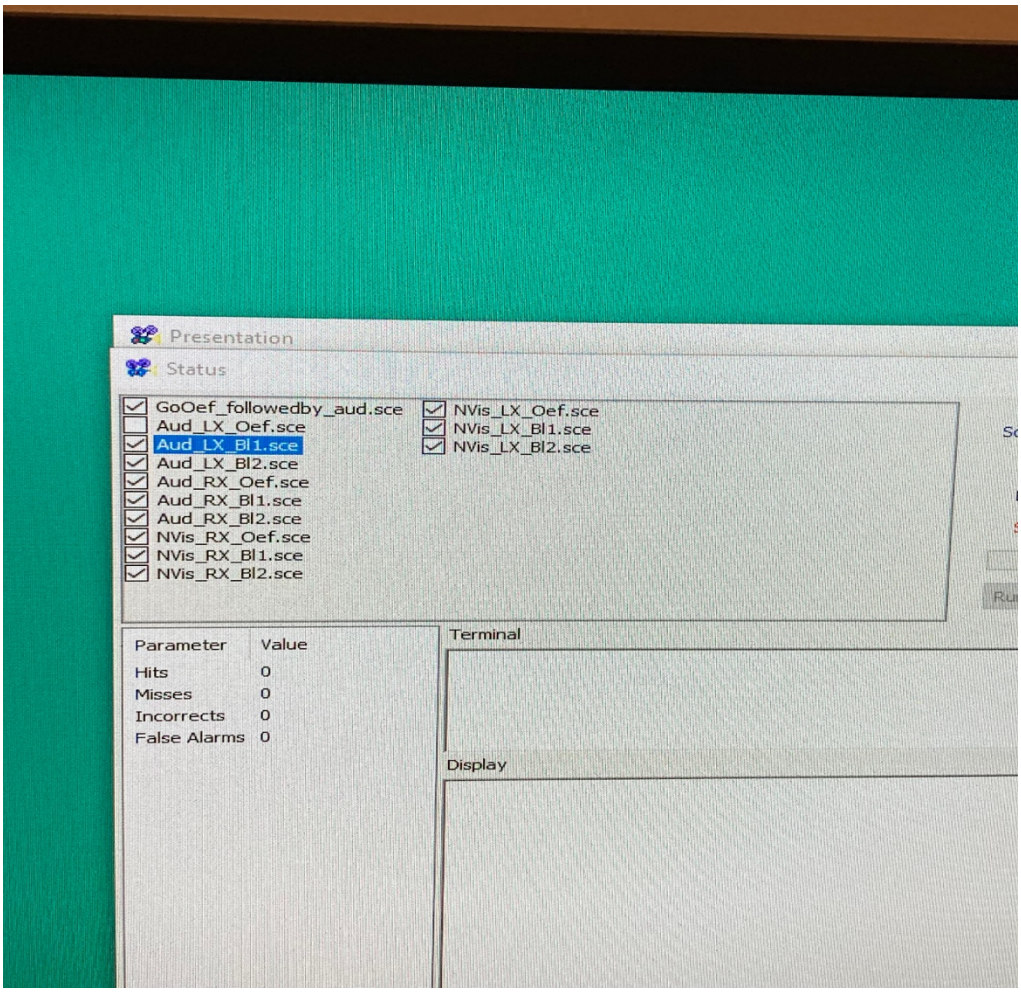
We will now move on to the practice block. Please read the instructions on the screen carefully. On the keyboard, you can see a key on the left and a key on the right. When the task has started, you will see an X and an O on the screen. When you see an X or an O you will have to react by pressing the left key or the right key. The computer instructions will tell you which key to press. Try to react as fast as you can.

Continuing the experiment with the next blocks

1. After the practice block, researcher 1 goes into the experiment room to check the participant whether they are still relaxed.

Well done! How was that?Are you still feeling relaxed? We will now start the official task. As before, you will have to react to an X and an O on the screen by pressing the left key or the right key. The computer will tell you which key to press, this may switch around in each block. However, there is one small change. *[Auditory]:* Whenever you hear a sound, you will need to inhibit your action. In this case, please do not press the corresponding key. *[Visual]:* Whenever you see a red screen flashing, you will need to inhibit your action. In this case, please do not press the corresponding key. There will be _____ blocks now, then we will take a short break. Good luck!

2. If the participant and researcher are unable to start a block in the experiment then the "presentation" program should be exited and restarted, making sure to deselect the blocks that have already been recorded and saved. (See image below)



3. The following are the codes of the auditory and visual stimuli.

Auditory	*Visual*
4	4
102 STOP	103 STOP
101 NOSTOP	128 NOSTOP
11 X	51 O
1 left button	1 left button
12 O	52 X
2 right button	2 right button
21 go followed by stop	31 go followed by stop
22 go followed by stop	32 o followed by stop

4. After every block, experimenter should inspect the task performance
   After every block, a summary of the performance of that block is depicted in the scenario window that Presentation has open.
   Here you can inspect the N Inh nsucces and N Inh failure for the past bock.

   If X Inh nsucces + O Inh nsucces < 13 then instruct: 'Please slow down a bit'
   If X Inh nsucces + O Inh nsucces > 19 then instruct: 'Please speed up a bit'
   If 13 <= X Inh nsucces + O Inh nsucces <= 19 just proceed with next block
   Note 13 = 40% of 32, 19 = 60% of 32.

   If an error message is given at the end of the block, this likely signifies 0 correct inhibitions, and the experimenter should check if the task instructions are clear.

Checking the participant summary data

This can be done in order to make sure that the task was well received by the participant.

1. Open the data folder on the desktop.
2. Navigate to the folder named SSTmodForLocationLaptop.
3. Select the task files subfolder.
4. From there, choose the log folder.
5. Within the log folder, you will find several output files.
6. To locate the summary data file, arrange the files by the last modified date.
7. The summary data will be located in the file you named yourself.
8. The file with the lowest KB is the summary file.
9. Review the summary data to determine if the participant correctly understood the task.

If the participant hasn't correctly understood the task, please tell them the following.

After each screen with instructions, you will be asked to press the spacebar. After pressing the spacebar, the experiment will start and you will see a white fixation cross. Each trial consists of the appearance of a stimulus: an X or an O, above the fixation cross. Your task is to react as fast as possible following this stimulus (an X or an O) The previous instructions will have stated the correct response according to the stimulus. This could be the left button on the keyboard with a tape or the right button on the keyboard with a tape. For instance, suppose Left = X and Right = O. When an X is shown, you should press the left

button as quickly as possible and press the right button as quickly as possible when the O is shown. But, sometimes the stimulus (X or O) could be followed by a stop signal. This can be an auditory beep or a visual red screen.

When you encounter a stop signal, you should try to stop your previous action as best as you can (which would be pressing one of the buttons). After a successful or an unsuccessful stop, the experiment will continue and you will be shown an X or an O again. And so forth.

So, an example trial could be that you are instructed to press the left button when an X is shown, so when you see an X, you get ready to press the X. BUT, you get a stop signal, so you stop your action and you will not press the left button anymore.
That's it.

It is randomised which trials will have a stop signal, so just react as quickly as possible by pressing the correct button. And when a stop signal is shown, try to stop your action of pressing the button.

01:00 | Break

After 6 blocks, the participant will have a 5-10 minute short break. They are not allowed to leave the room, but they can take their head off the chinrest. The researchers can come into the experiment room to talk with the participant.

Is everything still okay?
How has the task been so far?
Do you need anything?
Would you like some water?

01:05 | Continuation of the task

1. Instruct the participant
2. Leave the experiment room.

We will now continue the task. You will need to do the same thing as before. However, the task will change a little bit.

[*Continuing with auditory*]: Previously, you were required to cease pressing the corresponding key when you saw a red flash on the screen. As of now, a sound will be played in your ear to indicate when you should refrain from pressing the button.
[*Continuing with visual*]: Previously, you were required to cease pressing the corresponding key when you heard a sound played in your ear. As of now, you will see a red flash on the screen to indicate when you should refrain from pressing the button.

Good luck!

01:30 | End of task

1. Make sure to stop recording data and save the recorded data
2. Click "Pause save" in the bottom-left corner and then "Stop" in the right-left corner.
3. The data should now be saved.

The following tasks should happen quite quickly. It's easiest when the tasks are divided between the researchers.

Researcher 1	*Researcher 2*
1. Remove EEG cap with all sensors still attached gently from the head of the participant. 2. Give the EEG cap to researcher 2. 3. Remove all external sensors 4. Instruct the participant to clean themselves off. 5. Give the participant a towel. 6. While the participant washes their hair, prepare their payout/reward. 7. Escort the participant back to the front desk. 8. Return to the control room. 9. While researcher 2 cleans the cap, start cleaning the external sensors.	1. Remove earphones from participant and detach clips from their person. 2. Disconnect all sensors from the battery. 3. Receive the EEG cap with sensors from researcher 1. 4. Take off all the sensors from the EEG cap. 5. After the participant is finished washing their hair, start cleaning the cap using the pipe cleaners provided in the lab. 1. Be sure to clean *extensively*, poking fully through each hole and rinsing off the gel. 6. While researcher 1 is cleaning the electrodes, reconnect the battery back to the charger.

10. Clean the electrodes *extensively*, making sure there is no left-over gel. 11. When finished cleaning the external sensors and the electrodes, hang them up to try in the correct place.	
Researcher 1 & 2 Make sure that the lab is fully set-up for the next experimenters. Put the cleaning and measuring equipment back in the correct place and throw away any left-over rubbish.	

There is a lot of gel in your hair left. If you like, you can wash your hair in the sink. There is shampoo, and we also have a towel for you prepared.

Does exercise improve cognitive abilities? An inquiry into inhibitory control and its relation to physical exercise and EEG theta waves.

MSC APPLIED COGNITIVE PSYCHOLOGY

Justin van Zon