

University of Cape Town

Doctor of Philosophy
Thesis

Neurocircuitry of Attention in Methamphetamine Induced Psychosis: A comparison against schizophrenia patients and healthy controls

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Declaration

I, Jennifer Hsin-Wen Hsieh, hereby declare that the work on which this dissertation is based is my original work (except where acknowledgements indicate otherwise) and that neither the whole work or any part of it has been, is being, or is to be submitted for another degree in this or any other university.

I empower the university to reproduce for the purpose of research either the whole or any portion of the contents in any manner whatsoever.

Signature:

Date:

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Abstract

Background

Methamphetamine induced psychosis (MAP) and schizophrenia present with similar positive symptoms of psychosis, are characterized by evidence of attentional impairment, and show symptomatic response to treatment with dopamine antagonists. At the same time, MAP is considered a transient condition, while schizophrenia can be conceptualized as a neurodevelopmental disorder. Despite advances in the neurobiology of these two conditions, the extent to which their underlying attentional neurocircuitry show overlaps or differences has not often been directly compared. This thesis compared MAP, schizophrenia and healthy controls, in order to examine overlap and differences in 1) subcortical regulation of cortical inhibition and excitability, 2) resting state cortical and subcortical connectivity, and the dynamics of rhythmic neural activity between states, and 3) cortical-cortical connectivity using event related potential (ERP) responses to stimuli with a continuous performance task (CPT).

Methods

Outpatients treated for MAP and schizophrenia were recruited through hospitals and psychiatric institutions in the Western Cape. A final cohort of 24 MAP and 28 schizophrenia and 32 healthy control participants were included in the analyses for this thesis. For the cortical silent period (CSP) paradigm, the participant was asked to maintain isometric contraction between the thumb and index finger while TMS pulses at 120% and 140% resting motor threshold (RMT) were delivered to the primary motor cortical area corresponding to the abductor pollicis brevis (APB). Parameters extracted from CSP data included the latency to motor evoked potential (MEP), MEP amplitude and CSP duration. Electroencephalographs (EEGs) were performed with bilateral prefrontal, frontal, frontal temporal, central and parietal electrode locations. Relative EEG frequency power data were extracted from 3 stages during the EEG session, including states of eyes open, eyes closed, and during performance of the CPT. The CPT consisted of a series of random consonant letters. Participants were asked to respond to the letter "S" with a finger press only if it was the 3rd consecutive occurrence. ERP data were extracted and averaged from consecutive cues (S1 and S2), target (S3) and distractor (individual "S") stimuli in the CPT task. ERP data were analysed for group differences in N100, P200, N200 and P300 amplitudes and latencies at each electrode location with sufficient signal quality.

Results

In the CSP protocol, MAP and schizophrenia groups showed smaller MEP amplitudes at both 120% and 140% RMT stimulation levels in comparison to controls. Both MAP and schizophrenia groups had lower alpha and higher delta relative frequency band power, with schizophrenia showing significant differences from controls at more electrode positions than MAP. While controls demonstrated a decrease in alpha power between the eyes closed and eyes open resting states, this did not occur in MAP or schizophrenia. During the CPT, both MAP and schizophrenia achieved fewer correct targets and showed slower reaction times than healthy controls. In addition, MAP responded more often than the other two groups to the S2 stimulus (which required response inhi-

bition). ERP analysis found smaller N100, larger P200, larger N200 and larger P300 amplitudes in MAP in response to stimuli requiring inhibition than in schizophrenia and controls, whereas schizophrenia showed longer P300 latencies in response to the target and distractor stimuli than in MAP and controls.

Conclusions

MEP results suggest that MAP and schizophrenia may have similar subcortical dysregulation, suggestive of altered dopaminergic regulation in the basal ganglia-thalamus-cortex loop. EEG frequency power results suggest that MAP and schizophrenia both display an inflexibility of subcortical systems involved in adaptation to environmental changes, suggesting deficiencies in the CT-TRN-TC loop in both MAP and schizophrenia. CPT performance and the pattern of ERP alterations in MAP suggests greater cholinergic impairment during attentional performance in MAP than in schizophrenia. Taken together, while there is considerable overlap in cortical-subcortical inhibition and connectivity in MAP and schizophrenia, there are also important differences; findings that emphasize both the similarities and dissimilarities that are seen clinically.

1 Introduction

1.1 Opening Remarks

This thesis will explore overlaps and distinctions in the neurocircuitry involved with attentional function in methamphetamine induced psychosis (MAP) and schizophrenia. Chronic MAP (persistent psychosis more than 1 month post drug withdrawal) may be re-diagnosed as schizophrenia; both psychiatric illnesses have similar clinical characteristics, including symptoms of psychosis, such as delusions, hallucinations, and cognitive disturbances (Rössler et al., 2005; American Psychiatric Association, 2013). While chronic antipsychotic treatment is beneficial for managing many of the psychotic symptoms in MAP schizophrenia (Canadian Psychiatric Association, 2005; Bruijnzeel et al., 2014), cognitive symptoms associated with both illnesses may not respond to current antipsychotic medications (Braff and Light, 2004; Gold, 2004; Young and Geyer, 2015; O'Tuathaigh et al., 2017). MAP has been proposed as a model of schizophrenia (Sato et al., 1992), and is particularly rampant in South Africa (Weich and Pienaar, 2009).

In subsequent chapters, I will present results from 3 non-invasive methods, each measuring specific aspects of neural function in MAP, schizophrenia, and healthy control groups. 1) I measured cortical inhibition and excitation using transcranial magnetic stimulation (TMS) and electromyography (EMG), which provides indications of the connectivity and integrity of cortical neurons and networks. 2) I measured relative electroencephalography (EEG) frequency power, in resting states with eyes closed, eyes open, and while performing a continuous performance task (CPT). The contrast in neuronal activation between resting states and during task performance may identify particular networks differences that may underlie functional deficiencies in MAP and schizophrenia groups. 3) I measured cognitive event related potential (ERP) components during the performance of an in-house, custom CPT, including the N100, P200, N200 and P300 components for differing types of stimuli in this CPT. Comparisons of each of the component characteristics in response to each specific type of stimulus would provide better resolution and nuances of differing cognitive function between groups.

1.2 Burden of methamphetamine induced psychosis and schizophrenia

1.2.1 Methamphetamine abuse

Methamphetamine (MA) is a lipophilic compound used recreationally for its ability to temporarily induce a variety of desirable effects, including increased energy levels, positive mood, euphoria, reduced appetite, weight loss, enhanced mental acuity, social and sexual disinhibition (Cretzmeyer et al., 2003; Green and Halkitis, 2006; Cruickshank and Dyer, 2009). In South Africa, MA is almost exclusively smoked as "tik" (Plüddemann et al., 2008). Compared with other routes of administration, smoking has been shown to be more addictive (Beebe and Walley, 1995), and is associated more strongly with the induction of psychosis (after initial use) than with intravenous administration (Matsumoto, 2000; Matsumoto et al., 2002).

Worldwide, MA abuse has increased in prevalence globally, and is a serious public health concern (United Nations Office of Drugs and Crime, 2018). In the United States of America, the San Diego trauma center reported more than 70% rise in the number of individuals testing positive for MA from 2003 to 2005 (Swanson et al., 2007). In South Africa, data collected from treatment centers in Cape Town by the South African Community Epidemiology Network on Drug Use (SACENDU) found that the proportion of patients which list MA as their primary drug of abuse increased from 0.3% in 2002, to 42.3% in 2006 (Plüddemann et al., 2008, 2013) and further to 46% in 2014 (Dada et al., 2015). In 2016, a study of data collected from 10 000 secondary school learners with a mean age of approximately 14 (8th and 9th grade in March 2012) found that approximately 5% of learners had already used MA in their lifetime, and of those, 65% had used in the past month or week (Weybright et al., 2016). The proportion of adolescent patients under the age of 20 seeking treatment for MA use as a primary or secondary drug of abuse in 2019 was between 35% to 39% across various sites (Dada et al., 2019).

MA abuse in society has a multitude of repercussions, including violence (Plüddemann et al., 2010) criminal behaviour, incarceration, recidivism (Cartier et al., 2006), and the transmission of HIV (Halkitis et al., 2001a; Colfax and Guzman, 2006a). MA use results in sexual disinhibition and risky sexual behaviour (Yen, 2004), thus increasing the risk of transmission of sexually transmitted

diseases, the most pertinent in South Africa being HIV (Simbayi et al., 2005; parry and pithey, 2006; Bowie et al., 2008). Globally, the majority of HIV infections continue to occur in sub-Saharan Africa, where an estimated 1.7 million people became newly infected in 2018, while an estimated 24.5 million people living with HIV in 2019 (UNAIDS, 2019). These numbers would only be exacerbated with MA use (Colfax and Guzman, 2006b; Halkitis et al., 2001b). The societal effects of MA abuse place incalculable pressure on the criminal justice and public health systems, which are already under strain in South Africa (Plüddemann et al., 2010).

Repeated administrations, or administration of high doses of MA, commonly leads to psychosis (Connell, 1958; Bell, 1965; Angrist and Gershon, 1970; Bell, 1973; Curran et al., 2004; Batki and Harris, 2004; Mcketin, 2018), where symptoms typically include paranoid delusions, auditory hallucinations, increased activity and odd speech (Connell, 1958; Bramness et al., 2012). Recreational use of MA has been shown to increase the risk of developing psychotic symptoms by two to three fold (McKetin et al., 2010) especially if larger amounts of MA is used, or use began at a younger age (Chen et al., 2003).

1.2.2 Methamphetamine induced psychosis: acute and chronic

Symptoms of MAP were originally thought to dissipate within a week of MA withdrawal (Connell, 1958). However, the prevalence of MAP is difficult to determine because the diagnosis can often be confused with other psychotic disorders, or be related to the use of other drugs such as marijuana (Weich and Pienaar, 2009). An Australian study of 277 non-treatment-seeking illicit MA users with no prior diagnosis of schizophrenia or other psychotic disorder found that 51 (18%) had "clinically significant" psychotic symptoms (McKetin et al., 2006), and a U.S. study of 42 cocaine-dependent and 43 MA-dependent individuals, screened to exclude patients with other axis I disorders, reported psychotic symptoms of at least some type in at least 60% of both groups (Mahoney et al., 2008). In Thailand, approximately 10% of admissions to psychiatric facilities are attributed to MA related psychosis (Farrell et al., 2002). A 3-month study of emergency department admissions to a tertiary care hospital in Australia in 2005 found approximately 1.2% of patients (total 13 125 admissions) were involved with amphetamine use, of which 19.9% presented with delirium and 12.2% with acute psychosis; of these and 16% had prior episodes of amphetamine induced psychosis. In South Africa, a 3-month study of psychiatric patients admitted into Stikland Hospital in Cape Town reported that 6.7% were diagnosed with substance-induced psychotic disorders,

although the authors suggest that the percentage is a gross underestimation, since MAP can often become chronic, which becomes diagnosed as schizophrenia (Weich and Pienaar, 2009).

Studies have shown that, although the large majority of MAP symptoms resolve within one month (Iwanami et al., 1994b; Ujike and Sato, 2004; Deng et al., 2012), 30% of those with MAP had symptoms persist for up to 6 months (Deng et al., 2012), and 10% to 28% reported persisting symptoms for more than 6 months (Iwanami et al., 1994b; Deng et al., 2012). Symptoms of MAP have been shown to relapse even after long periods of abstinence (Sato et al., 1992; Yui et al., 1997, 1999). A Chinese study found that 5% of patients initially diagnosed with MAP had their diagnosis changed to schizophrenia in the interview conducted by the study (Deng et al., 2012). In Thailand, a similar study found that 38.8% of abstinent MA abusers who were initially hospitalized for MAP, were subsequently given a diagnosis of schizophrenia (Kittirattanapaiboon et al., 2010).

The DSM-V indicates that persistent psychosis after 1 month of abstinence from MA can be re-diagnosed as schizophrenia (American Psychiatric Association, 2013). However, while there are many clinical similarities between schizophrenia and chronic MAP, there is insufficient evidence to conclude whether or not chronic MAP can constitute a primary psychosis such as schizophrenia (Wearne and Cornish, 2018).

1.2.3 Schizophrenia

Schizophrenia affects approximately 1.1% of the world's population (Rössler et al., 2005; Zhang et al., 2018); and while the prevalence in the overall population of schizophrenia appears low, its debilitating nature makes it one of the top 10 causes of disability around the world, and is a serious public health concern, reducing the life expectancy of affected individual's by approximately 10 years (Rössler et al., 2005).

In addition to the direct burden of schizophrenia to the patients and their direct impact on the economy, there is also immense psychological and financial burden on the caregivers (Kennedy et al., 2014). The burden on the families and caregivers of patients with schizophrenia is intangible, but is extensive (estimated between 17% and 48% loss in earnings), especially as hospitals encourage shorter inpatient stays in attempts to reduce costs (Awad and Voruganti, 2008). Thus, while the cumulative burden of schizophrenia is difficult to quantify accurately, cost of illness per

patient per year is variable across countries, with estimates ranging from $5 818 in Thailand to $94 587 in Norway (Jin and Mosweu, 2017). In Canada, an estimate of the economic burden for schizophrenia was 6.85 billion CAN Dollars, 70% of which was due to loss of productivity due to morbidity (Goeree et al., 2005). In the United States, the burden of schizophrenia including indirect costs, has been estimated at $94 to $102 billion per year (Chong et al., 2016).

Unfortunately, as is typical for developing countries, similar estimates are not available in South Africa, with one of our "major knowledge gaps" being identified as requiring "accurate and thorough assessment of the health burdens of mental, neurological and substance use disorders" (Jack et al., 2014). Although statistics for the burden of MAP and schizophrenia are not available for South Africa, the burden of neuropsychiatric disease ranks third after HIV/AIDS and other infectious diseases, and the general lack of resource allocation to mental health care in South Africa only exacerbates its negative impacts on our society (Lund et al., 2008).

Treatment for MAP and schizophrenia still primarily involves chronic antipsychotic pharmacotherapy (Emsley et al., 2013), which is beneficial in managing many of the psychotic symptoms (Canadian Psychiatric Association, 2005; Bruijnzeel et al., 2014). However, cognitive symptoms, which are also fundamental to the illness (Kraepelin, 1919), are not alleviated by the current first and second generation of antipsychotic medications, and proposals for developing a "third generation" of medications to target cognitive deficits have been strongly advocated (Braff and Light, 2004; Gold, 2004; Young and Geyer, 2015).

1.3 Attention in Psychosis

Since Emil Kraepelin first defined "dementia praecox" (a.k.a. schizophrenia) as a distinct mental illness (Kraepelin, 1896), he had already regarded "impaired attention" as a prominent feature of schizophrenia (Kraepelin, 1919). Clinical observations in the early 1960's found that patients with schizophrenia had "perceptual disturbances" such as reduced size and distance constancy - i.e. an inability to compensate for changes in a stimulus which allows the maintenance of a stable perception on an object - as well as forming abstract concepts (Raush, 1952; Weckowicz, 1957). The "abnormalities of thinking and perception in schizophrenic patients" were described as an inability to attend selectively or to select relevant information due to "over-inclusiveness" (Weckowicz and Blewett, 1959). Further observations found that the difficulty in selective atten-

tion was "most pronounced when they have to inhibit stimuli in one sensory channel, in order to deal with information in an alternative channel", and that sensory stimuli could distract and disrupt the "normally smooth sequence of motor responses" (McGhie and Chapman, 1961). Indeed, impaired attention in schizophrenia was thought to be the major confounding factor in psychological research, eventually putting forth a "cognitive control theory" of attention in schizophrenia (Silverman, 1964; Orzack and Kornetsky, 1966).

Attentional impairments in schizophrenia are well established (Braff, 1993; Bortolato et al., 2015; Nikolaides et al., 2016). Ineffective treatment of these cognitive deficiencies result in poor functional outcomes, even after long term antipsychotic therapy (Braff and Light, 2004; Gold, 2004; Young and Geyer, 2015; Domingo et al., 2015).

Poor sustained attention has been considered a potential indicator for vulnerability to develop schizophrenia (Cornblatt and Keilp, 1994; Chen and Faraone, 2000; Kéri and Janka, 2004), and has been shown to be particularly detrimental for prognosis, quality of life, and productivity in schizophrenia (Chen et al., 1997; Liu et al., 2002; Chan et al., 2004; Hofer et al., 2005; Liu et al., 2006; Birkett et al., 2007; Pattanayak et al., 2012). The ability to sustain attention has been suggested to underlie symptom severity in schizophrenia (O'Gráda et al., 2009). People with schizophrenia, and even relatives of schizophrenia patients, have poorer sustained attention performance (Egan et al., 2000; Mirsky et al., 1995; Saoud et al., 2000; Suwa et al., 2004) than other controls without familial schizophrenia. Sustained attention has been shown to be poorer in schizophrenia patients across illness stages (Asarnow and MacCrimmon, 1981; Nuechterlein and Dawson, 1984), despite changes in clinical symptoms (Liu et al., 2002; Nuechterlein et al., 1994), and are generally not relieved by antipsychotic treatments (Finkelstein et al., 1997; Liu et al., 2000; Hong et al., 2002; Goswami et al., 2009).

Similarly, impairment of inhibitory control is also recognised as a core neuropsychological deficit in schizophrenia (Richardson, 2008), and has also been highly associated with poorer occupational and social outcomes (Reeder et al., 2004), higher levels of violence (Enticott et al., 2008), and comorbid substance abuse (Chambers et al., 2001). Individuals with schizophrenia typically perform more poorly in No-Go trials (Kiehl et al., 2000), and Stroop tasks (Everett et al., 1989; Besnier et al., 2009). Relatives of schizophrenia patients also perform more poorly in tasks requiring inhibitory control (Ross et al., 1998; Sitskoorn et al., 2004; Westerhausen et al., 2011).

Compared to the number of studies on schizophrenia, fewer have focused on attentional characteristics and markers of MAP, however, MAP have shown similar attentional impairments as schizophrenia in sustained attention (Ezzatpanah et al., 2014; Fassbender et al., 2015), and inhibition control has been found to be impaired in school age children who were prenatally exposed to MA (Derauf et al., 2012).

Since 1) MAP and schizophrenia have such similar symptomatology (Kittirattanapaiboon et al., 2010; Deng et al., 2012), 2) sustained attention and inhibitory control deficits are such a fundamental contributor to the quality of life in schizophrenia patients (O'Gráda et al., 2009) and 3) poor attentional control may be fundamental to psychosis in general (Lake, 2008); I explore whether the markers of attentional network function in MAP and schizophrenia are such that similar strategies to improve cognitive markers in schizophrenia may also be applicable in MAP, or whether alternative strategies may be required for MAP.

1.4 Models of attention and sustained attention

Experientially, attention is a simple concept. William James stated over a hundred years ago that "Everyone knows what attention is. It is the taking possession by the mind in clear and vivid form of one out of what seem several simultaneous objects or trains of thought" (James, 1890). However, over a century of research by various fields from clinical neurology to neuroscience to psychology has yielded unwieldy nomenclature, and numerous models around the various sub-processes that appear to constitute attention (Cohen, 2014). Four key models are summarized below to showcase the multitude of perspectives and constructs that researchers use to study attention, to highlight that the definition of sustained attention is consistent across the models in which it is featured, and to define a framework to consider sustained attention in the context of these various models of attention.

A clinical model of attention was developed in 1989 based on experimental literature, clinical observations, and patients' subjective complaints, in order to evaluate patients with different neurological pathologies (Sohlberg and Mateer, 1989). This model of attention is still useful today, and consists of 5 components. *1) Focused attention* - the ability to respond to discrete visual, auditory or tactile stimuli. *2) Sustained attention* - the ability to maintain a consistent behavioural response in a continuous and/or repetitive activity. *3) Selective attention* - the ability

to ignore irrelevant or distracting stimuli. *4) Alternating attention* - the ability to switch between at least two different tasks with different cognitive requirements. *5) Divided attention*- the ability to perform or respond to multiple simultaneous tasks or stimuli (Sohlberg and Mateer, 1989, 2001, 2017).

A neurobiological model was developed around the phenomena of attention in terms of 4 neurobiological components (Knudsen, 2007). *1) Working memory*, or short term memory - a dynamic form of memory that temporarily stores selected information for detailed analysis (Baddeley, 2003, 2010). *2) Competitive selection* - the process that determine which information gains access to working memory (Desimone and Duncan, 1995). *3) Top-down sensitivity control* - a process that regulates the relative signal strengths of the different information channels that compete for access to working memory (Egeth and Yantis, 1997). *4) Salience filters* - a process that filters stimuli that are likely to be behaviourally important (Koch and Ullman, 1987).

Cognitive neuroscience puts forward a model of attention that involves 3 neural networks (Posner and Petersen, 1990; Posner and Rothbart, 2007; Petersen and Posner, 2012). *1) Alerting network*, which involves neuromodulatory systems of the brain stem and thalamus that function together to produce an optimal level of alertness or arousal, in preparation for the brain to detect and respond to an expected signal. *2) Orienting network*, which involves the ability to prioritize sensory input by selecting a particular sensory modality or a particular location. *3) Executive control* which involves a top-down regulatory system, aiding focal attention and conflict monitoring processes (Posner and Petersen, 1990; Posner and Rothbart, 2007; Petersen and Posner, 2012).

Neuropsychology posits that attention is the by-product of 4 related but distinct neurobehavioural sets of processes. *1) Sensory selection* occurs when certain stimuli are given preference over others for subsequent processing. *2) Executive attention, response selection and control* involves selecting an optimal course of action to achieve certain goals. *3) Focus capacity* which refers to the interaction of available energetic factors, in essence arousal, on task performance. *4) Sustained attention, vigilance and response persistence* which requires the maintenance of all three of the above processes over time (Cohen, 2014).

Thus, regardless of whether sustained attention is included in the core of any particular model of attention, it is a construct that requires the maintenance of all, or at least several components or processes of attention, over a prolonged period of time. Specifically, sustained attention is defined

as the self-directed maintenance of cognitive focus under non-arousing conditions (Robertson and Garavan, 2004; Clayton et al., 2015), and the ability to maintain a high vigilance level for prolonged periods of time, allowing the subjects to respond in an appropriate way to infrequent and unpredictable stimuli (Sarter et al., 2001).

A useful framework for considering sustained attention, proposes that it requires at least 3 cognitive control functions (Stuss et al., 1995; Shallice et al., 2008). 1) An appropriate level of arousal that allows for effective monitoring and evaluation of ongoing cognitive processes, analogous to focus capacity (Cohen, 2014), perhaps through the maintenance of alerting and orienting networks (Petersen and Posner, 2012), as well as the use of working memory with activation of salience filters (Knudsen, 2007). 2) Activation of task-relevant processes, and 3) inhibition of task-irrelevant processes, both of which are essentially aspects of selective attention (Sohlberg and Mateer, 2017), sensory and behavioural selection (Cohen, 2014), or top-down sensitivity control (Egeth and Yantis, 1997), depending on the terminology of the model, but would likely be mediated through the executive control network (Petersen and Posner, 2012).

Mechanistic models of attention tend to categorize attentional control into "top down" or "bottom up" networks. Miller and Cohen (2001) provides an analogy of the brain being a set of tracks, neural signals to be transmitted being trains, and the pattern of tracks that the trains are required to travel to solve the task is the pattern of PFC firing. Processes which contribute to automatic and stereotypical behaviours in response to triggers in the external environment, such as orienting to a sudden sound or movement bypass the tracts of the PFC and continue along well established neural pathways between certain sensory stimuli and corresponding behavioural responses. These network activities that are largely controlled by subcortical activity are termed "bottom up" processes. However, when behavioural outcome involves rules and conditions and are internally determined, it is termed "top down" processing, and requires processing by an intact PFC. Constructs such as selective attention, behavioural inhibition, working memory, or goal-directed behaviour are all represented in the PFC as specific patterns of activity (Servan-Schreiber et al., 1990; Cohen and Servan-Schreiber, 1992; Miller and Cohen, 2001; Cohen, 2014). The active maintenance of these patterns of activity represent goals, which bias the signals, guiding the flow of neuronal activity along pathways that connect relevant inputs with outputs required to perform a particular task. Excitatory top-down signals that bias circuits towards the important features of the situation

likely underlies voluntary attention shifts, where the PFC provides a modulatory role as opposed to a transmissive role, guiding and priming neuronal activity along task relevant pathways (Miller and Cohen, 2001).

1.5 Subcortical modulation systems

A foundational state for an awake organism to function and perform goal oriented tasks requires an appropriate level of arousal which needs to be maintained so that ongoing sensory inputs and behavioural outputs can be effectively monitored and evaluated moment to moment, for novelty and salience (Knudsen, 2007; Petersen and Posner, 2012). This foundational state has been suggested to be somewhat analogous to focus capacity (Cohen, 2014).

The neural mechanisms which underlie the maintenance of arousal and evaluation of salience are largely controlled by three sub-cortical neurotransmitter modulation systems, namely norepinephrine (NE) released from the locus coeruleus (LC) (Nieuwenhuis et al., 2005), dopamine (DA) released from the ventral tegmental area (VTA) and substantia nigra pars compacta (SNc) (Polich and Criado, 2006; Polich, 2007; Ott and Nieder, 2019), and acetylcholine (ACh) released from the pedunculopontine nucleus (PPN) and basal forebrain (BF) (Ranganath and Rainer, 2003). It is noted that the histaminergic system is also important for the regulation of arousal (Cheng et al., 2021), and the serotinergic system is involved with psychomitetic effects of psychedelic drugs (Geyer and Vollenweider, 2008), and both contribute, to a lesser degree, to aspects of attention and neuropsychiatric disorders.

All incoming sensory information (except for olfactory signals) are processed through the thalamus prior to reaching the cortex. However, on the way up to the thalamus, the neurons carrying these sensory signals also send collaterals numerous sensory nuclei (Otake et al., 1994), and/or the LC (Waterhouse and Navarra, 2019) and VTA and SNc. These systems modulate the information, and then sends this more processed information to the thalamus, before the thalamus does the final processing and sends it to the cortex. In the following subsections, I will first review the modulatory systems, followed the thalamus and the cortex, in the context of attention.

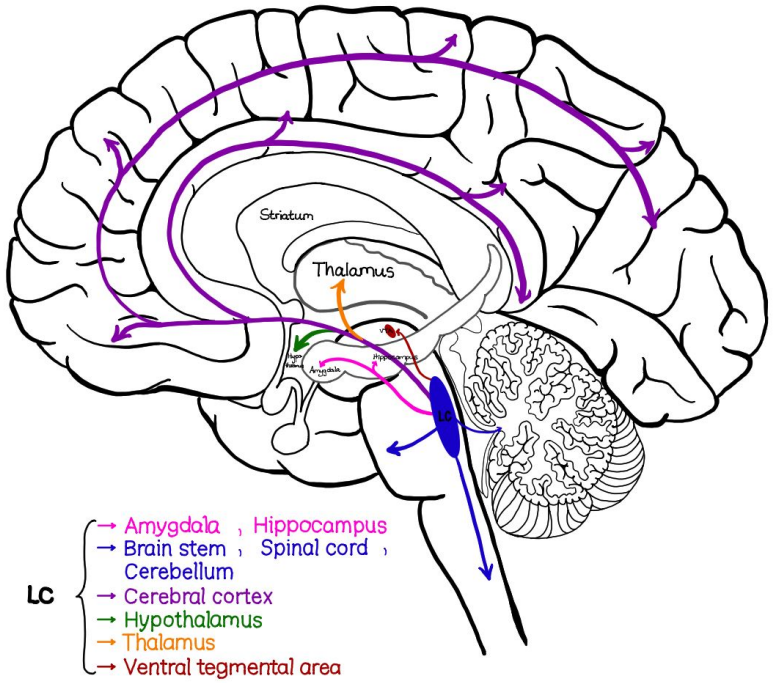


Figure 1.1 – Pathways of the noradrenergic system Cell bodies at the LC (blue) project via a variety of pathways to the majority of brain areas, including the brainstem, cerebellum and spinal chord (blue), hippocampus and amygdala (pink), hypothalamus (dark green), thalamus (orange), VTA (red), and the entire cortex (purple). Image adapted from (Morris et al., 2020)

1.5.1 The norepinephrine system

A dysfunction in NE transmission has been suggested to underlie some of the symptoms in schizophrenia since the early 70's (Stein and Wise, 1971) and this hypothesis still holds merit today, suggesting that aberrant NE signalling may play a particular role in the paranoid subtype of schizophrenia, which may warrant research into using more selective NE modulating drugs for some subtypes of schizophrenia (Fitzgerald, 2014).

The LC receives afferents from the nucleus paragigantocellularis (PGi) and nucleus prepositus hypoglossi (PrH) in the medulla (Aston-Jones et al., 1991), which are integration points for somatic and visceral sensory information, such as from the vestibular, visual, circulatory and gastrointestinal systems (Van Bockstaele et al., 1989; Aston-Jones et al., 1991; Van Bockstaele et al., 1993). These signals are further integrated at the LC, which is the primary source of NE in the brain (Seguela et al., 1990; O'Donnell et al., 2012), and then projects widely to the majority of brain areas, including the hippocampus, amygdala, thalamus, hypothalamus, VTA, substantia nigra (SN), BF and the entire cortex (Bari et al., 2020) (Figure 1.1).

The projections of the LC neurons are not only wide reaching, but also highly heterogeneous in

terms of their physiological response characteristics and molecular profiles, depending on their efferent targets, and thus the effects of NE at the neuronal terminal can vary depending on many more variables than can be covered in this brief review (Waterhouse and Navarra, 2019; Chandler et al., 2019). The heterogeneity of the LC-NE system may however explain the inconsistent results around NE activity in schizophrenia (none have been performed on MAP), with both excessive NE transmission, and insufficient NE transmission both being suggested (Lake et al., 1980; Kemali et al., 1982; Arnsten and Goldman-Rakic, 1985; Van Kammen et al., 1990; Powchik et al., 1998; Friedman et al., 1999).

Many studies have shown that pharmacologically increasing the availability of NE can improve performance on a variety of cognitive tasks (Arnsten and Goldman-Rakic, 1985; Rajkowski et al., 1994; Sara et al., 1994; Devilbiss and Waterhouse, 2000; Berridge and Waterhouse, 2003; Aston-Jones and Cohen, 2005; Devilbiss and Berridge, 2006; Devilbiss and Waterhouse, 2011; O'Donnell et al., 2012; Morris et al., 2020). For example, functional magnetic resonance imaging (fMRI) during the performance of a goal directed visuomotor task, blocking NE reuptake with reboxetine augmented visual processing and improved behavioural performance (Grefkes et al., 2010).

An appropriate level of arousal is important for task performance, and the NE system influences cognition by controlling arousal and regulating sensory signal processing depending on behavioural demands (Sara and Bouret, 2012; Berridge and Waterhouse, 2003). Optogenetic research has shown that direct photostimulation of NE release from the LC has the ability to rapidly switch an animal between wake and sleep states (Carter et al., 2010). Decades of research has shown that NE sets the "awake" state by creating an appropriate tone of neural activation in relevant areas of the brain that are required to receive sensory information. Then, while awake, moment to moment NE release to specific areas (e.g. relevant areas of the thalamus, sensory cortex and PFC, that relate to the sensory input) regulates the information transmitted from the sensory fields along ascending sensory pathways, refining signal to noise ratios of incoming stimuli and enhancing sensory information processing (Berridge and Waterhouse, 2003; Waterhouse and Navarra, 2019).

The effects of NE are concentration dependent, following the inverted-U shape of the Yerkes Dodson law, where concentrations that are too low or too high above the optimum produces deleterious effects to function (Devilbiss and Berridge, 2006). Other variables such as location of

NE release (e.g. thalamus vs cortex, or whether the receptors involved in the synapse include α 1 or β-adrenergic receptors), and the mode at which the NE is released are also highly relevant (Waterhouse and Navarra, 2019).

LC neurons have two firing modes. A tonic single spiking mode, and a phasic burst mode (Rajkowski et al., 1994). In the tonic mode, LC neurons fire individual action potentials at varying rates. For example, tonic discharges occur more frequently during spontaneous behaviours, and more slowly during sleep, or when animals are less attentive to the environment. This mode favours distractibility and surveillance behaviours and shifts the animal to explore other behaviours that might be more useful (Aston-Jones and Cohen, 2005). For example, in rats, increased tonic LC firing interrupts and re-directs foraging behaviour from its current strategy to a different foraging strategy if the latter strategy is better rewarded (Kane et al., 2017). In the phasic mode, the LC neurons fire in high frequency bursts, in trains of 3 to 7 action potentials, in response to novel, alerting, or task relevant stimuli, and biases the post synaptic cells towards strong stimuli (Ciombor et al., 1999). This mode favours sensory discrimination, focusing the animal more narrowly on fewer and more intense stimuli, which improves decision making and motor responding (Clayton et al., 2004) on tasks requiring focused attention (Aston-Jones and Cohen, 2005). Phasic bursting of NE at the thalamus switches the thalamic neurons from their own burst mode to tonic mode (Castro-Alamancos and Bezdudnaya, 2015), the importance of which will be expounded on in later subsections.

When in tonic mode, the amount of NE released at terminal sites is linearly correlated to the tonic firing rate, however, during phasic bursts, a much larger amount of NE is released at terminal sites than the amount released by the equivalent number of tonic spikes (Florin-Lechner et al., 1996; Berridge and Abercrombie, 1999). The switch between the tonic and phasic modes and vice versa in the LC can occur rapidly. While an animal is awake, the LC neurons may fire tonically and slowly while relaxed and grooming, a sudden external sensory stimulus may trigger a switch to phasic burst of action potentials, thereby shifting the attention of the animal towards the stimulus immediately (Aston-Jones and Bloom, 1981; Foote et al., 1983; McCormick, 1992).

Whether by shifting from tonic to phasic mode, or by varying tonic spike rate, NE regulation appears to have the general effect of shifting the efficacy of brain circuit activity to favour those stimuli that are alerting, or behaviourally relevant (Foote et al., 1991; Aston-Jones and Cohen,

2005; Bouret and Sara, 2005; Sara and Bouret, 2012); by increasing the signal to noise ratio (Livingstone and Hubel, 1981) of neuronal receptive fields (O'Donnell et al., 2012; Morris et al., 2020). For example, electrically stimulating the LC at physiological burst frequencies greatly increases the responsiveness of layer V neurons in the sensory barrel cortex to a single whisker deflection, while also increasing surround inhibition that distincly sharpened the borders of their receptive fields (Motaghi et al., 2006). This occurs because NE increases the postsynaptic neuron response to excitatory inputs by activating postsynaptic $\alpha 2$ and β adrenergic receptors, which inhibits incoming GABA signals to the target post synaptic neuron, however, $\alpha 1$ receptors on presynaptic GABA neurons are activated by the NE, leading to increased GABA release that amplifies surround inhibition in the vicinity the postsynaptic neuron (Waterhouse et al., 1980, 1982; Salgado et al., 2012).

NE is chemically made from DA, DA centers receive LC input, and both NE and DA systems respond to novel, task relevant and salient sensory cues. Work in monkeys has suggested that LC neuronal firing appears to predict the amount of effort that may be necessary to execute the task and achieve the reward, while SNc firing appear to predict the amount of the actual reward that may be achieved by executing the task (Varazzani et al., 2015), however, the LC also innervates the SNc (Geisler and Zahm, 2005). Further research is necessary to more effectively distinguish the roles between NE and DA during the performance of the same cognitive task. It is however clear that both are highly relevant for modulating key mechanisms for task performance.

1.5.2 The dopamine system

A dysfunction in the DA system remains one of the key hypotheses for the etiology of schizophrenia (Carlsson, 1988), and psychosis in general, as the majority of antipsychotics used for treating the symptoms, particularly positive symptoms of psychosis function by inhibiting D_2 receptors (Carlsson et al., 1997; Emilien et al., 1999a,b). The hypothesis suggests that positive symptoms in schizophrenia patients may be caused by excess DA assigning aberrant salience to sensory stimuli (Howes and Kapur, 2009), and/or excessive D_2 receptor activation in schizophrenia produces "unstable representations" of sensory and motor signals in the PFC, that lead to positive symptoms like hallucinations and intrusion of thought (Rolls et al., 2008; Mueser, 2004). While D_2 blocking medications may be effective for treating positive symptoms, they are less effective for treating negative symptoms and cognitive deficits in schizophrenia (Meltzer and Stahl, 1976; Kim et al.,

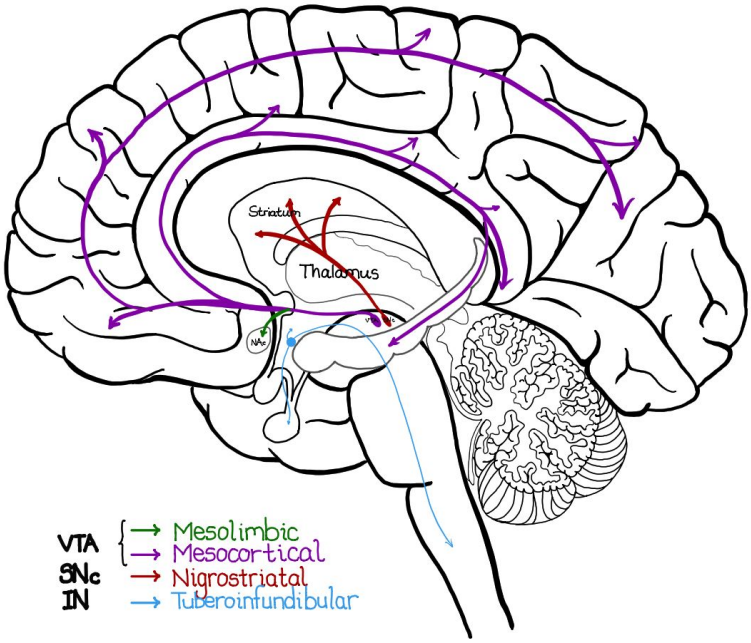


Figure 1.2 – Pathways of the dopaminergic system The four major dopaminergic pathways include the mesolimbic, with cell bodies in the VTA projecting to the NAc; mesocortical, where cell bodies in the VTA project to the majority of the cortex; nigrostriatal, where cell bodies in the SNc project to the striatum in the BG, and tuberoinfundibular, where cell bodies in the hypothalamus project to the median eminence. BG = basal ganglia; NAc = nucleus accumbens; SNc = substantia nigra pars compacta; VTA = ventral tegmental area). Image source (Scarr et al., 2013)

2009; Meltzer, 2017), thus, while important, DA comprises only one part of multiple dysfunctional neurosystems in schizophrenia. Additional relevance to this work is that MA exerts the bulk of its effects via increasing the availability of DA in the synapses, stimulating vesicular release of DA (Fallon and Moore, 1978; Haber and Knutson, 2010), and reversing both the vesicular monoamine transporter 2 (VMAT2) and dopamine transporter (DAT) autoreceptors, resulting in even more DA release through what should have been re-uptake channels (Sulzer et al., 1995; Sora et al., 2009).

Like for NE, the effect of DA follows an inverted-U curve as a function of its concentration, where both too low and too high cause deleterious results (Björklund, 1984; Björklund and Dunnett, 2007). A functioning DA system is critical for cognitive processes. DA neurons are rapidly activated by novel stimuli, and primary reinforcers that are either rewarding, such as food, or punishing, such as pain (Lak et al., 2016; Bromberg-Martin et al., 2010; Matsumoto and Hikosaka, 2009; Horvitz, 2000), and in addition, they signal a reward prediction error, where DA neurons are inhibited if a predicted reward does not arrive as expected, enabling reinforcement learning (Montague et al., 1996; Schultz, 1998; Watabe-Uchida et al., 2017). In the PFC, appropriate

DA transmission has been found to be important for cognitive functions like working memory (Goldman-Rakic et al., 2000; Shimamura, 2000; Arnsten and Li, 2005; McNab and Klingberg, 2008; Arnsten, 2011; Clark and Noudoost, 2014), selective attention (Clark and Noudoost, 2014; Thiele and Bellgrove, 2018), and flexible behavioural choice in response to changing task or environmental conditions (Floresco and Magyar, 2006; Arnsten et al., 2012; Vijayraghavan et al., 2017).

DA exerts its effects through 5 subtypes of receptors, simply named D_1 to D_5 receptors. All are G-protein-couple receptors that do not produce postsynaptic currents directly, and rather modulate neuronal firing through initiating intracellular cascades when receptors are bound. D_1 and D_5 are similar in function, and activation of these receptors takes the cells closer to depolarization, whereas D_2, D_3 and D_4 are more similar, and activation takes the cells closer to repolarization or hyperpolarization (Lidow et al., 1991; Jackson and Westlind-Danielsson, 1994; Seamans and Yang, 2004; Surmeier et al., 2007). Like NE, DA also generally serves to improve signal-to-noise ratios and sharpening neuronal receptive fields while processing signals through each junction of its various pathways (Servan-Schreiber et al., 1990).

DA is produced and released in 3 centers of the brain, namely the VTA, the SNc, and the infundibular nucleus of the hypothalamus and project along 4 major pathways, i.e. the tuberoinfundibular, mesolimbic, nigrostriatal and mesocortical pathways (Albanese et al., 1986). The tuberoinfundibular pathway, where cell bodies in the hypothalamus project to the median eminence, is largely involved in the inhibition of prolactin and not critical for cognition, thus will not be discussed further. The other 3 pathways affect cognitive processes and bahavioural choice and control in different and important ways.

The mesolimbic pathway consists of dopaminergic cell bodies in the VTA projecting to the GABAergic cells at the NAc, hippocampus, amygdala and medial prefrontal cortex (PFC) (Albanese and Minciacchi, 1983). The release of DA in this pathway is associated with the experience of reward or euphoria, and in the subjective perception of pleasure (Koob and Bloom, 1988; Volkow et al., 1996; Drevets et al., 2001; Berridge and Kringelbach, 2015). This regulates incentive salience, i.e. motivation to perform effortful tasks (Salamone et al., 2007), re-enforcement learning, and reward-related motor learning (Nicola, 2007; Malenka et al., 2009; Berridge and Kringelbach, 2015), translating emotions into actions (Mogenson et al., 1980). These functions are largely achieved by DA release from the VTA to the NAc core, which consists largely of GABAergic

neurons. GABA inhibition on the tonically active GABAergic neuron in the SNr/GPi results in disinhibition of the thalamus, and an increase in cortical glutamate, thus amplifying the initial rewarding signal which triggered the DA release from the VTA (Maurice et al., 1999; Nicola, 2007; Hsieh et al., 2014).

The nigrostriatal pathway consists of cell bodies from the SNc that project to the striatum. It incorporates the well known direct and indirect pathways that control and coordinate the execution of planned behaviour (Albanese et al., 1986). The direct pathway is activated when the GABAergic striatal cells that express D_1 receptors are stimulated, while the indirect pathway is activated when the striatal cells expressing D_2 receptors are stimulated (Balleine et al., 2007; Nicola, 2007).

At rest, there is little movement because the substantia nigra pars reticulata (SNr) GABAergic neurons are tonically active, which constantly inhibits thalamic neurons that project to the motor cortices and thus preventing the execution of movement (Reubi et al., 1977, 1978; Celada et al., 1999; Benazzouz et al., 2000). In addition, striatal cholinergic and GABAergic interneurons also have general inhibitory effects on projection neurons and ensure stillness at rest (Reubi et al., 1977, 1978; Rymar et al., 2004). Signals for specific movements are sent via glutamatergic, cortico-striatal neurons from relevant cortical areas to the topographically mapped area in the striatum. (Note: the same cortical signal is simultaneously sent to the PFC and cerebellum for additional forms of processing as well (Bosch-Bouju et al., 2013)). The relevant neurons in the striatum that receive the cortical signals via NMDA receptors become primed into an "upstate", where the neuron is more sensitive to depolarization, favouring particular pathways relevant to the necessary behaviour (Wilson and Kawaguchi, 1996). Once primed, small increases of activation such as by DA released from the SNc via the nigrostrial pathway would lead to the generation of action potentials that finally activate the primed pathway (Wilson, 1993; Tepper and Bolam, 2004). DA release into the striatum from the SNc and causes synergistic activation of both the D_1 and D_2 receptors allows DA to simultaneously activating the direct pathway, and inhibiting the indirect pathway, with the net result of enhance glutamate signals from the motor cortices in the striatum (Hu and White, 1997). In fact, DA can be released from the terminals of neurons originating from the SNc, without activation of cell bodies at the SNc, because activation of striatal cholinergic interneurons triggers DA release via the activation of nicotinic acetylcholine receptors (nAChR) on dopaminergic axons (Bergson et al., 1995; Threlfell et al., 2012).

The mesocortical pathway consists of two parallel systems (Williams and Goldman-Rakic, 1998). In the first, cell bodies in the VTA innervates both the dorsal and ventral anterior cingulate cortex (ACC), and the ventral medial PFC. In the second, the dorsal and lateral SNc projects to the DLPFC, and the surrounding medial PFC and lateral orbitofrontal cortex (Goldman-Rakic et al., 1989; Williams and Goldman-Rakic, 1998; Tzschentke, 2001; Petrides, 2005).

These pathways convey saliency and motivational signals to the PFC (Simon et al., 1980; Goldman-Rakic et al., 2004; Bromberg-Martin et al., 2010; Matsumoto and Takada, 2013) by increasing the sensitivity of relevant sensory neurons in the PFC, which increases their probability of firing. In addition, it also reduces the variability of PFC neuronal firing, increasing signal fidelity (Servan-Schreiber et al., 1990; Jacob et al., 2013). Optimal levels of DA also stimulate cortical GABAergic neurons and "tune" the receptive fields of pyramidal neurons, increasing the signal to noise ratios of sensory and feedback signals, and enhances cognitive performance (Muly et al., 1998).

Thus in the PFC, both the NE and DA systems play a major role in multiple aspects of cognition, and ACh is also able to influence behavioural choice at the level of the striatum. The ACh system is also highly relevant to the topic of attention and will be discussed next.

1.5.3 The acetylcholine system

Individuals with schizophrenia have a higher prevalence of smoking, which has been considered potentially as self medication (Mitchell and Dahlgren, 1986; Nisell et al., 1995), as it can improve attention and positive symptoms in schizophrenia (Nisell et al., 1995; Brunzell and McIntosh, 2012). Little is known for MAP, however, adjunctive treatment of schizophrenia with acetylcholinesterase inhibitors was found to be effective for treating visual hallucinations (Patel et al., 2010) suggesting that schizophrenia may also have a hypocholinergic neural system. Nicotine use also increases cortical DA release, and it has been proposed that an imbalance between the ACh and DA systems may underlie the pathology of schizophrenia (Tandon and Greden, 1989; Nisell et al., 1995).

ACh is involved in a wide variety of functions, such as sleep, attentional gating and signal detection (Parikh et al., 2007; Berry et al., 2014; Gritton et al., 2016), inhibiting inappropriate behaviours (Condy et al., 2007) and cognitive processing such as working memory (Croxson et al., 2011). These diverse functions are processed through 2 different families of receptors and three main

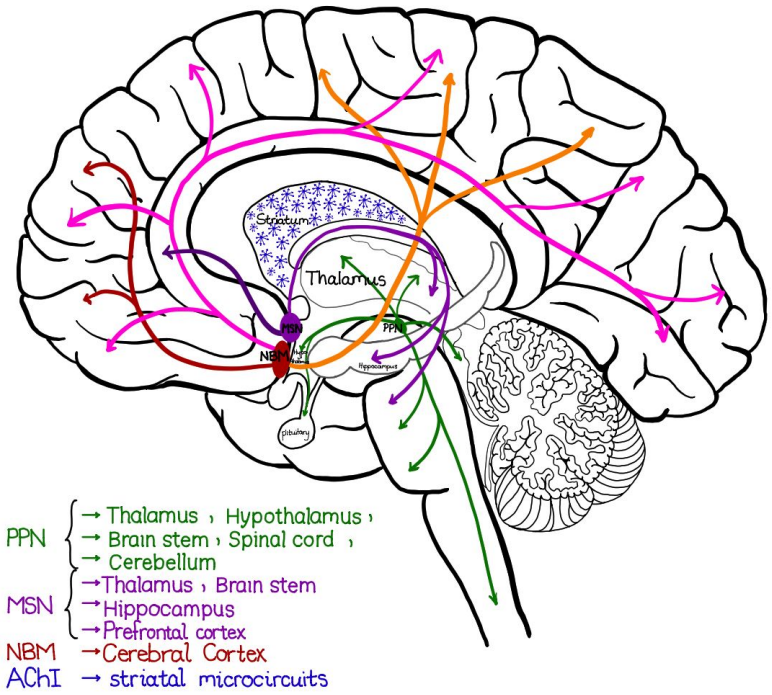


Figure 1.3 – **Pathways of the cholinergic system** ACh is largely produced in the PPN (green), some nuclei in the BF, including the MSN (purple), NBM (red, pink, orange), and NDB (not shown), and AChI (blue). AChI = interneurons within the striatum and NAc, MSN = medial septal nucleus, NBM = nucleus basalis of Meynert, NDB = nucleus of the diagonal band, PPN = pedunculopontine nucleus. Image adapted from (Scarr et al., 2013) and (Abudukeyoumu et al., 2019)

pathways, where efferent targets also overlap with targets of the NE and DA systems.

ACh exerts its effects through two families of receptors. The nAChR are a family of ligand-gated Na^+ and/or K^+ channels. Each channel consists of 5 protein subunits, which can be made up of a combination of 9 variations of alpha subunits, and 3 variations of beta subunits (Millar et al., 2011). Different combinations of the various types of subunits give the nAChRs distinct properties.

The muscarinic acetylcholine receptors (mAChR) are a family of metabotropic receptors, G-protein coupled receptors that modulate neuronal firing through initiating intracellular cascades when receptors are bound. There are 5 types of mAChRs (M1-M5), where M1, M3, and M5 use cAMP as a second messenger, while M2 and M4 use IP3 as a second messenger. (Lucas-Meunier et al., 2003)

In the striatum (as well as NAc and VTA), cholinergic cells are interneurons that innervate and regulate the GABAergic cells that largely make up the striatum (Butcher, 1984; Zhou et al., 2002; Pakhotin and Bracci, 2007; Sullivan et al., 2008). People with schizophrenia have lower numbers of both dorsal and ventral striatal cholinergic interneurons, which may have important consequences

to striatal function in schizophrenia (Holt et al., 1999, 2005), as each neurotransmitter system exerts effects over the other. The cholinergic interneurons themselves express D_1 and D_5 receptors (Bergson et al., 1995), thus activating D_1 receptors in the striatum stimulates ACh release, while D_1 receptor blockade decreases ACh release (Bertorelli and Consolo, 1990; Acquas and Fibiger, 1998). The opposite is true for D_2 receptors, where activation decreases ACh release and blockade of D_2 receptors increases ACh release in the striatum (Gorell and Czarnecki, 1986; Damsma et al., 1990).

Nicotine is able to stimulate DA release (Zhou et al., 2001, 2002). DA axons from the SNc that innervate the striatum express nAChRs, and ACh release can trigger DA release in the striatum from these terminals without the activation of the SNc (Threlfell et al., 2012). However, all mAChRs are expressed in the striatum, but differential localization of expression can increase the number of ways that ACh can modulate the activity of DA in the striatum. For example, all neurons expressing D_1 receptors also express M1 and M4 receptors, which D_2 expressing neurons also express M1 receptors, but less than half express M4 receptors (Weiner et al., 1990; Ince et al., 1997). Thus, considering the possibilities of pre and post synaptic locations, as well as different signalling cascades used by the muscarinic receptors, stimulating mAChRs could result in either enhancing or inhibiting the effects of DA in the striatum (Scarr et al., 2013).

The BF nuclei (medial septal nucleus (MSN), nucleus basalis of Meynert (NBM), and nucleus of the diagonal band (NDB)) strongly innervate the PFC as well as the rest of the cortex, hippocampus and RN (Sofroniew et al., 1982; Mesulam et al., 1983; Hallanger et al., 1987; Levey et al., 1987; Steriade and Llinas, 1988; Rubboli et al., 1994). The PPN sends projections to the thalamus and thalamic reticular nucleus (TRN) (Hallanger et al., 1987; Jones and Beaudet, 1987; Steriade and Llinas, 1988; Fitzpatrick et al., 1989), and the thalamus also contains high concentrations of both nAChRs and mAChRs (Rubboli et al., 1994; Spurden et al., 1997).

The above selective review of the NE, DA and ACh ascending modulatory systems has covered a multitude of circuits that prepare the brain and specific networks within the brain for receiving or inhibiting ascending sensory signals, which also get processed further to increase signal-to-noise ratios through the mesocortical, nigrostriatal, LC-cortical, BF cortical pathways. However, after the cortex has gone through its processing of the signals, they are all routed back to the thalamus, where a final integration of processed signals appears to occur, prior to the thalamus sending

signals to the primary motor cortex to execute a particular movement. Of course, these networks continue to operate in parallel, integrating new sensory and feedback signals through respective networks repeatedly, allowing tight moment-to-moment behavioural control.

The thalamus however, is also highly regulated by the TRN. I will thus review the thalamocortical (TC) loop next.

1.6 The thalamo-cortical system

The thalamus has been viewed as a hub that is involved in generating other symptoms of schizophrenia, including hallucinations, delusions, and other neurocognitive problems such as learning and memory (Gur et al., 2007; Ferrarelli and Tononi, 2010; Pergola et al., 2015; Pratt and Morris, 2015; Young and Wimmer, 2017), and thalamic activity has been shown to directly contribute to cognitive processing speed (Klostermann et al., 2006). There is much electrophysiological evidence which supports the involvement of the TRN in sensory gating (Krause et al., 2003), and attentional modulation (Guillery et al., 1998; McAlonan et al., 2000; Zikopoulos and Barbas, 2006; Mayo, 2009), where dysfunction of the TRN results in attentional deficits (McAlonan et al., 2006, 2008). Induced decrease in TRN firing resulted in decreased auditory gating (Krause et al., 2003).

Deficits in thalamic function due to poor control of TC neuron firing by the TRN may underlie a substantial number of schizophrenia symptoms (Ferrarelli and Tononi, 2010; Pergola et al., 2015; Pratt and Morris, 2015; Young and Wimmer, 2017), as well as the deficient top-down prefrontal control of attention (Zikopoulos and Barbas, 2006, 2007a), resulting in attentional deficits (McAlonan et al., 2006, 2008). Sleep spindles are involved with memory consolidation (Tandon et al., 1992; Gais et al., 2002; Schabus et al., 2004; Clemens et al., 2005, 2006; Eschenko et al., 2006; Fogel and Smith, 2006; Nishida and Walker, 2007; Morin et al., 2008; Schabus et al., 2008; Fogel and Smith, 2011; Molle and Born, 2011; Tamaki et al., 2013). People with schizophrenia have shown poorer sleep-dependent memory consolidation of procedural learning activities (Manoach et al., 2004, 2010), and schizophrenia research have consistently shown deficits in spindles during non rapid eye movement (NREM) sleep (Ferrarelli et al., 2007, 2010; Manoach et al., 2014; Ferrarelli, 2015; Tesler et al., 2015; Ferrarelli and Tononi, 2017). Sleep spindles are generated then sustained and relayed to the cortex by intrathalamic and TC loops, and ongoing network activity

between the TRN and TC neurons (Huguenard and Mccormick, 2007; Astori et al., 2013; Bartho et al., 2014). It is unknown whether MAP may have similar deficits in the TC, TRN, cortical loop, however cocaine exposure has been shown to disrupt GABA transmission in the TRN in rodents (Urbano and Bisagno, 2017a), which suggests a possibility for TRN damage in MAP. Since impairments in this circuit leads to attentional problems in general, this is a highly relevant system for studying attention in MAP.

All sensory systems, including all somatosensory and viscerosensory systems, with exception of the olfactory system, are delivered by the ascending sensory pathways and enter the thalamus at topographically organized nuclei, terminating on relevant TC neurons (Kandel et al., 2000). On their way to the thalamus however, the ascending sensory pathways send collaterals to various sensory nuclei in the medulla (Kandel et al., 2000). Some collateral branches innervate other sensory nuclei, for example, the nucleus of the solitary tract, and/or the nucleus paragigantocellularis (PGi), prior to being delivered to the LC (Aston-Jones et al., 1991); or to the periaqueductal gray, prior to being delivered to the VTA (Geisler and Zahm, 2005), while others directly innervate the VTA, SNc, BF and LC nuclei. How sensory signals are modulated through these systems, and then output to relevant nuclei in the thalamus were reviewed previously.

Both TC and CT neurons are glutamatergic. Thalamic neurons that receive driving signals from the ascending systems are termed first order (FO) neurons, while thalamic neurons that receive driving signals from cortical layer V/VI are termed higher order (HO) neurons. TC cells output largely to cortical layers III/IV, and send collaterals to the TRN. Similarly CT neurons largely from layer VI send cortical feedback to both FO and HO neurons, and also send collaterals to the TRN.

The TRN is a thin and shell shaped structure made entirely of GABAergic cells (Houser et al., 1980; Ferrarelli and Tononi, 2010), found between the core of the dorsal thalamus and the cortex, and is a hub for cortico-thalamic communications (Crabtree, 1999; Guillery and Harting, 2003; Jones, 2007). Particularly important pre-frontal areas to note for psychosis include the dorsolateral prefrontal cortex (DLPFC) and the ACC, which provide large inputs to the RN (Devinsky et al., 1995; Paus, 2001), and have shown consistent evidence for impairment in MAP and schizophrenia (Manoach et al., 2000; Zhou et al., 2007; Mulert et al., 2008; Yamamuro et al., 2016; Ipser et al., 2018). The brain stem projects cholinergic, noradrenergic and serotonergic inputs to the TRN

(Morrison and Foote, 1986; Hallanger et al., 1987; Guillery et al., 1998). Pre-frontal areas send widespread glutamatergic projections to the TRN neurons (Zikopoulos and Barbas, 2006, 2007a), and these pre-frontal projections also overlap with projections from the sensory cortices at the TRN (Zikopoulos and Barbas, 2007b). The BF and globus pallidus (GP) project GABAergic inputs to the TRN (Asanuma, 1989; Hazrati and parent, 1991; Asanuma, 1994). The SN also sends some dopaminergic projections to the TRN (Gandia et al., 1993).

The variety of inputs into this hub at the TRN allows signals from all areas of the brain to modulate and contextualize the activity of TC neurons to global brain activity. In fact, the TRN receives more cortical input than thalamic input (Pinault, 2004). There are 10 fold more corticothalamic (CT) neurons than TC neurons (Guillery, 1967, 1995), and there are 3.7 times more cortical inputs into the TRN than cortical inputs into the thalamus (Golshani et al., 2001).

The cortex, thalamus and TRN all contain cells that have either bursting and/or tonic firing capabilities that are mediated by the expression of low-voltage gated T-type Ca^{2+} channels (Talley et al., 1999). The biophysics of the the currents created by the interaction of these Ca_v channels with Na^{2+} and K^+ currents, result in "window currents", that allow cells expressing T-type Ca^{2+} channels to have two membrane potentials, or membrane bistability (Crunelli et al., 2005). T-type Ca^{2+} channels activate upon depolarization when over the membrane potential of around -50 mV, inactivate at membrane potentials below -50 mV, however, when the cell membrane becomes further hyperpolarized to around -80 mV, channels de-inactivate, allowing an influx of Ca^{2+} (Crunelli et al., 2005; Ferrarelli et al., 2007; Kovács et al., 2010; Ferrarelli and Tononi, 2017). There are 3 types of low voltage gated Ca^{2+}, $Ca_v3.1$, $Ca_v3.2$, $Ca_v3.3$, each with slightly different properties, in-

Table 1.1 – Thalamic inputs and outputs

Inputs	Outputs
mammilothalamic tract	anterior cingulate
fornix	posterior cingulate
substantia nigra	parietal and temporal cortex
ventral anterior nucleus	posterior parietal cortex
globus pallidus	occipital visual areas
deep cerebellar nuclei	primary visual cortex
medial lemniscus	primary auditory cortex
spinothalamic tract	somatosensory cortex
trigeminal, gustatory and optic tracts	primary motor cortex
superior and inferior colliculi	pre motor cortex
posterior parietal cortex	pre frontal cortex
pre frontal cortex	
amygdala	

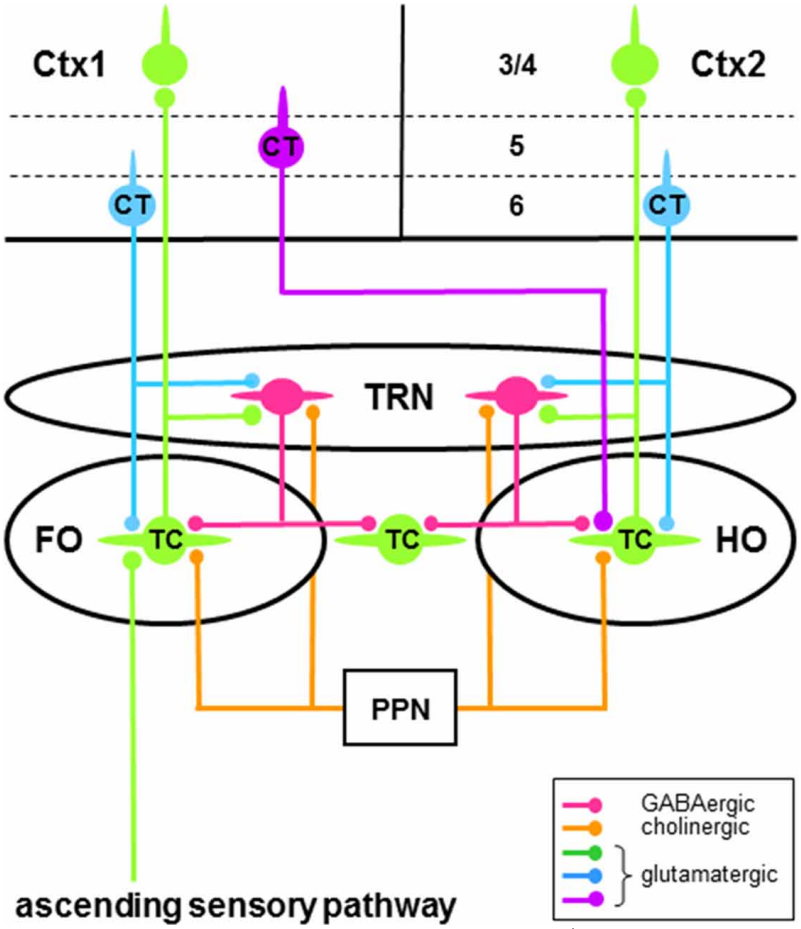


Figure 1.4 – The thalamo-cortical circuit. All TC cells (green, glutamatergic) receive inputs from the RN, brainstem modulators such as the PPN (orange, cholinergic), and cortical input from layer VI (blue, glutamatergic); HO TC cells receive driving signals from CT cells originating in layer V (purple, glutamatergic); FO TC cells receive driving inputs from the ascending sensory pathway (green). RN neurons (pink, GABAergic) receive 10 times more arborations from layer VI CT cells than arborations from TC cells, thus cortical modulation has greater impact on RN activity than TC signals. Image source (Crabtree, 2018). Ctx = cortex; CT = corticothalamic; FO = first order; HO = higher order; PPN = pedunculopontine nucleus; RN = reticular nucleus of the thalamus; TC = thalamocortical.

cluding differences in their rates and voltages at which activation, inactivation and de-inactivation occurs. Thus different expression levels of these proteins between cell types would garner each unique properties. $Ca_v3.1$, $Ca_v3.2$ have more similar properties, while $Ca_v3.3$ are slower to activate and inactivate during the depolarization portion of the action potential (Klockner et al., 1999; Catterall et al., 2003; Cataldi et al., 2007; Hildebrand et al., 2007), and unlike the other two channels, the inactivation is insensitive to changes in membrane potential (Huguenard and McCormick, 1992; Destexhe and Sejnowski, 2003).

TC neurons express mostly $Ca_v3.1$ and very little amounts of $Ca_v3.2$ and $Ca_v3.3$ channels (Talley et al., 1999; Perez-Reyes, 2003). Hyperpolarization de-inactivates the more predominantly expressed $Ca_v3.1$ T-type channels in the TC neurons, and the influx of Ca^{2+} triggers membrane

depolarization produces a burst of action potentials. This burst mode transmits internally generated signals at 0.1-4 Hz to the cortex and TRN, termed delta rhythms, which are commonly observed in EEG recordings during slow wave sleep. (Destexhe and Sejnowski, 2003; Ulrich, 2014; Herrera et al., 2016). Depolarization of the TC neurons above -80 mV membrane potential briefly inactivates T-type channels, but further depolarization to about -50 mV membrane potential switches the TC neurons to single spiking threshold. This tonic mode transmits sensory information to the cortex during wake (Destexhe and Sejnowski, 2003; Ferrarelli and Tononi, 2017). The multitude of inputs into both the TRN and the thalamus, as well as reciprocal connections between them, modulates whether the TC neurons finally sends tonic or burst signals to the cortex (Destexhe and Sejnowski, 2003; Ferrarelli et al., 2007; Herrera et al., 2016).

Mutations in the CACNA1H gene coding for the $Ca_v3.2$ channel, and also the CACNA1C gene coding for the $Ca_v1.2$ (high-voltage gated, L-type Ca^{2+} channel), both abundantly expressed in TC neurons have been strongly associated with schizophrenia (Purcell et al., 2014; Heyes et al., 2015). While the effects of mutations on various sites of these genes are being studied further, there is evidence that mutations at several different site may cause loss of function in both genes (Bigos et al., 2010; Purcell et al., 2014; Yoshimizu et al., 2015). Loss of function in these channels have been linked to poor TC neuron function, and neuropsychiatric illnesses, including schizophrenia (Heyes et al., 2015; Yoshimizu et al., 2015). While little is known about T-type channels in MAP, cocaine has been shown to disrupt GABA transmission in the TRN in animals (Urbano and Bisagno, 2017a), which suggests that the TRN may also be damaged in MAP, whether by genetic predisposition or cumulative damage from extended exposure.

The dendrites of TRN GABAergic neurons express predominantly $Ca_v3.3$ channels, and much lower amounts of $Ca_v3.2$, and very little if any $Ca_v3.1$ channels (Huguenard and McCormick, 1992; Talley et al., 1999; Perez-Reyes, 2003). $Ca_v3.3$ channels have a larger I_T window (Klockner et al., 1999), so they are slower to activate and inactivate during the depolarization portion of the action potential compared to $Ca_v3.1$ and $Ca_v3.2$ (Catterall et al., 2003; Cataldi et al., 2007; Hildebrand et al., 2007), and the inactivation is insensitive to changes in membrane potential (Huguenard and McCormick, 1992; Destexhe and Sejnowski, 2003). These characteristics make them more sensitive to cortical inputs than TC neurons, and allows them to generate long-lasting bursts of neuronal firing (Destexhe and Sejnowski, 2003; Murbartian et al., 2004). The $Ca_v3.3$

channels also play a major role as the pacemaker of sleep spindles in the thalamus (Astori et al., 2011). A genetic deletion of $Ca_v3.3$ channels severely decreases Ca^{2+} currents and prevents the low threshold bursting necessary to sustain spindle oscillations (Astori et al., 2011).

CACNA1I (Ca^{2+} voltage-gated channel pore-forming subunit alpha I) gene that encodes the $Ca_v3.3$ of T-type Ca^{2+} channels (Perez-Reyes, 2006; Monteil et al., 2015), has been reported by large genome wide association study (GWAS) reports as a candidate gene associated with schizophrenia (Irish Schizophrenia Genomics and The Wellcome Trust Case Control C., 2012; Hamshere et al., 2013; Schizophrenia Psychiatric Genome-Wide Association Study (GWAS) Consortium, 2014; Xu et al., 2018). In schizophrenia, a mutation of a single copy of the CACNA1I gene may result in mRNA truncation, and partial protein expression (Rivas et al., 2015). An *in vitro* study of alternative splicing of the CACNA1I mRNA showed that additions and/or subtractions of mRNA regions result in channels with slower rates of opening, or slowed activation and inactivation kinetics (Murbartian et al., 2004). In schizophrenia, a particular missense variation (R1346H) results in lower expression, lower glycosylation, and lower membrane surface concentration of $Ca_v3.3$ channels, reducing the Ca^{2+} currents by about 50%, when expressed in human cell lines (Andrade et al., 2016). Modelling the consequences of this mutation, this study found that a 22% or more decrease of $Ca_v3.3$ channel current densities in the TRN can eliminate rebound bursting (Andrade et al., 2016). Lower $Ca_v3.3$ activity may lead to reduced ability to remain in burst mode, and have a greater propensity to switch into tonic firing mode (McCormick and Bal, 1997). Indeed, a selective T-type channel blocker (TTA-P2) which blocks low voltage Ca^{2+} currents without affecting any other currents, abolished burst firing in the TC and TRN, without affecting tonic firing (Dreyfus et al., 2010).

Recently, *Nature* published a comprehensive, multi-modal study of the cellular sub-populations in the TRN (Li et al., 2020). This study discovered that all cells in the TRN express Spp1 and Ecel1 genes in opposite concentration gradients, where cells that have the highest expression of Spp1 express no Ecel1, and the lower amount of Spp1 expression, the higher amount of Ecel1 expression occurs, resulting in double labelled (and neither labelled) cells, and other cells that express only Ecel1. Using $Spp1^+$ and $Ecel1^+$ as markers for differentiating neuronal types in the TRN, they discovered, using RNA FISH, that $Spp1^+$ neurons co-expressed with CACNA1I, and $Ecel1^+$ neurons co-expressed with SLC6A1 (encodes a GABA transporter that removes GABA

from the synapse). Continuing to use Spp1 and Ecel1 as markers for cell types in the TRN, using fluorescent retrograde labelling in conjunction with RNA FISH, they discovered that the majority of $Spp1^+$ neurons located in the core region of the TRN, and projected to FO thalamic neurons, while $Ecel1^+$ neurons projected largely to the shell region of the TRN and projected to HO thalamic neurons. And finally, combining whole cell patch-clamp recordings to record electrophysiological properties of 76 individual neurons across the entirety of the TRN, then sending the cell contents of each cell for single nucleus RNA sequencing (snRNA-seq), they discovered that the cells that had produced the most robust burst firing (average of 5.5 $\pm$ 2.4 bursts per 5) with higher spike frequencies when bursting (166.1 $\pm$ 40.2 Hz) and a large post-burst after-hyperpolarization (AHP) (26.5 $\pm$ 8.6 mV) were $Spp1^+$. On the other hand, those cells that showed less robust burst firing (average of 0.95 $\pm$ 0.8 bursts per 5 s, lower intra-burst spike frequency (86.1 $\pm$ 44.7 Hz) with smaller post-burst AHP (12.25 $\pm$ 9.7 mV). The cells expressing both or neither gene presented mixed features in relation to the ratio of Spp1 and Ecel1 expressed. Given these results, the authors suggest that the $Spp1^+$ TRN neurons, which co-express CACNA1I, project to FO neurons with more robust burst firing are most probably involved in sensory gating. On the other hand, the $Ecel1^+$ TRN neurons that co-express SLC6A1, project to HO neurons with fast dynamics instead of burst firing, could be involved in the integration of complex features across modalities or the generation of sensory induced motor signals. This cellular diversity may facilitate the intrinsic flexibility of TRN to meet the diverse and graded spatial and temporal demands of TC interactions in the context of sensation, action and cognition (Li et al., 2020).

Taking together the above evidence, the TC loop converges signals from the anterior and posterior cortical areas to enhance relevant stimuli, and also to suppress irrelevant inputs. For schizophrenia, hallucinations have been thought of as impairments in gating internal cortical stimuli, while delusions tend to arise in a state of hypervigilance, where increased neuronal activity enhances response to incoming inputs. Attention, learning and memory also all rely heavily on proper internal and external sensory modulations. Thus poor attention, hallucinations and delusions may potentially all be explained by reduced ability of the TRN to inhibit TC activity, resulting in hyperactivation of the cortex (Ferrarelli and Tononi, 2010).

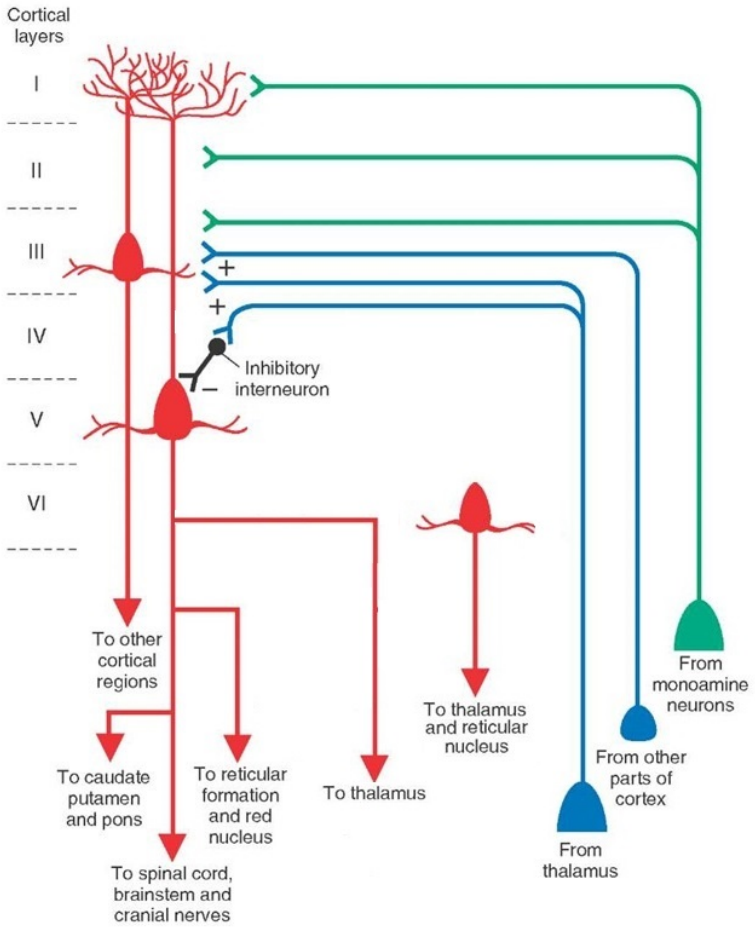


Figure 1.5 – Input and output connections of cortical layers Layers I/II consist mostly of dendrites from cells originating in layers III/IV and V, and axon terminals from the thalamus, other monoamine modulator nuclei, and other cortical regions; integrating cortical and subcortical signals. Monoaminergic projections mainly terminate in more superficial layers. TC neurons largely terminate in layers III/IV, but can also both excite (+) or inhibit (-) pyramidal cells in layer V. Cells in layers III/IV send axons to layers I/II/III and IV of other cortical regions, supporting the bulk of cortico-cortical connections. Layer V cells output driver signals to the spinal cord, cranial nerve motor nuclei, other brainstem structures, thalamus, and neostriatum. Layer VI cells output to the thalamus and RN. Image modified from source (The Crankshaft Publishing, 2012).

1.7 Cortical circuits

There is wide consensus in the literature from several meta-analyses supporting deficiencies in the DLPFC and ACC (and thalamus) in schizophrenia (Glahn et al., 2005; Fusar-Poli et al., 2007; Minzenberg et al., 2009; van der Meer et al., 2010; Kraguljac et al., 2012). Similarly, ^{1}H-MRS studies showed that acute and short term MA abuse is associated with lower *N*-acetylaspartate (NAA) in both the ACC and DLPFC, and higher mI in the ACC, suggesting that acute MA abuse results in neuroinflammation and loss of neuronal integrity in these regions (Burger et al., 2018). In MA dependence and MAP, NAA is lower in both the ACC and DLPFC compared to healthy controls demonstrating loss of neuronal integrity and viability with MA use and MAP (Howells

et al., 2014).

The DLPFC receives inputs from multiple secondary associative areas that have already converged multiple modes of sensory information (Jones and powell, 1970; Chavis and Pandya, 1976; Pandya et al., 1987), and strongly modulates motor behaviours through direct connections with the frontal eye fields (controlling voluntary gaze), supplementary and pre-supplementary motor areas, pre-motor cortex, cerebellum and superior colliculus (Goldman and Nauta, 1976; Bates and Goldman-Rakic, 1993; Schmahmann and Pandya, 1997). The decisions for outputs based on complex associative information are governed by rules. For example, The same behaviour could be elicited by two separate cues, but one DLPFC neuron will fire for one cue, while a different PFC neuron will fire for the other cue (Barone and Joseph, 1989a,b; Watanabe, 1990; Boussaoud and Wise, 1993; Miller and Cohen, 2001; Holroyd and Yeung, 2012).

The ACC detects conflict, in the form of co-activation of competing sets of inputs, for example during the performance of a conflicting Stroop task where a strong practised pathway to read the word regardless of the colour that it is written in conflicts with the instruction to name the colour that the word is written in instead of the word (Carter et al., 1998; Botvinick et al., 1999; Carter et al., 2001). Increased ACC activation during this task allocates more resources to the DLPFC that "diverts" the trains onto tracks that would co-ordinate the signals to their destinations without collision (Miller and Cohen, 2001; Holroyd and Yeung, 2012).

There are 6 identifiable layers throughout the canonical cerebral cortex [Douglas et al. (1989)], with some regional differences where some layers could be more prominent, or some others less so. The layers are named I through VI, with layer I being the most superficial. Instead of describing the cortical layers in numerical order, I will describe it as if a hypothetical simplistic signal were sent from the thalamus to the cortex.

Such a hypothetical signal would arrive on the terminals of TC neurons, and synapse with cell bodies and dendrites of pyramidal neurons in layers III/IV. The signal would travel through the highly branched axons of these pyramidal neurons to superficial layers I/II. These branched axons would synapse with highly branched dendrites of cells whose bodies reside in layer V. The branched dendrites of these layer V cells receive signals from a multitude of cortical areas, which summate within the individual layer V neurons. These neurons also have extensive horizontal dendrites between layer V and layer VI cells, thus connecting a multitude of signals between the cells of

these deep layers. The axons of layer V, having amalgamated signals from relevant areas in the cortex, drive higher order neurons in relevant areas of the thalamus. Layer VI neurons, having mostly received amalgamated signals horizontally between layer V and layer VI neurons, project their axons to the thalamus with collaterals to the TRN (Zhang and Deschenes, 1998).

The above hypothetical circuit only traced the simplistic signal through single glutamatergic synapses from the thalamus, cortex, and back to the thalamus. However, it is important to note that collaterals from the thalamus, limbic, and other systems are also sent to relevant areas of the cortex, largely to layers II/IV, but also to layers I/II and V. In addition, all signals are transmitted and received simultaneously and with quick succession, with each pyramidal neuron tasked with whether or not to fire an action potential. Considering the close spatial proximity of the cells, and the number of possible different signals, the information would likely become blurred if certain firing zones were not circumscribed and timed, such that only certain relevant neurons are active within a particular space at a given time.

The task of circumscribing receptive fields of pyramidal neurons are undertaken by cortical GABAergic interneurons, which constitute 20% of cortical neurons. While GABAergic interneurons are a diverse family of cells, the most common type are differentiated by their expression of parvalbumin (PV). These interneurons would have also received collaterals of the canonical signal from the same TC neuron that had been delivered to layers III/IV. GABAergic interneurons prevent aberrant firing of cortical processes by inhibiting irrelevant cortical neurons and shaping the receptive fields of relevant TC signals (Jones, 1993), and dynamically modulating the gain of pyramidal neurons (Klausberger et al., 2003; Isaacson and Scanziani, 2011). In addition, interneurons facilitate feed-forward inhibition, where a single thalamic fibre can activate its pyramidal target as well as an interneuron, which will inhibit the pyramidal target within 1-10ms, providing fine temporal control of pyramidal firing (Gabernet et al., 2005). These cells are necessary for inhibitory modulation, disinhibitory modulation, discriminative processing, gating of signals, as well as contribute in the generation of oscillatory rhythms that unify pyramidal cell discharge (Benes and Berretta, 2001).

Similar to the thalamic and TRN cells, cortical neurons also express various T-type Ca^{2+} channels. In layers II/III, there are medium levels of $Ca_v3.1$ and low levels of $Ca_v3.2$ and Cav3.3. In layer IV there was high expression for $Ca_v3.1$, no expression of $Ca_v3.2$ and moderate expression of

$Ca_v3.3$. Layer V had moderate expression of $Ca_v3.1$ and $Ca_v3.2$, and much lower amounts of $Ca_v3.3$. Layer VI had high levels of $Ca_v3.1$ and low levels of $Ca_v3.3$ (Talley et al., 1999). Thus, considering possible genetic mutations in the schizophrenia of at least the $Ca_v3.2$ and $Ca_v3.3$ channels that have been proposed to underlie dysfunction in the thalamus and TRN, they may also underlie the dysfunction in the cortex.

1.8 Transcranial magnetic stimulation (TMS)

A TMS pulse directed at a target area of the scalp generates localized electrical currents in the brain approximately 1 to 2 cm through the skull. These electric currents then either depolarize or hyperpolarize neurons in the area, depending on the membrane characteristics and activity of the neurons at that moment. The non-invasive nature of TMS makes it a popular tool for studying the connections within the cortex, and between the cortex and the periphery, an dis also increasingly used for diagnostic and therapeutic purposes in the fields of neurology and psychiatry.

There are some recent studies that have found potentially promising results for using 10 Hz repetitive transcranial magnetic stimulation (rTMS) over the DLPFC for the treatment of drug craving in MA dependent individuals (Liu et al., 2017; Liang et al., 2018; Liu et al., 2019). However, none have been performed on MAP to study neural connectivity, even in the context of single pulse TMS such as the present study.

In contrast, many studies have been performed to further understand cortical connectivity in schizophrenia and healthy participants. Using different TMS paradigms designed to delineate the timing and amplitudes of muscular reactions together with pharmacological manipulations, studies have suggested that the cortical silent period (CSP) is generated as a result of $GABA_B$ function (Sanger et al., 2001). Drugs which enhance $GABA_B$ action, such as baclofen, vigabatrin, and tiagabine, have been found to lengthen the CSP (Ziemann et al., 1996b; Werhahn et al., 1999). In addition, the cellular time duration of $GABA_B$ function is approximately 150-200 ms, which corresponds to a typical duration of a CSP (McCormick, 1989; Deisz, 1999b,a; McDonnell et al., 2006). The length of CSPs have thus been suggested to indicate cortical connectivity as a result of $GABA_B$ function (Daskalakis et al., 2002b). Several studies have found shorter CSPs in participants with schizophrenia compared to healthy controls (Fitzgerald et al., 2004; Liu et al., 2009; Hasan et al., 2012), which support the theory of impaired transmission of GABA by

interneurons of the cortex in schizophrenia (Daskalakis et al., 2002b).

CSP measurements can also reflect cortico-subcortical network activity. The CSP was found to be shortened in healthy volunteers, after administration of diazepam (Inghilleri et al., 1996). Inghilleri *et.al* suggested that this may be due to diazepam's effect on GABAergic neurons in the basal ganglia or TRN, although a network mechanism was not proposed (Inghilleri et al., 1996). In stroke patients, infarction of the primary motor cortex (PMC) also led to CSP shortening, while infarction to the thalamus lengthened the CSP (Liepert et al., 2005). These studies support that thalamic impairments may predict prolonged duration of the CSP. In Parkinson's Disease (PD) patients have shortened CSPs (Priori et al., 1994; Cantello et al., 2002), while DA enhancers like L-DOPA and DA agonists like pergolide lengthen the CSP (Priori et al., 1994; Ziemann et al., 1996a), so a shorter CSP can also reflect dopaminergic hypoactivity (Ziemann et al., 1997, 2015). The hypothesis of dopaminergic hyperactivity in schizophrenia (Seeman and Kapur, 2000; Kapur et al., 2005), would then also predict prolonged duration of the CSP. Indeed, several studies have found longer CSPs in participants with schizophrenia compared to healthy controls (Bajbouj et al., 2004; Wobrock et al., 2009). Since animal studies that have shown that regions of the rat cortex that have more DA innervations are more responsive to GABA agonists, and DA depletion decreases GABA sensitivity (Beauregard and Ferron, 1991), the effect of DA agonists lengthening CSPs may be due to DA's indirect increase in cortical GABA function (Priori et al., 1994; Cantello et al., 2002).

In a relaxed muscle, the amplitude of the motor evoked potential (MEP) reflected on the EMG in response to a suprathreshold TMS pulse over the corresponding PMC area can indicate the level of cortical excitability. In healthy participants, N-methyl-D-aspartate (NMDA) receptor and NE agonists and DA antagonists increase MEP amplitudes. In contrast, $GABA_A$ receptor agonists decrease MEP amplitudes consistently across studies. While less consistent across studies, $GABA_B$ receptor agonists voltage gated Na^+ blockers and DA agonists have also been shown to decrease MEP amplitudes (Paulus et al., 2008; Ziemann et al., 2015).

In the active muscle, the MEP elicited by the same TMS pulse over the same area of the PMC could reflect the ability of actively firing PMC neurons to further increase neuronal activity, and/or the ability of this additional stimulus into an already active system, to be transferred and executed at the periphery.

Metrics such as CSP duration and MEP amplitude can provide indications of cortical inhibition mechanisms, underlying neural connectivity and neural integrity, as well as indications of neural excitability and capacity for signal transduction, all of which fundamentally contribute to neural mechanisms of attention.

1.9 Electroencephalographic (EEG) frequency power

As previously mentioned, sustained attention requires an appropriate level of arousal, that is modulated by specific ascending neurotransmitter systems that are activated by incoming stimuli (Steriade and McCarley, 2013). Several decades of research have determined that neural oscillatory dynamics play a key role in brain function and are associated with a variety of arousal, perceptual and cognitive processes (Ward, 2003). Changes in the EEG represent fundamental changes in cortical neurons in response to the activity of ascending neurotransmitter systems from brainstem, hypothalamic and BF nuclei (Steriade and McCarley, 2013). Many associations between frequency band characteristics with particular physiological states (such as at rest or during CPT performance) and in a variety of populations, including MAP and schizophrenia, have been established.

EEG frequencies are usually measured and each band power gets averaged over several minutes of data collection, during a particular state, such as resting state with eyes open, or while performing a cognitive task. Typically, EEG frequencies are divided into delta (0.1-4 Hz), theta (4-7 Hz), alpha (7-14 Hz), beta (15-30 Hz), and gamma (>30 Hz) bands (Dolce and Waldeier, 1974; Herrmann et al., 2016).

Delta oscillations are a particularly prominent characteristic of deep slow wave sleep in humans (Steriade et al., 1993), and has been shown to have increased power in schizophrenia as compared to healthy controls during resting wakefulness (Itil et al., 1972; Boutros et al., 2008; Matheson et al., 2014). In particular, frontal delta power has been found to be higher in schizophrenia compared to healthy controls, which has also been related to decreased frontal lobe blood oxygen levels (Ingvar et al., 1976), as well as glucose utilization, suggesting reduced frontal activity (Guich et al., 1989). This hypofrontality has been associated with more severe negative symptoms (Wolkin et al., 1992; Gerez and Tello, 1995; Harris et al., 1999; Sponheim et al., 2000; Gross et al., 2006; Gschwandtner et al., 2009) and cognitive deficits in schizophrenia (Karbasforoushan et al., 2015).

Alpha power has been related to states of thalamic gating and arousal (Klimesch, 1999), and has been consistently shown to be decreased in schizophrenia (Itil, 1977; Fenton et al., 1980; Borisov et al., 2005; Begić et al., 2011). Low alpha power is associated with excessive levels of arousal and excessive cortical responsiveness to stimuli (Robbins et al., 1998; Klimesch, 1999; Détári, 2000), resulting poor sensory gating, poor selective attention, and poor impulse control in schizophrenia (Lake, 2008).

Reports of theta and beta power in schizophrenia have been inconsistent. Theta power has been associated with learning and memory performance in both animals and humans (Klimesch, 1999; Jezek et al., 2011; Brandon et al., 2013; Dupret et al., 2013), although participants with schizophrenia have been shown to have increased theta power in some studies (Itil et al., 1972; Elbert et al., 1992), and decreased theta power in others (König et al., 2001). Beta frequencies have been associated with the promotion of the current existing state of movement (Pfurtscheller et al., 1996; Crone et al., 1998; Weinberger et al., 2006; Miller et al., 2007), as well as cognitive processes (Ray and Cole, 1985; Engel and Fries, 2010). In schizophrenia, studies in beta power have also been inconsistent, where some have reported higher (Miyauchi et al., 1990) and other reported lower (Itil et al., 1972) beta power as compared to healthy controls.

Consistent findings of low alpha power and high delta power in schizophrenia suggest impairments in ascending neurotransmitter systems from the brainstem, particularly the VTA and LC, through the thalamus, and TRN, to the cortex. These neural network connections will be reviewed in further detail in chapter 4.

EEG frequency power research related to MA is sparse. Only our group has published EEG frequency studies in MAP, finding higher delta/alpha power during resting eyes closed, resting eyes open, as well as during active performance of a sustained attention task as compared to healthy controls (Howells et al., 2018). Other studies have investigated EEG frequency power in MA dependence, showing increased theta and delta power in dependent individuals (Newton et al., 2003, 2004; Kalechstein et al., 2009), or no frequency power differences (Trites and Others, 1976). In MA abuse individuals, results have not been consistent. Recent small studies have found altered small world indices for connectivity patterns compared to controls but no changes in frequency power during resting eyes open (Khajehpour et al., 2019b,a), altered small world network properties in the gamma band during resting eyes closed (Ahmadlou et al., 2013), or lower

relative delta and theta power during resting eyes open (Shafiee-Kandjani et al., 2019).

This work will measure EEG frequency power during different states of arousal, i.e. during resting eyes open and resting eyes closed states, as well as during CPT performance, between MAP and schizophrenia groups when compared to healthy controls. This aims to compare the functionality of their ascending neuromodulatory networks, and TC connections, which may affect or explain behavioural and ERP results recorded during CPT performance in patients.

1.10 Continuous Performance Task (CPT)

In order to investigate which specific part of an attentional neural network may be functionally impaired, one needs to elicit activity from the relevant network to be measured. A multitude of cognitive tests have been developed to elicit and assess each of the sub-components of attention that have been identified by the many models of attention that have been proposed. One of the most relevant tasks for eliciting inhibitory networks is AX-type CPT.

In the AX- type CPT, the participant is instructed to press a button in response to the target letter "X" only when it was preceded by a different letter "A". Thus the letter "A" is a salient cue that prepares the participant for a behavioural response. However, if the cue letter "A" appears, followed by any other letter except X, the participant would be required to inhibit their prepared behaviour. If the participant presses the button in response to a non-target letter after "A", it could indicate an inability to inhibit a prepared response. If the participant presses the button to the letter "X" without it being preceded by "A" however, it could indicate an inability to utilize cues effectively. The reaction time from appearance of the target to the correct pressing of a button could indicate processing speed.

This work used a modified version of CPT that was largely developed in 2010 by our group (Howells et al., 2010). The task consists of individual presentations of random consonant letters on a screen, interspersed with sequences of three presentations of the letter "S" in a row. Participants were asked to respond to the target letter "S" only on the third presentation of the letter. The task also included single presentations of the letter "S" within the sequence of other consonants, which served as salient distractors requiring additional engagement of inhibition networks over a duration of 5 mins (Roberts et al., 1994).

In our task, the cue stimuli are identical to the target stimulus, which removed the variable of cue usage and enhances the salience of the cues to focus on inhibitory effects. Our task also has two cues prior to the target. This would focus on the inhibition of a prepared response because the first and second appearances of "S", are identical to the target and would thus more salient than using a different cue. The salience should lead to stronger preparation to execute behaviour, but also more demanding inhibition; since the task required a response to the salient stimulus only in the context of it coinciding with mental counting to the number "3" (having needed to count toward the 3rd "S"), and not immediately after the first or second salient cues. Inhibition was required even after a second salient cue. Responding correctly to the 3rd "S" would indicate effective inhibition to two prior salient cues, while responding to the first or second "S" would indicate poor response inhibition.

Individuals with schizophrenia typically perform more poorly, responding to more non-targets while missing more targets, when the target was achieved, the reaction time is slower, and they have poorer ability to use cues (van den Bosch et al., 1996; Umbricht et al., 2003). MA abuse and dependence have been associated with poorer response inhibition, but it is unknown whether MAP would perform more similarly to MA abuse or schizophrenia (Salo et al., 2002; Smith et al., 2014).

Simultaneous recordings of CPT performance, with its various types of cognitive stimuli, together with electrophysiological and/or neuroimaging techniques, have identified characteristic signatures of neural network activity which correspond to specific attentional constructs. The present work will also utilize this powerful combination of techniques, and will measure CPT performance concurrently with EEG frequency power and ERP recordings, to identify specific networks that may be impaired in MAP and schizophrenia.

1.11 Event related potentials (ERP)

Studying ERPs time locked to a specific stimulus that participants are required to inhibit a response to, allows us to examine particular facets of the attention circuit that may not be functioning effectively in MAP and schizophrenia, or may be functioning differently between the two groups.

There have been few ERP studies in MAP, but there is a wide literature on the ERP characteristics of schizophrenia that could guide this research towards likely impairments. For example, the P300 has been consistently found to be smaller in amplitude and slower in latency in schizophrenia compared to controls (Roth, 1977; Begleiter et al., 1986; McCarley et al., 1991; Yamaguchi and Knight, 1991; Martın-Loeches et al., 2001; Daffner et al., 2003; Jeon and Polich, 2003; Bramon et al., 2004; Ertekin et al., 2017). Similarly the N100 in schizophrenia has been found to be smaller in schizophrenia (Boutros et al., 1999; Brenner et al., 2009).

The P300 is generated by the specific co-operation of several neural systems. The DA system is likely involved (Braver and Cohen, 2000; Polich, 2007), since, among other evidence, PD patients with low DA levels had longer P300 latency in standard auditory odd-ball paradigms compared to healthy controls (Hansch et al., 1982; Stanzione et al., 1991); and DA monotherapy was able to normalize P300 latency (Stanzione et al., 1991). The NE system is also likely involved, since the P300 amplitude and latencies are highly influenced by arousal, and lesion and pharmacological studies have show that normal functioning of the LC-NE system is necessary for P300 generation (Swick et al., 1994; Nieuwenhuis et al., 2005; Walz et al., 2013; Wostyn et al., 2017; Waterhouse and Navarra, 2019). The amount of attention available for attention allocation and task performance is thought to be governed by the overall arousal level (Kahneman, 1973; Kok, 1990). When task conditions are not demanding, the P300 amplitude is relatively large and peak latency is relatively short. More demanding tasks requiring more attentional resources have been associated with smaller P300 amplitudes and longer peak latencies, suggesting that processing resources are used for task performance (Polich, 1987; Kok, 2001). The P300 latency is thought to index classification speed, which is proportional to the time needed to detect and evaluate a target stimulus (Kutas et al., 1977; Magliero et al., 1984; Polich, 2007).

The neural origins of the P300 are not completely known, since, like many volume conducted signals, the inverse problem prevents precise localization. However, source localization studies have identified the network of areas that are likely involved in generating the P300. Using Low Resolution Brain Electromagnetic Tomography (LORETA), P3a response generators were localized over bilateral frontal and superior temporal regions, and P3b sources included frontal, parietal and limbic lobes (Bachiller et al., 2015). A different group, using dynamic causal modelling has proposed a sequential circuit for the generation of the P300. In controls, visual signals are first

processed by the occipital lobes, then sent to the IPS, and then simultaneously sent to the DLPFC and ACC. The DLPFC and ACC may (or may not) process the signals between areas, however the ACC then sends the signal back to the IPS. The authors found that the sequence of firing is different for schizophrenia, where the signal from the IPS is sent to the ACC only, and not simultaneously to the DLPFC. The ACC then sends the signal to the DLPFC. Also, the return signal to the IPS arrises from the DLPFC, which generates a smaller and slower P300 in schizophrenia (Li et al., 2018).

The N100 appears to reflect arousal (Strik et al., 1992), degree of effort during task performance (Mulert et al., 2005), and selective attention (Hillyard et al., 1973; Polich, 2007). When subjects were asked to attend to tones in the one ear and ignore tones played in the other, demonstrating selective attention, the N100 amplitude was larger for the attended tones, suggesting that the N100 may be dampened for the unattended stimuli because they are not selected for later processing (Hillyard et al., 1973). In and ERP-LORETA study of healthy volunteers performing a choice reaction task where participants were asked to perform the task under three conditions: 1) no response, listen to tones only (control condition), 2) respond to target tone in a relaxed manner (relaxed condition), 3) respond to target tone as fast as possible (effort condition). Compared to the relaxed condition, the subjects had shorter reaction times, larger N100 amplitudes, and increased ACC activity in the effort condition. This effect was present only in participants who engaged the task with true effort (according to their subjective visual analogue scales). These results are direct evidence for a close relationship between conscious effort and ACC activity (Mulert et al., 2005). The same group performed a similar study using single-trial coupling of EEG and fMRI, and found that the N100 amplitude was larger in the effort condition compared to the control condition, and N100-specific blood oxygen level dependent (BOLD) activity was located at the ACC. The findings suggest that the N100 component corresponds to activation of the ACC, which is activated during effort-related decision making (Mulert et al., 2008). An experiment that administrated biperiden, an M1 AChR antagonist, to healthy participants found that N100 amplitudes increased (Caldenhove et al., 2017). There could thus be a corollary that activation of M1 receptors may decrease N100 amplitudes, although such a study has not yet been performed. Thus, while know less about the generation of the N100 than the P300, it is most likely generated by a complex network of cortical areas (Rosburg et al., 2008), involves the ACC, and also at least the ACh system.

1.12 Aims

The purpose of this thesis is to compare overlaps and differences in cortical and subcortical mechanisms of attention networks between MAP and schizophrenia.

Using TMS and the CSP paradigm, I will examine cortical excitation and inhibition in MAP and schizophrenia. My hypothesis is that both MAP and schizophrenia groups will show similarly poor cortical inhibition and excitation metrics, compared to healthy controls.

Using EEG frequency power measurements, I will examine baseline neural activity at rest in MAP, using EEG frequency power measures including relative delta, alpha, theta and beta band powers. My hypothesis is that MAP will have similar frequency power metrics as schizophrenia compared to healthy controls. In addition, I will measure the change in frequency power rhythms between states and study baseline functioning and adaptability of modulatory systems and TC loop in MAP and schizophrenia. My hypothesis is that MAP and schizophrenia may both have poorly adapting TC systems, which will be reflected by a smaller change in alpha power when eyes shift from closed to open.

Using the amplitude and latency characteristics of cognitive ERPs elicited by the performance of an in-house CPT, I will examine neural activity related to behavioural activation (button press) vs behavioural inhibition (inhibition of button press) in response to salient stimuli in MAP and schizophrenia. I hypothesise that MAP and schizophrenia may have similar amplitudes of the N100, P200, N200 and P300 ERP, and that schizophrenia would present with the commonly observed smaller amplitude and longer latency P300 ERP.

2 Methods

2.1 Research design

This chapter presents common study processes applicable for all remaining chapters, including processes beginning at ethical approval and participant recruitment to data collection and general statistical strategy (Figure 2.1). The detailed set-up, procedures, data processing and analysis of each method of investigation are presented in chapters 3, 4, and 5.

There are three groups, namely the schizophrenia group, the methamphetamine induced psychosis (MAP) group and a healthy control group, with a recruitment target of 30 participants per group. Data from three different brain imaging methods were collected from each group. cortical silent period (CSP) parameters were collected by transcranial magnetic stimulation (TMS), relative frequency power and event related potential (ERP)s were collected by electroencephalography (EEG) during concurrent performance of a visual task which included both resting and continuous performance task (CPT) portions. Each participant completed each protocol in the same order within the same specified time according to the Test Day schedule in Table 2.1 in order to control circadian variations and standardize potential protocol effects as much as possible.

Table 2.1 – CIAM brain imaging Test Day schedule

Time	Description
8:00	Participant arrives at Valkenberg Hospital Education Centre. Researcher explains the day's procedures and obtains signed consent from participant
8:15	Researchers and participant leave for the imaging center at Tygerberg hospital. Subjective questionnaires (Handedness questionnaire, ASRS-v1.1, and ASSIST) are administered en route by the researcher
8:45	Participant changes into hospital gown
8:50	The imaging center radiographer completes the MRI safety check with participant
9:00	MRS protocol (data analysis is not within scope of this work)
10:00	Researcher, research assistant and participant leave Tygerberg hospital; participant offered juice and snack bar
10:30	Researchers and participant arrive back at VBH and take height and weight measurements of participant
10:50	TMS protocol (Chapter 3)
12:00	Participant takes a short break
12:10	EEG protocol (Chapters 4 and 5)
13:00	Participant takes a lunch break. Lunch and additional snacks are provided
13:30	Participant completes clinical scales with research nurse, psychiatric clinician, or appropriately trained research professional
14:30	Participant receives R200 Pick 'n Pay voucher and thanked for their participation

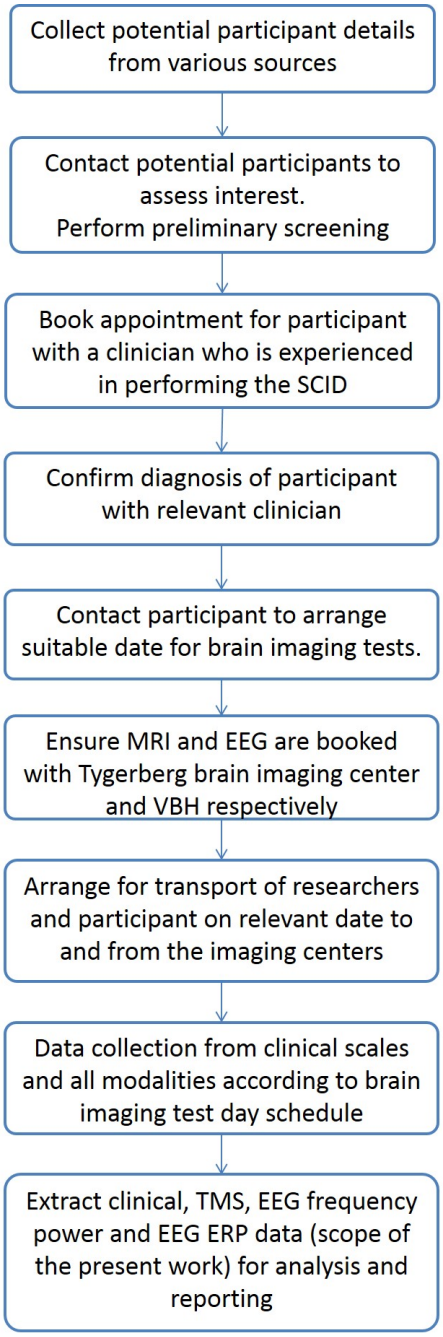


Figure 2.1 – Flow chart summary of the process from recruitment to data extraction

2.2 Ethical considerations

Human ethical approval was granted for this project, Human Research Ethics Committee (HREC) number 192/2010 (Appendix A.1), with renewals to the conclusion of the study (Appendix A.2 and A.3). Additional hospital clearance was granted for Groote Schuur Hospital (GSH) for access to patient files for pre-recruitment screening A.4. All research was conducted in accordance with the declaration of Helsinki (World Medical Association, 2013).

Participants received a detailed explanation of the procedures prior to the day, usually by telephone call, as well as a detailed information sheet prior to or on the day of testing (Appendix A.2). Initial statement of interest and verbal consent were obtained over the telephone, and the participant was scheduled for a structured clinical interview for DSM-IV-TR axis-I disorders (SCID) with a clinician. Written consent for the SCID was provided on the day prior to the interview. If the SCID confirmed suitability and relevant diagnosis, participants were scheduled for a "Test Day". A second written informed consent was provided on the morning of the Test Day with the completion of a detailed consent form prior to commencement of any test protocols (Appendix A.2).

Participation was stipulated as voluntary and participants were clearly informed that they retained the right to withdraw from the study at any stage of their involvement, without penalty or reprimand of any kind.

2.3 Participant Recruitment

Participant contact details were collected via a variety of sources that were different for participants with psychotic disorders, and control participants.

For participants with psychotic disorders, clinicians who agreed to assist in the project identified potential participants during their clinics, and asked their patients whether they would be interested to participate in this research study. If the participant showed interest and gave permission, their contact details were given to the researchers. Permission to access patient medical files from GSH and Valkenberg Hospital (VBH) were also obtained to increase selection possibilities (Appendix A.4 and A.5). Medical files were systematically screened, and potentially suitable

candidates' contact details were captured. Few participants were recruited from their participation in previous research studies that had similar recruitment criteria. Potential participants were contacted by phone, when study aims and procedures were explained. If the individual showed interest, they were screened for general exclusion criteria. If the participant was generally suitable, initial consent and interest were obtained over the phone, and the participant was scheduled for a SCID with a clinician for diagnostic confirmation.

A conservative estimate of 5000 medical files from both hospitals were screened over a period of 3 years for potentially suitable MAP and schizophrenia participants. An approximate total of 900 contact details of potential participants for all groups were collected from all accessible sources. Unfortunately the majority of the potential participants could not be contacted as patient details are often not updated. Of those who could be contacted, a large proportion were not interested to participate. Of those who indicated interest to participate, many did not arrive for the SCID. Of those who arrived for the SCID, many were not suitable for the study. Of those who completed the SCID and were suitable for testing, several did not arrive on Test Day, and could not be re-scheduled.

For control participants, personal networks within communities of comparable social economic status as patient groups were used. Information about the study was also subsequently carried by word of mouth from those that had already participated in this study. Some were recruited from their participation in previous research studies that had similar recruitment criteria. Online classifieds were posted and potential participants were carefully screened via telephone interview, prior to recruiting the participant for a SCID.

2.4 Participant Inclusion and Exclusion Criteria

2.4.1 General Exclusion Criteria

In order to control for data variability due to age, we excluded individuals who were younger than 18 years, or older than 40 years. We also excluded participants who had potentially confounding conditions and/or contraindications for performing any aspects of the study, including psychosis due to a general medical condition; claustrophobia; cardiac devices; implanted medication pumps; intra-cardiac lines; cardiac disease; existence of bullets or shrapnel still embedded in

bodily tissues; measured shoulder circumference of greater than 120 cm (for placement in MRI machine); apparent mental retardation, a history of epilepsy or seizure in the participant or first-degree relatives, major brain trauma and or brain surgery, chronic medical condition including Parkinson's disease, Huntington's chorea, multiple sclerosis, or dementia; a history of stroke or brain aneurysm; history of treatment with repetitive transcranial magnetic stimulation (rTMS) therapy or electroconvulsive therapy (ECT) for any disorder; known HIV positive status; known or suspected pregnancy; women who were breast-feeding. Participants were also checked against set criterion from the TMS adult safety screen (Keel et al., 2000) by the researcher involved, and an MRI safety screen by radiographer at the imaging center.

2.4.2 Participants with schizophrenia

2.4.2.1 Inclusion

Participants were included in the schizophrenia group if the diagnosis was confirmed with the research version of the SCID. Individuals were also included if there was residual but stable psychosis, alcohol use (but not abuse or dependence) and nicotine use, abuse, or dependence. If there was no evidence of a relationship between cannabis use with psychosis presentation, then participants with using cannabis were also included.

2.4.2.2 Exclusion

Potential participants were excluded from the schizophrenia group if the SCID diagnosed schizoaffective, or other schizophreniform disorders. Participants were also excluded if: they were currently experiencing a severe psychotic episode with resulting inability to provide informed consent, and inability to complete testing protocol; if they had previously abused or been dependent on methamphetamine (MA) where before or after a diagnosis of schizophrenia; if cannabis use was ever related to psychotic episodes; and if they were currently dependent on alcohol.

2.4.3 Participants with methamphetamine induced psychosis

2.4.3.1 Inclusion

Participants were included in the MAP group if the psychotic episodes or symptoms that they were in treatment for resulted from the following scenarios: recent or previous MA use, continued

MA use and repeated acute MAP episodes, and chronic MAP, i.e. if they were currently abstinent with persistent psychoses which meet the criteria for a diagnosis of schizophrenia,but their first episodes of psychoses were MA induced.Individuals were also included if there was residual but stable psychosis, alcohol use (but not abuse or dependence) and nicotine use, abuse, or dependence. If there was no evidence of a relationship between cannabis use with psychosis presentation, then participants with using cannabis were also included.

2.4.3.2 Exclusion

Potential participants were excluded from the MAP group if they were currently experiencing a severe psychotic episode with resulting inability to provide informed consent, and inability to complete testing protocol, if they preferred the use of methaqualone (mandrax) over that of MA as primary drug of choice, and if they had known familial diagnosis of schizophrenia.

2.4.4 Control Participants

2.4.4.1 Inclusion

Individuals were included in the healthy control group if they matched the race, gender, social economic status and approximate education levels of the participants with psychosis. Participants were also included if any previous illicit drug use that did not result in episodes of psychosis, and if they currently used but not abused cannabis and alcohol, and if they had current nicotine use, abuse, or dependence.

2.4.4.2 Exclusion

Individuals were excluded from the healthy control group if there was a family history of psychotic disorders, current drug abuse or addiction, including alcohol, but excluding nicotine.

2.5 Final Study Participants

2.5.1 Participants with schizophrenia

An initial 36 SCZ participants underwent Test Day procedures. 8 of these individuals were excluded after data collection following further scrutinization of clinical folders by researchers. Rea-

sons for exclusions: 1 was too ill on day of testing, 2 were previously diagnosed with MAP, 3 were previously dependent on MA, 1 was previously dependent on methaqualone, 1 with alcohol dependence. List-wise deletions of these participants resulted in a final N of 28 SCZ participants. Of the 28 participants in the SCZ group, 2 were not taking any antipsychotic medication, 1 was prescribed a combination of typical antipsychotic medications (trifluperazine and zuclopenthixol), and 2 were prescribed a combination of typical and atypical antipsychotic medications (trifluoperazine and clozapine; haloperidol, sulpride and clozapine). In total, 16 SCZ participants were prescribed atypical antipsychotic medication (5 risperidone, 8 clozapine, 2 olanzapine, 1 quetiapine), while 12 were not prescribed atypical antipsychotic medications; 11 SCZ participants were prescribed typical antipsychotic medication (4 haloperidol, 4 zuclopenthixol, 4 trifluoperazine, 1 sulpride), while 17 were not prescribed typical antipsychotic medications.

2.5.2 Participants with methamphetamine induced psychosis

An initial 27 MAP participants underwent Test Day procedures. 3 of these individuals were excluded after data collection following further scrutinization of clinical folders by researchers. Reasons for exclusions: 1 with previous meningitis and additional head injury with loss of consciousness, 1 with alcohol and methaqualone dependence, 1 with current diagnosis of schizophrenia (SCZ). List-wise deletions of these participants resulted in a final N of 24 MAP participants.

Of the 24 participants in the MAP group, 2 were not taking any antipsychotic medication, 2 were prescribed a combination of typical antipsychotic medications (chlorpromazine and haloperidol; chlorpromazine and flupenthixol), and 1 was prescribed a combination of typical and atypical antipsychotic medications (flupenthixol and risperidone). In total, 5 MAP participants were prescribed atypical antipsychotic medication (risperidone), while 19 were not prescribed atypical antipsychotic medications; 18 MAP participants were prescribed typical antipsychotic medication (15 haloperidol, 3 chlorpromazine, 2 flupenthixol), while 6 were not prescribed typical antipsychotic medications.

2.5.3 Control participants

An initial 38 controls participants underwent Test Day procedures. 6 of these individuals were excluded after data collection following further scrutinization of clinical folders by researchers.

Reasons for exclusions: 1 with chronic general medical condition (systemic lupus erythematosis), 1 with MRI pathology (found during MRI scan), 2 with bipolar type II diagnoses, 1 HIV positive, 1 with previous cocaine induced depression and co-morbid bulimia. List-wise deletions of these participants resulted in a final N of 32 controls participants.

A brief characterization of the final participant demographics that were included in the present study is presented in Table 2.2. Participant details pertaining to individual modalities within the study are presented in subsequent relevant chapters.

Table 2.2 – General demographics and counts of participants included in this study

	Control Group (CON)			Methamphetamine induced psychosis (MAP)			Schizophrenia (SCZ)		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
Participant details:									
Age (yrs)	26.8 ± 5.6	26.1 ± 3.79	26.5 ± 4.83	24.5 ± 4.49	27.4 ± 5.93	25.7 ± 5.22	31.6 ± 5.59	29.1 ± 6.12	30.4 ± 5.86
Height (m)	1.78 ± 0.07	1.68 ± 0.07	1.74 ± 0.09	1.77 ± 0.06	1.62 ± 0.05	1.71 ± 0.09	1.8 ± 0.09	1.63 ± 0.07	1.72 ± 0.11
Weight (kg)	74.4 ± 17.4	67.7 ± 8.02	71.5 ± 14.3	72.6 ± 12.8	61.3 ± 14.4	67.9 ± 14.4	88.5 ± 18.2	85.1 ± 28.2	86.9 ± 23
Total Education (yrs)	13.7 ± 3.4	14.1 ± 4.02	13.9 ± 3.63	10.1 ± 2.09	11.3 ± 2.66	10.6 ± 2.37	11.7 ± 3.51	12.1 ± 3.07	11.9 ± 3.26
Participant numbers:									
N[1]	18	14	32	14	10	24	15	13	28
Medication (N)									
Atypical Antipsychotics (Yes)	0	0	0	2	3	5	10	6	16
Atypical Antipsychotics (No)	18	14	32	12	7	19	5	7	12
Typical Antipsychotics (Yes)	0	0	0	11	7	18	6	5	11
Typical Antipsychotics (No)	18	14	32	3	3	6	9	8	17
Handedness (N)									
Left Hand dominance	1	0	1	0	2	2	2	1	3
Right Hand dominance	16	14	30	14	8	22	13	12	25
Ambidextrous	1	0	1	0	0	0	0	0	0

[1] Participant N may vary between chapters and analyses, depending on participants' availability for particular methods of investigation and quality of the collected data for analyses;
[2] Across all subsets in subsequent chapters, there were significant differences between groups for age, weight, education and medication parameters, which are discussed in respective chapters.

2.6 Clinical scales

The following clinical scales were also performed on Test Day for the MAP and SCZ participants:

Positive and Negative Syndrome Scale (PANSS) (Kay et al., 1987), Brief Psychiatric Rating Scale (BPRS) (Overall and Gorham, 1988; Leucht et al., 2005), Clinical Global Impression Severity Scale (CGI-S) (Busner and Targum, 2007), Hamilton Depression Rating Scale (HAMD) (Hamilton, 1960), Young Mania Rating Scale (YMRS) (Young et al., 1978), Global Assessment of Functioning Scale (GAF) (Aas, 2011), Adult ADHD Self-Report Scale (ASRS-v1.1) (Van de Glind et al., 2013), Alcohol, Smoking and Substance Involvement Screening Test (ASSIST) (Humeniuk et al., 2008),

A description of each clinical scale can be found in the Appendix secion A.3.

2.7 Logistics

2.7.1 Participant Transport

The majority of participants used independent transport methods to get to VBH on both the SCID day, and the Test Day. Some required transport in order to attend their SCID, or on Test Day, and these were arranged where possible.

In order to ensure safety and liability, transport for the researchers and the participant from VBH to the imaging center was provided by a university vendor on each Test Day.

2.7.2 Remuneration

As cash remuneration may trigger drug cravings and relapse in psychiatric patients, participants who attended the Test Day were remunerated with R200 in grocery vouchers of a national chain store (Pick 'n Pay South Africa).Participants received R50 cash at the end of the SCID, in order to reimburse them for transport costs to and from VBH. Unfortunately it was impractical to reimburse transport costs with grocery vouchers. This was not given in cases where this project had provided transport for the SCID.

2.8 Statistical Comparisons

2.8.1 General statistical strategy

Participant numbers and data distributions varied slightly for each method of investigation, and depending on the quality of data that was recorded, and specific details for statistical analysis will be detailed in each of the subsequent chapters.

All statistical analyses were performed using R, version 3.4.1 (R Core Team, 2017). The common analyses performed for data in all chapters consisted of mixed effects models, similar to analysis of variance (ANOVA) models, with the added ability to account for random effects of certain variables. Mixed effects models ("lme4" package (Bates et al., 2015)) were used to compare fixed

effects (e.g. Group), while accounting for random effects (e.g. Participant) in cases where multiple data points per participant were analyzed (e.g. both left and right hemispheric CSPs for each participant were used). Since mixed effects models do not typically report p-values, F-tests with Kenward-Roger approximations ("pbkrtest" package (Halekoh and Højsgaard, 2014)) were used in addition to the "lme4" package to determine p-values for main effects. Where significant main effects were observed from mixed effects models, post-hoc multiple comparisons ("multcomp" package (Hothorn et al., 2008)) were performed with false discovery rate corrections.

As per convention in our laboratory, the p-value for significance was set at $p < 0.05$, p-value for tendency was set at $0.05 < p < 0.07$. Adherence to linear statistical assumptions was confirmed by visually inspecting the standard plots of residuals, Normal Q-Q, and Cook's distance plots for each of the models. Where linear statistical assumptions were not met, non-parametric Kruskal-Wallis tests were used for group comparisons. Full statistical outputs are presented in the appendices of relevant chapters.

2.8.2 Identification of potential confounding variables

First, demographic and clinical scale variables were compared between MAP, schizophrenia and control groups to determine potential confounding variables for each method of investigation. Data for demographic, clinical and medication variables did not meet linear model assumptions and Kruskal-Wallis tests were used. Where Kruskal-Wallis tests found a significant main effect, additional multiple comparisons ("nparcomp package") adjusting for Tukey's comparisons were used to compare MAP vs schizophrenia results. Since medication and certain clinical scales such as the PANSS were only given to patient groups and not given to the control group, potential clinical confounding variables were only assessed between MAP and schizophrenia groups using Kruskal-Wallis tests.

Second, since any demographic or clinical scale variables that were found to be significantly different between any groups could be potential confounding variables to group differences in other experimental measures, participant variables (continuous variables) were correlated against each measurement for each method of investigation (e.g. CSP duration (ms), relative alpha band power (%) or P300 amplitude (mV)) in each relevant chapter), using Spearman's correlations,. Significant correlations were identified as potential confounding variables (e.g. Appendix tables C.3).

Third, where participant variables were count variables (e.g number of participants prescribed each medication), Spearman's correlations was not statistically appropriate against measurements that provided continuous data (such as CSP duration (ms)). Each medication count variable that was significantly different between the MAP and schizophrenia groups (for example as in Table 4.6) were considered potential confounding variables for each measurement.lastly, each potential confounding variable was then added as an additional fixed effect into group comparisons as individual ANCOVAs. All ANCOVA and non-parametric ANCOVA analyses can be found in the appendices relevant to each chapter. These results were not presented in the thesis proper because the number of participants and the covariate nature of the confounding variables with group differences in the measurements, violate analysis of co-variance (ANCOVA) assumptions (Glass et al., 1972) and thus potential confounding factors could not be effectively corrected for with post-hoc ANCOVA. However, identifying these potentially confounding co-variate factors allows for more careful interpretation of the results, and highlight areas to target for future research with a larger number of participants.

3 Transcranial Magnetic Stimulation: Cortical Inhibition and Excitability

3.1 Introduction

This chapter explores the cortical excitation and inhibition mechanisms in MAP using TMS and the CSP paradigm. I first review a brief history of the discovery of the CSP, and the review the current knowledge of the associations, and underlying mechanisms that may generate of the motor evoked potential (MEP) and CSP parameters.

3.1.1 Brief history

Electrical stimulation to investigate muscle and neuronal function was first documented in the late 1700's by Luigi Galvani (Galvani, 1791). About a hundred years later, scientists began to electrically stimulate the cortex to activate muscles, with each stimulation producing a MEP recorded on crude electromyography (EMG) (Marey, 1880; Horsley and Schäfer, 1886). These cortical activations allowed scientists to map the human motor and sensory cortices by the mid 1900's, discovering the "homunculi", which are topographical representations of peripheral body locations in the cortices that directly connect peripheral motor and sensory signalling to specific locations in the brain (Penfield and Boldrey, 1937). By the late 1900's, it was well known that brief cortical stimulation of specific locations on the motor cortex could lead to brief reliable activation of relaxed target skeletal muscles, termed an MEP.

However, in 1983, Marsden *et al* discovered that, if the muscle was already voluntarily and isometrically active, cortical stimulation to the relevant motor cortical area caused the expected MEP (a brief muscular activation in addition to the background activity), *as well as* a prolonged muscular inhibition (termed "silent period") before voluntary activity could resume (Marsden et al., 1983).

"Silent periods" in EMG recordings had previously been elicited by electrical stimulations to peripheral nerves, and had already been widely used to perform a variety of peripheral nerve research, such as spinal reflexes and spinal motor neuron refractory periods. Marsden suggested that the "silent period" in the EMG which he elicited via stimulation to the cortex was different, and that the "cortical silent period" (CSP) reflects the cortical control of movement, and changed depending on the location of the cortex that is stimulated (Merton, 1951; Wolters et al., 2008). Further research replaced the more painful electrical stimulations with the less invasive TMS, and deconstructed the relative contributions of cortical vs spinal inhibitory mechanisms that generated the CSP, attributing the first 40 to 50 ms of the CSP to spinal neuronal afterhyperpolarization, and the inhibition on voluntary activity after these first 50 ms to cortical origins (Fuhr et al., 1991; Inghilleri et al., 1993).

TMS has since become a convenient tool for studying the connections between the cortex and the periphery. Today, applying TMS over the motor cortex to elicit and measure MEPs and CSPs is an established neurophysiological method to examine cortical connectivity in a wide range of neurological disorders such as multiple sclerosis, stroke, and Parkinson's Disease (PD) (Weber and Eisen, 2002; Kobayashi and pascual Leone, 2003; Groppa et al., 2012), as well as psychiatric disorders, such as Obsessive Compulsive Disorder (OCD), Major Depressive Disorder (MDD) and, of course, schizophrenia (Daskalakis et al., 2007; Radhu et al., 2013).

3.1.2 Proposed mechanisms underlying the CSP

A TMS pulse delivers a sudden change in the magnetic fields of the target site that penetrates approximately 1 to 2 cm through the skull, and generates electrical currents in the targeted area. In layer V pyramidal cells, a TMS pulse activates excitatory synaptic input to connected cell bodies and dendrites, which, depending on the stimulus intensity and the state of the cell, triggers an action potential from this cell from stimuli reaching it closest to the axon hillock. At the same time, the action potential back propagates to its dendrites. While back propagation alone wouldn't normally be able to trigger a Ca^{2+} spike, in conjunction with other depolarizations that had been activated by the TMS in the distal dendrites, the Ca^{2+} spike is generated, which is able to trigger another AP from the axon hillock without needing to propagate to the soma. Since Ca^{2+} spikes can last longer than 10 ms, and generate burst firing at the axon hillock, which only declines after the depolarizations triggered by the TMS in the most distal dendrites have arrived at the

hillock and contributed to the burst depolarization (Larkum et al., 1999, 2001; Wagner et al., 2009; Di Lazzaro and Ziemann, 2013; Ugawa et al., 2020). The effect of the pulse is thus determined by whether the neurons that received the electric current were more likely to become depolarized or hyperpolarized, which depends on other neuronal characteristics including the connectivity between neurons, the branching of dendrites, and expression of various receptors.

A supra-threshold TMS pulse applied to the motor cortical area of a voluntarily active target muscle activates primary motor pyramidal neurons, as well as surrounding premotor and parietal regions, which also send direct cortico-spinal projections (Murray and Coulter, 1981b,a; Dum and Strick, 1996; Bestmann and Krakauer, 2015). These areas project via the internal capsule (and the pyramidal decussation in the brain stem), to terminate directly onto the cell bodies of target alpha motor neurons in the spinal cord. This leads to contraction of all the muscles controlled by the region of the motor cortex that was activated by TMS, regardless of whether they innervate the target or counter muscles. The stimulated contraction of the target muscle is recorded as the MEP in the contracting muscle where the EMG electrode was placed. The MEP typically appears after a latency period of approximately 20 ms post stimulus (Priori et al., 1999; Saisanen et al., 2008) as sharp biphasic curves, which can be measured from the negative peak to the positive peak, or the maximal amplitude can be measured after rectification of the curve (Julkunen et al., 2013). After the MEP there is a transient period of forced muscular inactivity termed the CSP (Calancie et al., 1987), which can last up to 300 ms. The CSP ends when voluntary isometric muscular activity returns and is measured on the EMG (Figure 3.1).

An MEP is a compound signal measured at the activated muscle with an EMG, and is generated by a series of descending cortical-spinal signals. MEP amplitudes in the inactive muscle have been shown to increase with the administration of N-methyl-D-aspartate receptor (NMDAR) and NE agonists, as well as dopamine (DA) antagonists have also shown increases in MEP amplitudes (Ziemann, 2013). In contrast, $GABA_A$ receptor agonists decrease MEP amplitudes consistently across studies, and while less consistent across studies, $GABA_B$ receptor agonists voltage-gated Na^+ blockers and DA agonists have also been shown to decrease MEP amplitudes (Paulus et al., 2008; Ziemann et al., 2015).

A popular hypothesis stipulates that the CSP is caused by TMS induced activation of cortical interneurons (Tergau et al., 1999). After an initial delay due to synaptic transmission of GABA,

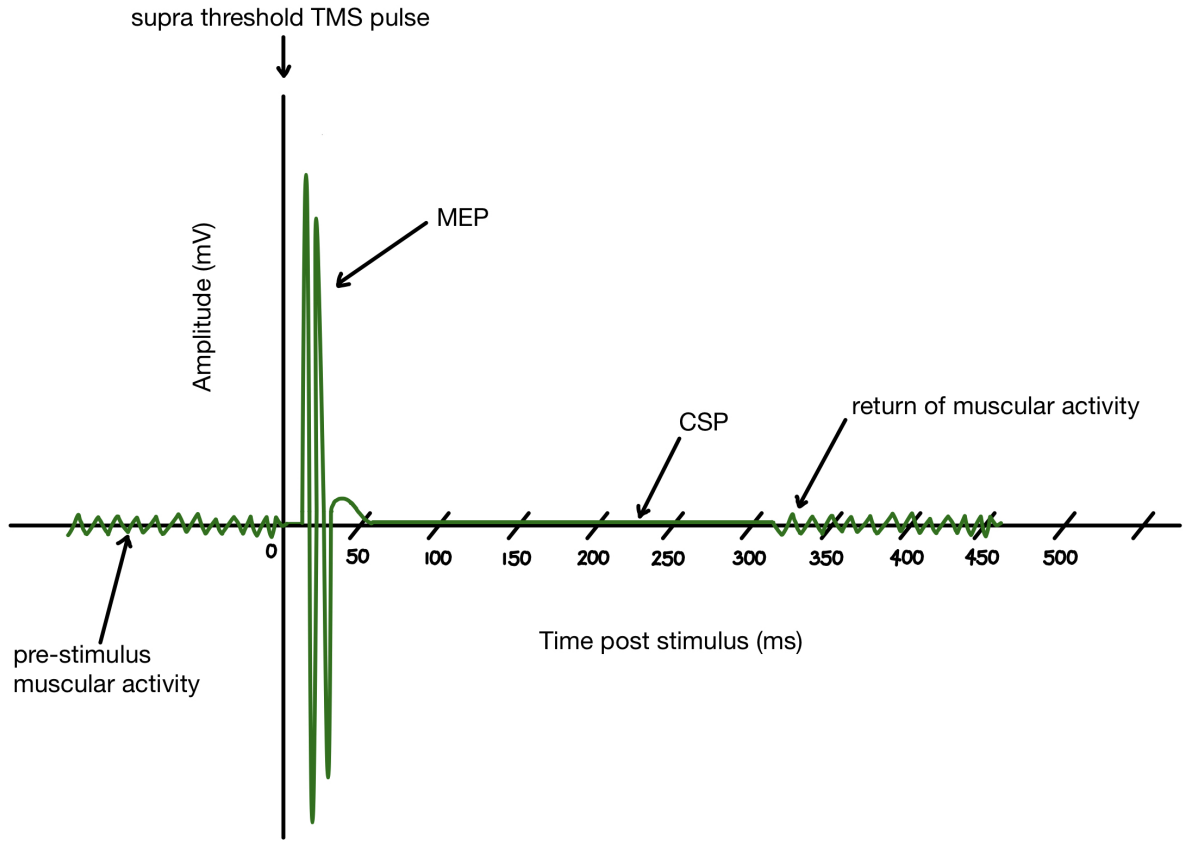


Figure 3.1 – Generic representation of a non-rectified CSP trace. The suprathreshold TMS pulse is delivered at time = 0. After the TMS pulse there is a brief 20 ms latency, followed by the MEP, and then a period of forced muscular inactivity termed the CSP, prior to the return of baseline muscular activity of the isometric contraction. CSP = cortical silent period, MEP = motor evoked potential.

cortical inhibitory neurons could inhibit the pyramidal neurons, resulting in the inhibition of cortical drive to maintain voluntary activity in an active target muscle (Calancie et al., 1987; Fuhr et al., 1991; Inghilleri et al., 1993; Tergau et al., 1999; Wolters et al., 2008). Several lines of evidence support this hypothesis. In animal studies, The long duration of the CSP fits the time course of IPSPs generated by $GABA_B$ receptor activation with baclofen (Connors et al., 1988a; Ziemann, 2013), and a study in a patient with generalized dystonia, who was receiving high doses of baclofen injected directly into the spinal canal also showed longer CSP (Siebner et al., 1998; Ziemann, 2013). Thus the length of CSPs has been considered an indication of cortical connectivity as a result of cortical $GABA_B$ function (Daskalakis et al., 2002b). Several studies have observed shorter CSP in schizophrenia, and provide evidence to support the theory of impaired transmission of GABA by interneurons of the cortex in schizophrenia patients (Daskalakis et al., 2002a; Fitzgerald et al., 2004; Liu et al., 2009; Hasan et al., 2012).

There are likely also subcortical contributions to the generation of the MEP and CSP, since

only 10% of neurons from the primary motor cortex (PMC) connect directly to the spinal cord (Rivara et al., 2003). A large proportion of the cortical neurons terminate directly on the thalamic reticular nucleus (TRN) (Guillery et al., 1998; Guillery and Harting, 2003), and the TMS pulse to the cortex also strongly stimulates the RN (Ferrarelli and Tononi, 2010). In fact, there are 10 fold more corticothalamic (CT) neurons than thalamocortical (TC) neurons (Guillery, 1967, 1995) and there are 3.7 times more cortical inputs into the TRN than cortical inputs into the thalamus (Golshani et al., 2001). Thus the TRN receives more cortical input than thalamic input (Pinault, 2004), and stimulation of the TRN also contributes to the generation of the CSP, since a stimulation of the TRN via CT neurons would produce overwhelming inhibition of the (previously) voluntarily controlled ongoing pre-motor cortical signals from going through the thalamus to continue voluntary isometric contraction (Chouinard et al., 2003).

3.1.3 Cortical inhibition and excitability in schizophrenia

Deficits in cortical inhibition (CI) have been proposed as a key mechanism through which the symptoms of schizophrenia develop (Daskalakis et al., 2002a, 2007). There have been many TMS paradigms used to study CI and cortical excitability in schizophrenia as well as other psychiatric disorders such as Tourette's syndrome, Attention Deficit Hyperactivity Disorder (ADHD), Bipolar Disorder (BPD), OCD and MDD (Bunse et al., 2014), although only one meta-analysis has been conducted (Radhu et al., 2013). No TMS studies on MAP have yet been reported.

Studies of RMT in unmedicated patients with schizophrenia have produced inconsistent results. Some studies found no differences between schizophrenia and healthy controls (Fitzgerald et al., 2002a; Wobrock et al., 2009), some have found decreased RMT levels (Abarbanel et al., 1996; Eichhammer et al., 2004), while others have found increased RMTs (and thus decreased cortical excitability) (Hasan et al., 2011, 2012). Results from medicated patients with schizophrenia are just as inconsistent, showing no difference (Fitzgerald et al., 2002a), decreased (Daskalakis et al., 2002a) or increased (Pascual-Leone et al., 2002; Soubasi et al., 2010) RMT between medicated patients against healthy controls. One may argue that the inconsistencies in the results from the medicated patients may be due to the wide range of available antipsychotics, and indeed, in one study, risperidone has been found to increase while olanzapine decreased the RMT in medicated patients compared to healthy controls (Fitzgerald et al., 2002b), however, in another study, although olanzapine treatment resulted in lower RMT levels compared to patients treated

with ziprasidone, the olanzapine treated patients still had higher RMTs than healthy controls (Soubasi et al., 2010).

CSP results in unmedicated first-episode patients with schizophrenia have been similarly inconsistent, several studies have found shorter CSP durations (Fitzgerald et al., 2004; Liu et al., 2009; Hasan et al., 2012), while others have found longer CSPs (Bajbouj et al., 2004; Wobrock et al., 2009). Studies of the effects of antipsychotics in schizophrenia have also found disparate results, with the exception of clozapine, which appears to consistently increase CSP duration (Daskalakis et al., 2008a; Liu et al., 2009). The single meta-analysis of cortical inhibition and excitability, which included qualifying studies from 1990 to 2012, did not find a reliable difference between schizophrenia and healthy controls, in terms of CSP duration (Radhu et al., 2013). While on might want to attribute these inconsistent findings in CSP measures to different disease states such as first-episode patients vs chronically-ill patients, or different medications (Bunse et al., 2014), these inconsistencies persisted even between similar studies of only first-episode schizophrenia as already mentioned.

3.2 Aims

Using TMS and the CSP paradigm, I will examine cortical excitation and inhibition in MAP and schizophrenia. My hypothesis is that both MAP and schizophrenia groups will show similarly poor cortical inhibition and excitation metrics than healthy controls, which will be reflected by longer CSP duration, and higher RMT units.

3.3 Methods

All participants were recruited and selected according to the protocol detailed in Chapter 2 (page 41). All CSP data were recorded between 10:50 am and 12:00, according to the Test Day schedule (Chapter 2, Table 2.1, page 42). Participants who were not willing to undergo TMS, or whose resting motor threshold (RMT) were greater than 100% of stimulator output were excluded from the analysis. Final participant numbers and demographics for the 120RMT and 140RMT datasets are presented in Tables 3.2 and 3.8 respectively.

3.3.1 TMS protocol

Three areas of each forearm were cleaned with alcohol wipes, including the palmar area over each abductor pollicis brevis (APB) muscle, the metacarpophalangeal joint at each thumb, and the inner forearm. Surface electromyographic electrodes were placed in a tendon-belly configuration over the cleaned areas, with the ground electrode on the inner forearm.

The area of the motor cortex that controls the contralateral APB was localized with a Magstim Rapid^2 (The Magstim Company LTD) TMS in the expected area; approximately 5 cm lateral from the sagittal midline towards the pinna of the ear. The TMS coil was held at a tangent to the head, with the handle pointing backward at approximately 45 degrees lateral from the midline.

The RMT is *the minimal stimulation intensity (TMS equipment output intensity) that is required to elicit 5 out of 10 motor evoked potentials that are at least 50 μV from the relaxed APB.* Separate RMTs were obtained for each hemisphere. This sets an intra-individual baseline intensity required to elicit a specified physiological response. The stimulation intensity at which the criteria for RMT was met, is denoted as stimulation level "100RMT", and subsequent stimulation intensities were calculated as percentages relative to the RMT for each stimulation level. For example, 80RMT is the RMT stimulation intensity $\times$ 0.8; 100RMT is equal to RMT; 120RMT is the RMT stimulation intensity $\times$ 1.2; 140RMT is the RMT stimulation intensity $\times$ 1.4 and 160RMT is the RMT stimulation intensity $\times$ 1.6.

The Magstim Rapid^2 has maximum output intensity units of "110%". Subjects with an RMT greater than 69% stimulation intensity could thus not complete a stimulation level of 160RMT, subjects with an RMT greater than 78% stimulation intensity could thus not complete a stimulation level of 140RMT, and subjects with an RMT greater than 92% stimulation intensity could thus not complete a stimulation level of 120RMT. Bilateral recordings for every stimulation level were also not always possible in participants that had higher RMT in one hemisphere, unilateral recordings for the relevant stimulation level was then collected. Final sample size for males and females in each group, at 120RMT and 140RMT are reported in their respective results subsections.

The maximal pinch strength (kg) of each hand was first measured with a pinch gauge. Subjects were then asked to maintain an isometric contraction at 40% of maximal strength on the

pinch gauge between the thumb and index fingers (Mathis et al., 1999; Saisanen et al., 2008). Each CSP was achieved by stimulating the motor cortical area corresponding to the APB muscle while subjects maintained the muscle contraction. At each stimulation level, 12 consecutive TMS stimulations were applied to obtain a continuous recording of 12 CSPs from each hemisphere. Randomized stimulation intervals of between 3 to 5 ms were used to prevent participants from predicting the next stimulation.

3.3.2 Data processing and Statistics

3.3.2.1 Parameter Extraction

From each participant, 12 CSPs were collected (Biopac MP150, 2000 samples/second) at each stimulation level, in each hemisphere. The first 10 CSPs without artefact were averaged from 200 ms pre-stimulus to 400 ms post-stimulus (Acqknowledge 4.0, Biopac Inc.). The root mean square (RMS) was calculated for each averaged CSP (0.005s integration intervals) (Fridlund and Cacioppo, 1986). The following CSP parameters were extracted from the RMS graph for analysis: latency to MEP (ms), average baseline muscle contraction (mV), average size of the MEP (mV), relative CSP duration (ms) (Figure. 3.2).

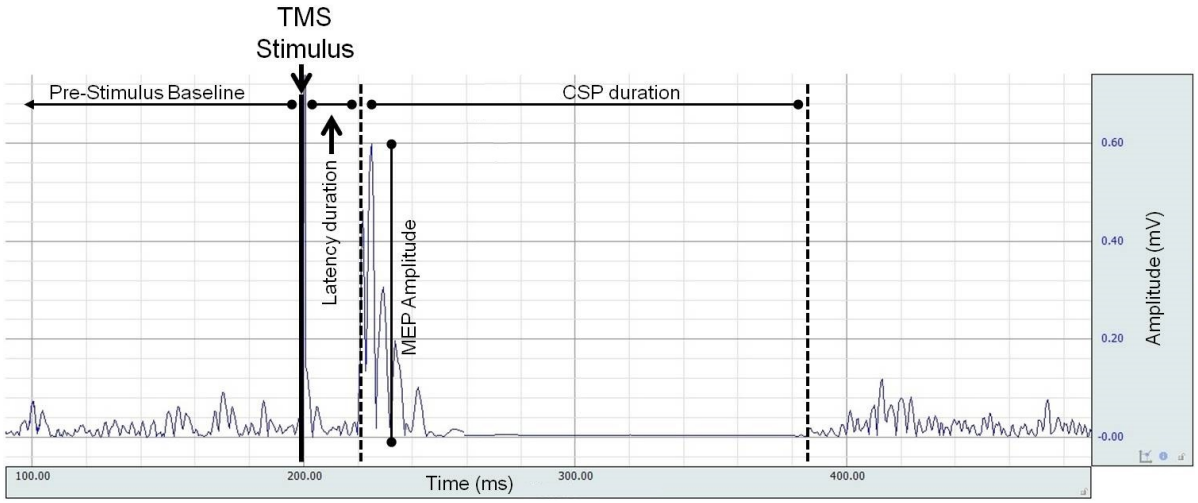


Figure 3.2 – Labelled sample of an averaged root mean squared graph. The TMS stimulus occurs at 200 ms; the pre-stimulus baseline muscle activity is averaged over 200 ms prior to the TMS stimulus; the latency duration begins from the TMS stimulus and ends at the commencement of the motor evoked potential (MEP); the CSP duration begins at the commencement of the MEP and ends when muscle contraction returns.

3.3.2.2 Statistics

3.3.2.3 Identification of potential confounding variables

Data were analysed using R version 3.3.0 (R Core Team, 2016). Since higher stimulation levels provide more reliable results (Saisanen et al., 2008) and are more widely reported in the literature, and 160RMT were not possible in a large proportion of participants, datasets for 120RMT and 140RMT were isolated. Demographic, Clinical and medication variables did not meet linear model assumptions. To determine potential demographic confounding variables, the demographic variables for participants that provided data for each dataset were compared between all three groups, using Kruskal-Wallis tests. Where Kruskal-Wallis tests found a significant main effect, additional multiple comparions ("nparcomp package") adjusting for Tukey's comparisons were used to compare between three groups, including MAP vs schizophrenia. To determine potential clinical confounding variables between the patient groups, the clinical scale scores and medication variables were compared between MAP and schizophrenia groups using Kruskal-Wallis tests.

Demographics, clinical scale scores or medication variables that were found to be significantly different between any groups were tested as potential confounding variables to group differences in CSP measures, these participant variables were correlated against each TMS parameter measured (Relative CSP, Latency to MEP, MEP Size, Baseline muscle contraction and Stimulation Intensity), using Spearman's correlations. Significant correlations were identified as potential confounding variables (For 120RMT see Appendix tables B.1 and B.2, for 140RMT see Appendix tables B.3 and B.4).

Since Spearman correlations of medication count variables against continuous TMS measures between MAP and schizophrenia was not statistically appropriate, each medication count variable that was significantly different between the MAP and schizophrenia groups (for example as in Table 3.6) were considered potential confounding variables to each CSP measure.

3.3.2.4 Group Comparisons

Group comparisons of each TMS measure between all three groups were performed using linear mixed effects models ("lme4" package) with Group as a fixed effect and Participant as a random effect to account for the dependent measure of 2 hemispheres per Participant. F-tests with Kenward-Roger approximations ("pbkrtest" package) were used to determine p-values for main

effects of the mixed effects models. Where main effects were significant, they were followed with multiple comparisons ("multcomp" package) adjusting for false discovery rates.

As per convention in our laboratory, the p-value for significance was set at $p < 0.05$. Adherence to linear statistical assumptions was confirmed by visually inspecting the standard plots of residuals, Normal Q-Q, and Cook's distance plots for each of the models. Where linear statistical assumptions were not met, non-parametric Kruskal-Wallis tests were used for group comparisons. Since mixed effects models are not appropriate for non-parametric data, and thus could not be used to account for nested dependencies in the dataset, only the data for the left hemisphere was included in order to maintain accurate N for participants in Kruskal-Wallis tests.

3.4 Results

3.4.1 120% Resting motor threshold cortical silent period

3.4.1.1 Participant demographics, physical attributes, drug use and clinical measures

The 120RMT subset included data from 28 controls, 22 MAP and 20 schizophrenia. The schizophrenia group were significantly older ($p < 0.05$) and the MAP had lower levels of education compared to controls ($p < 0.01$). Physically, schizophrenia weighed more ($p < 0.01$) and BMI was greater ($p < 0.001$) compared to the control group (Table 3.2). In terms of drug use, the MAP reported higher drug use as measured by the ASSIST than control and schizophrenia ($p < 0.0001$) (Table 3.4).

Within groups with psychosis, schizophrenia had reported significantly longer duration of diagnosis than MAP ($p < 0.01$). No significant difference in severity of clinical symptoms, or medication dosage was found between MAP and schizophrenia (Table 3.5).

MAP were prescribed significantly more FGAs ($p < 0.01$), as seen by higher number of haloperidol prescriptions in MAP ($p < 0.001$), while significantly more schizophrenia were prescribed SGAs ($p < 0.01$), as seen by higher number of clozapine prescriptions in schizophrenia ($p < 0.01$) (Table 3.6).

Table 3.1 – Demographic and physical attributes for participants included in the 120RMT subset

	CON (N=28)			MAP (N=22)			SCZ (N=20)		
Demographic Variables	**Median**	**Min**	**Max**	**Median**	**Min**	**Max**	**Median**	**Min**	**Max**
Age on day of testing (yrs)	25	19	40	24	19	35	29	20	40
Years at school (yrs)	12	8	14	10	7	12	11.5	6	14
Years of tertiary education (yrs)	0.5	0	10	0.15	0	4.5	0	0	6
Total years of education (yrs)	12	8	22	10.5	7	16.5	11.5	7	18
Female : Male (N)	14 : 14			9 :13			7 : 13		
Physical Attributes									
Height (m)	1.74	1.57	1.88	1.71	1.52	1.89	1.72	1.51	1.87
Weight (kg)	67.5	53.5	133	66.56	47.9	98	84.65	50	136
BMI (kg/m^2)	23	17.47	38.44	22.6	18.51	30.66	27.64	20.28	47.47
Right hand max force (kg)	7.5	5	13	7.5	4	11	7.5	4	12
40% Right hand max force (kg)	3	2	5.2	3	1.6	4	3	1.6	4.8
Left hand max force (kg)	7.5	5	12	7.1	4	11	7.75	3.5	11.5
40% Left hand max force (kg)	3	2	4.8	2.8	1.6	5.6	3.1	1.4	4.6
Ambidextrous : Left : Right Handed (N)	1 : 1 : 26			0 : 2 : 20			0 : 3 : 17		

Table 3.2 – Group comparisons of demographic and physical attributes for participants included in the 120RMT subset

	Kruskal-Wallis Main Effects			Non-parametric multiple comparisons		
				CON vs MAP	CON vs SCZ	MAP vs SCZ
Demographic Variables	**Chi-squared**	**df**	**p-value**	**p-value**	**p-value**	**p-value**
Age on day of testing (yrs)	6.71	2	**0.0348***	0.9724	**0.0411***	0.0706
Years at school (yrs)	8.39	2	**0.0151***	**0.0081***	0.1878	0.8296
Years of tertiary education (yrs)	5.52	2	0.0632	**0.0359***	0.8169	0.2321
Total years of education (yrs)	8.92	2	**0.0116***	**0.0044***	0.2327	0.4507
Female : Male (N)	1.11	2	0.5753			
Physical Attributes						
Height (m)	0.56	2	0.7543			
Weight (kg)	12.35	2	**0.0021***	0.8479	**0.0053***	**0.0027***
BMI (kg/m^2)	15.1	2	**0.0005***	0.8839	**0.0004***	**0.0002***
Right hand max force (kg)	1.11	2	0.5733			
40% Right hand max force (kg)	1.27	2	0.5309			
Left hand max force (kg)	0.56	2	0.7553			
40% Left hand max force (kg)	0.41	2	0.8130			
Ambidextrous : Left : Right Handed (N)	0.73	2	0.6927			

* $p < 0.05$

3.4.1.2 Group comparisons

A significant main effect of MEP amplitude ($p < 0.01$), and a tendency for an effect of SI ($p < 0.1$) was found. Post-hoc multiple comparisons found significantly smaller MEP amplitudes in schizophrenia and MAP compared to the control by 36 μV ($p < 0.01$) and 32 μV ($p < 0.01$) respectively, Figure 3.3. schizophrenia SI was found to be 7.3% (Magstim output units are provided in percentages) higher as compared to controls ($p < 0.05$) (Appendix B.1.2 and Appendix B.1.2.1).

Differences between MAP and schizophrenia for latency to MEP and MEP amplitude measures may have been confounded by duration of diagnosis (Appendix B.2). However, no group differences

Table 3.3 – Attention deficit and drug use scores for participants included in the 120RMT subset

	CON (N=28)			MAP (N=22)			SCZ (N=20)		
Subjective Scores	**Median**	**Min**	**Max**	**Median**	**Min**	**Max**	**Median**	**Min**	**Max**
ASRS Part A (above cut off)	1	0	5	2	0	4	2	0	4
ASRS Part B (above cut off)	2	0	5	2	0	8	3	0	6
ASSIST Subscore Tobacco	0	0	26	18	9	31	10.5	0	30
ASSIST Subscore Alcohol	2.5	0	25	3.5	0	21	3	0	12
ASSIST Subscore Cannabis	0	0	6	5.5	0	31	0	0	18
ASSIST Subscore Methamphetamine	0	0	0	7	0	38	0	0	26
ASSIST Total Score	9.5	0	34	34.5	6	127	10.5	0	94

ASRS = Adult ADHD Self-Report Scale;
ASSIST = Alcohol, Smoking and Substance Involvement Screening Test

Table 3.4 – Group comparisons of attention deficit and drug use scores for participants included in the 120RMT subset

	Kruskal-Wallis Main Effects			Non-parametric multiple comparisons		
				CON vs MAP	CON vs schizophrenia	MAP vs SCZ
	Chi-squared	**df**	**p-value**	**p-value**	**p-value**	**p-value**
ASRS Part A (above cut off)	2.71	2	0.2585			
ASRS Part B (above cut off)	4.73	2	0.0938	0.6184	0.0589	0.6990
ASSIST Subscore Tobacco	20.87	2	**<0.0001***	**<0.0001***	0.1763	0.1414
ASSIST Subscore Alcohol	0.74	2	0.6890			
ASSIST Subscore Cannabis	13.16	2	**0.0014***	**0.0019***	0.9613	**0.0282***
ASSIST Subscore Methamphetamine	45	2	**<0.0001***	**<0.0001***	0.3396	**<0.0001***
ASSIST Total Score	26.98	2	**<0.0001***	**<0.0001***	0.9786	**<0.0001***

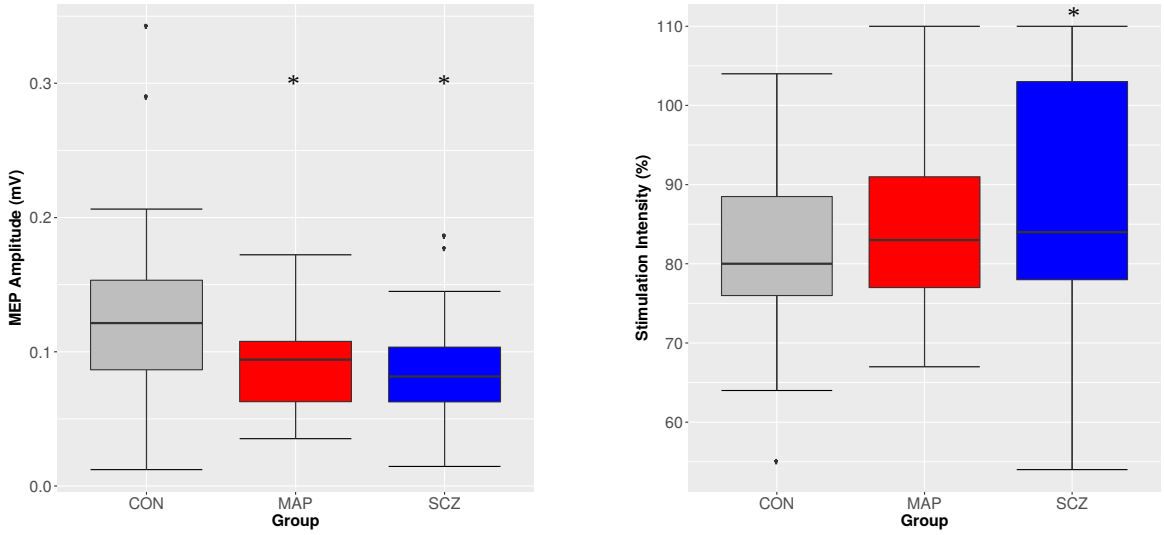
* $p < 0.05$;
ASRS = Adult ADHD Self-Report Scale;
ASSIST = Alcohol, Smoking and Substance Involvement Screening Test

were found with the inclusion of Duration of Diagnosis as an additional fixed variable during post hoc statistical correction (Appendix B.2.3).

Table 3.5 – Clinical scale scores for participants with psychosis included in the 120RMT subset

	MAP (N=22)			SCZ (N=20)			Kruskal-Wallis Main Effects		
	Median	**Min**	**Max**	**Median**	**Min**	**Max**	**Chi-squared**	**df**	**p-value**
Duration of Diagnosis (yrs)	1.25	0.25	13	7	1	20	9.29	1	**0.0022***
Extrapyramidal side effects	0	0	9	1	0	4	0.57	1	0.4466
PANSS Total	45.5	30	77	46	30	100	0.14	1	0.7045
PANSS Positive subscale	8	7	30	11	7	24	3.12	1	0.0769
PANSS Negative subscale	13	7	27	13	7	28	0.001	1	0.9686
PANSS General Psychopathology subscale	22.5	16	38	22	16	50	0.07	1	0.7831
CDSS Total	1	0	9	3	0	7	1.25	1	0.2624
YMRS Total	2	0	5	1	0	10	0.01	1	0.9135
HAMD Total	3	0	12	4	0	15	0.35	1	0.5533
Clinical Global Impression Severity	2	1	4	3	1	4	2.12	1	0.1453
Global Assessment of Functioning	65.5	31	90	60	3	80	1.33	1	0.2479

* $p < 0.05$;
PANSS = Positive and Negative Syndrome Scale;
CDSS = Calgary Depression Scale for Schizophrenia;
YMRS = Young Mania Rating Scale;
HAMD = Hamilton Depression Rating Scale



(a) MEP Amplitude **(b)** Stimulation Intensities

Figure 3.3 – Group differences in MEP amplitudes and stimulation intensities at 120RMT. a) Motor Evoked Potential amplitudes at 120 RMT were significantly smaller in MAP and schizophrenia groups as compared to control group, * $p < 0.01$. **b)** SI were significantly greater in the schizophrenia group as compared to control group, * $p < 0.05$.

Table 3.6 – Medication prescribed for participants with psychosis included in the 120RMT subset

	MAP (N=22)		SCZ (N=20)		Kruskal-Wallis Main Effects		
Prescribed medication OR Category of medication (N)	**Yes**	**No**	**Yes**	**No**	**Chi-squared**	**df**	**p-value**
Any Antipsychotic	20	2	16	3	0.41	1	0.5185
First Generation Antipsychotics	17	5	6	14	9.22	1	**0.0023***
haloperidol	14	8	1	18	14.60	1	**0.0001***
chlorpromazine	2	20	0	19	1.77	1	0.1832
trifluoperazine	0	22	1	18	1.15	1	0.2819
flupentixol (long acting injectable)	1	21	0	19	1.77	1	0.1832
zuclopenthixol decanoate (long acting injectable)	1	21	2	17	0.52	1	0.4689
fluphenazine (long acting injectable)	0	22	1	18	1.15	1	0.2819
Second Generation Antipsychotics	4	18	13	7	9.30	1	**0.0022***
clozapine	0	22	6	13	7.93	1	**0.0048***
olanzapine	0	22	2	17	2.37	1	0.1233
risperidone	4	18	4	15	0.05	1	0.8193
quetiapine	0	22	1	18	1.15	1	0.2819
sulpiride	0	22	1	18	1.15	1	0.2819
Antidepressants							
fluoxetine	1	21	2	17	0.52	1	0.4689
citalopram	0	22	1	18	1.15	1	0.2819
amitriptiline	1	21	1	18	0.01	1	0.9163
Mood Stabilizers							
lithium	0	21	1	12	1.61	1	0.2037
sodium valproate	3	19	3	16	0.03	1	0.8476
Anticholinergics							
orphenadrine	8	14	4	15	1.12	1	0.2886
	Median	**Min-Max**	**Median**	**Min-Max**			
Cumulative antipsychotic dose expressed as chlorpromazine equivalents (mg)	112.5	0-450	200	0-1500	1.58	1	0.2085

* $p < 0.05$

3.4.2 140% Resting motor threshold cortical silent period

3.4.2.1 Participant demographics, physical attributes, drug use and clinical measures

While 27 of the 28 control participants could provide data for both 120RMT and 140RMT, 17 of the 22 MAP participants provided 140RMT data and only 10 of the 20 schizophrenia participants could provide 140RMT data. Similar to the 120RMT data, the schizophrenia group had higher weight ($p < 0.01$) compared to the control and MAP groups and the MAP group had lower levels of education compared to controls ($p < 0.05$) (Table 3.8). Similar to the 120RMT results, MAP had higher ASSIST scores than both control and schizophrenia groups ($p < 0.0001$) (Table 3.10).

Table 3.7 – Demographic and physical attributes for participants included in the 140RMT subset

	CON (N=27)			MAP (N=17)			SCZ (N=10)		
Demographic Variables	**Median**	**Min**	**Max**	**Median**	**Min**	**Max**	**Median**	**Min**	**Max**
Age on day of testing (yrs)	25	19	40	28	19	35	28.5	20	36
Years at school (yrs)	12	8	14	10	7	12	12	10	12
Years of tertiary education (yrs)	1	0	10	0	0	4.5	1.5	0	4
Total years of education (yrs)	12	8	22	11	7	16.5	13.5	10	16
Female : Male (N)	13 : 14			7 : 10			5 : 5		
Physical Attributes									
Height (m)	1.74	1.57	1.88	1.71	1.52	1.89	1.67	1.51	1.87
Weight (kg)	68	53.5	133	67.1	47.9	98	79.05	57	136
BMI (kg/m2)	22.91	17.47	38.44	22.2	18.51	30.66	26.89	21.16	47.47
Right hand max force (kg)	7.5	5	13	7.5	4.5	11	7.25	4	10.5
40% Right hand max force (kg)	3	2	5.2	3	1.8	4	2.9	1.6	4.2
Left hand max force (kg)	7.5	5	12	7	4	11	7.75	3.5	10
40% Left hand max force (kg)	3	2	4.8	2.8	1.6	4.2	3.1	1.4	4
Ambidextrous : Left : Right Handed (N)	1 : 1 : 25			0 : 2 : 15			0 : 1 : 9		

Table 3.8 – Group comparisons of demographic and physical attributes for participants included in the 140RMT subset

	Kruskal-Wallis Main Effects			Multiple comparisons		
				CON vs MAP	CON vs SCZ	MAP vs SCZ
	Chi-squared	**df**	**p-value**	**p-value**	**p-value**	**p-value**
Age on day of testing (yrs)	1.35	2	0.5080			
Years at school (yrs)	9.41	2	**0.0091***	**0.0172***	0.5368	0.1337
Years of tertiary education (yrs)	4.57	2	0.1013			
Total years of education (yrs)	8.40	2	**0.0149***	**0.0113***	0.7578	0.1052
Female : Male (N)	0.26	2	0.8752			
Physical Attributes						
Height (m)	1.09	2	0.5798			
Weight (kg)	5.11	2	0.0774			
BMI (kg/m2)	8.68	2	**0.0129***	0.8282	**0.0085***	**0.0088***
Right hand max force (kg)	1.11	2	0.5739			
40% Right hand max force (kg)	1.29	2	0.5236			
Left hand max force (kg)	0.77	2	0.6772			
40% Left hand max force (kg)	0.95	2	0.6198			
Ambidextrous : Left : Right Handed (N)	0.19	2	0.9081			

* $p < 0.05$

Table 3.9 – Attention deficit and drug use scores for participants included in the 140RMT subset

	CON (N=27)			MAP (N=17)			SCZ (N=10)		
Subjective Scores	**Median**	**Min**	**Max**	**Median**	**Min**	**Max**	**Median**	**Min**	**Max**
ASRS Part A (above cut off)	1	0	5	2	0	4	1.5	1	4
ASRS Part B (above cut off)	2	0	5	2	0	8	3	0	6
ASSIST Subscore Tobacco	0	0	26	21	9	31	3	0	30
ASSIST Subscore Alcohol	2	0	25	4	0	21	3	0	12
ASSIST Subscore Cannabis	0	0	6	6	0	31	0	0	9
ASSIST Subscore Methamphetamine	0	0	0	6	0	38	0	0	3
ASSIST Total Score	9	0	34	36	6	127	12	3	36

ASRS = Adult ADHD Self-Report Scale;
ASSIST = Alcohol, Smoking and Substance Involvement Screening Test

Table 3.10 – Attention deficit and drug use scores for participants included in the 140RMT subset

	Kruskal-Wallis Main Effects			Multiple comparisons		
				CON vs MAP	CON vs SCZ	MAP vs SCZ
Subjective Scores	**Chi-squared**	**df**	**p-value**	**p-value**	**p-value**	**p-value**
ASRS Part A (above cut off)	2.14	2	0.3430			
ASRS Part B (above cut off)	3.4339	2	0.1796			
ASSIST Subscore Tobacco	21.193	2	**<0.0001***	**<0.0001***	0.7917	**0.0311***
ASSIST Subscore Alcohol	0.79276	2	0.6728			
ASSIST Subscore Cannabis	12.417	2	**0.0020***	**0.0071***	0.7366	0.1268
ASSIST Subscore Methamphetamine	35.187	2	**<0.0001***	**<0.0001***	0.5728	**<0.0001***
ASSIST Total Score	23.734	2	**<0.0001***	**<0.0001***	0.6296	**<0.0001***

* $p < 0.05$;
ASRS = Adult ADHD Self-Report Scale;
ASSIST = Alcohol, Smoking and Substance Involvement Screening Test

The results of duration of diagnosis and clinical scales score comparisons between MAP and schizophrenia groups are presented in (Table 3.11). No significant difference in severity of clinical symptoms was found between MAP and schizophrenia.

schizophrenia reported a significantly higher dosage of cumulative antipsychotic medication expressed as chlorpromazine equivalents ($p < 0.05$). Significantly more MAP participants were prescribed FGAs ($p < 0.01$), as seen with higher number of halperidol prescriptions ($p < 0.01$), while significantly more schizophrenia participants were prescribed SGAs ($p < 0.01$), as seen with higher number of clozapine prescriptions ($p < 0.05$) (Table 3.12).

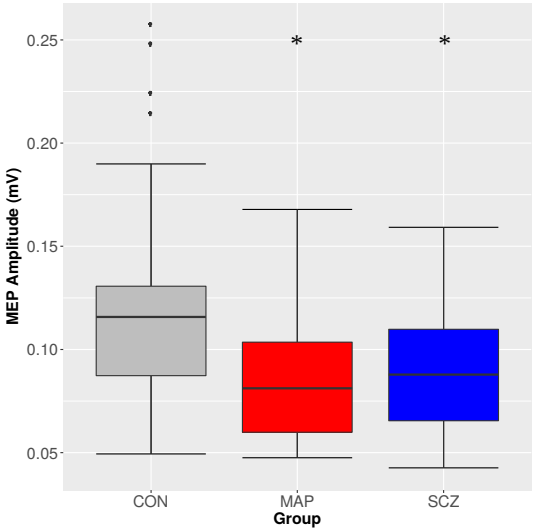
3.4.2.2 Group comparisons

Group comparisons found a significant main effect of MEP amplitude ($p < 0.01$). Post-hoc multiple comparisons found significantly smaller MEP amplitudes in the MAP and schizophrenia group compared to the control group by 31.7μV ($p < 0.01$) and 26.7μV ($p < 0.05$) respectively (Figure 3.4, Appendix B.3.2 and B.3.2.1).

Table 3.11 – Clinical scale scores for participants with psychosis included in the 140RMT subset

	MAP (N=17)			SCZ (N=10)			Kruskal-Wallis Main Effects		
	Median	**Min**	**Max**	**Median**	**Min**	**Max**	**Chi-squared**	**df**	**p-value**
Duration of Diagnosis (yrs)	1.5	0.25	13	4.5	1	15	2.77	1	0.0959
Extrapyramidal side effects	0	0	9	1	0	3	0.29	1	0.5868
PANSS Total	49	30	77	43	33	100	0.20	1	0.6512
PANSS Positive subscale	8	7	30	8	7	24	0.29	1	0.5868
PANSS Negative subscale	14	7	27	12	8	28	0.33	1	0.5609
PANSS General Psychopathology subscale	23	16	38	21.5	17	50	0.07	1	0.7820
CDSS Total	1	0	9	3.5	0	6	0.99	1	0.3190
YMRS Total	2	0	5	0	0	10	0.72	1	0.3959
HAMD Total	3	0	12	4	0	13	0.36	1	0.5436
Clinical Global Impression Severity	2	1	4	3	1	4	0.96	1	0.3265
Global Assessment of Functioning	65	31	75	60	30	80	0.33	1	0.5611

* $p < 0.05$;
PANSS = Positive and Negative Syndrome Scale;
CDSS = Calgary Depression Scale for Schizophrenia ;
YMRS = Young Mania Rating Scale;
HAMD = Hamilton Depression Rating Scale



(a) MEP Amplitude

Figure 3.4 – Group differences in MEP amplitudes at 140RMT. Motor Evoked Potential amplitudes at 140RMT were significantly smaller in MAP and schizophrenia groups as compared to control group, * $p < 0.01$.

Table 3.12 – Medication prescribed for participants with psychosis included in the 140RMT subset

	MAP (N=17)		SCZ (N=10)		Kruskal-Wallis Main Effects		
Prescribed medication OR Category of medication (N)	**Yes**	**No**	**Yes**	**No**	**Chi-squared**	**df**	**p-value**
Any Antipsychotic	16	1	10	0	0.58	1	0.4431
First Generation Antipsychotics	13	4	2	8	7.83	1	**0.0051***
haloperidol	10	7	0	10	8.99	1	**0.0027***
chlorpromazine	2	15	0	10	1.22	1	0.2687
trifluoperazine	0	17	1	9	1.70	1	0.1923
flupentixol (long acting injectable)	2	15	0	10	1.22	1	0.2687
zuclopenthixol decanoate (long acting injectable)	0	17	0	10			
fluphenazine (long acting injectable)	0	17	1	9	1.70	1	0.1923
Second Generation Antipsychotics	4	13	9	1	10.73	1	**0.0010***
clozapine	0	17	3	7	5.52	1	**0.0187***
olanzapine	0	17	2	8	3.53	1	0.0600
risperidone	4	13	3	7	0.13	1	0.7162
quetiapine	0	17	1	9	1.70	1	0.1923
sulpiride	0	17	0	10			
Antidepressants							
fluoxetine	1	16	1	9	0.14	1	0.6986
citalopram	0	17	1	9	1.70	1	0.1923
amitriptiline	1	16	0	10	0.58	1	0.4431
Mood Stabilizers							
lithium	0	17	1	9	2.28	1	0.1306
sodium valproate	3	14	1	9	0.28	1	0.5961
Anticholinergics							
orphenadrine	7	10	2	8	1.22	1	0.2687
	Median	**Min-Max**	**Median**	**Min-Max**			
Cumulative antipsychotic dose expressed as chlorpromazine equivalents (mg)	125	0-450	300	0-1150	4.93	1	**0.0263***

* $p < 0.05$

3.5 Discussion

The main finding in this chapter was a smaller MEP amplitude in both MAP and schizophrenia groups compared to to the controls. No other significant group differences were found for SI, RMT, latency to MEP, CSP or pre-stimulus baseline measures. This is the first report of MEP characteristics in MAP. The hypothesis for longer CSP durations and higher RMT were not observed.

It is important to note that in the CSP paradigm, the hand is in an *active* state of voluntary, continuous and controlled (isometric) contraction, when the MEP is induced. In this case, the suprathreshold TMS elicits *additional* neural activity from already active neurons, which more likely tests for maximal capacity of neuronal output, as opposed to "cortical excitability", which is the "readiness" of cortical neurons to fire, typically indicated by a low RMT, or a larger MEP elicited from a *relaxed*muscle. Previous studies that had deconstructed the cortical vs spinal contributions to the CSP had not in fact investigated the cortical factors that influenced the generation of the MEP which preceded the CSP (Fuhr et al., 1991; Inghilleri et al., 1993).

There are many factors that influence the amplitude of the MEP, one of which is SI. The MEP is generated from an already voluntarily active muscle, the primary motor neuron controlling the muscle was initially actively sending signals to the spinal cord and target APB muscle. The TMS pulse applied during the context of this voluntary contraction further stimulates the primary motor neurons. Even though MEP sizes increase with stimulation levels, amplitudes typically reach a maximum and plateau at stimulation levels above 140% RMT, suggesting that the stimulation has activated the maximum number of primary motor neurons in the cortex. One suggestion from these results would be that there may be fewer pyramidal neurons in the motor cortex of the MAP and schizophrenia. If this was true, the RMT for these participants should have been higher, since weaker Stimulation intensity (SI) recruits fewer neurons and produces smaller MEP size (Priori et al., 1999; Saisanen et al., 2008). Indeed, the MAP and schizophrenia groups showed slightly stronger SIs than the control group. This only confirms that the smaller MEP amplitudes observed are not due to weaker absolute SIs. Each participant was also stimulated at a percentage of their individual RMT, ensuring that factors such hair, skin and skull affecting distance between the stimulator and the neurons were accounted for.

Besides SI, smaller MEP amplitudes in the MAP and schizophrenia groups could result from several, or a combination of other possibilities, which relate to some key hypotheses for the etiology of schizophrenia such as 1) fewer PMC neurons were present and thus there were fewer that could be stimulated; 2) loss of neuronal integrity, potentially decreasing maximal output of primary motor neurons may be lower in MAP and schizophrenia; 3) neural circuits involved in maintaining the pinch were less synchronized in the MAP and schizophrenia, thus a TMS pulse applied in the context of unsynchronized neuronal firing may have a lower effect than a pulse arriving while neurons were firing in synchrony during maintenance of the isometric contraction.

A multitude of studies have found decreased neuronal integrity in schizophrenia. *N*-acetylaspartate (NAA) levels measured by ^{1}H-MRS is used as a marker of neuronal density, integrity and function (Meyerhoff et al., 1993; Cheng et al., 1997; Demougeot et al., 2001), and lower levels of NAA is often observed in schizophrenia (Kraguljac et al., 2012; Fusar-Poli et al., 2013; Paslakis et al., 2014). The synthesis of NAA is closely coupled with the functional integrity of neuronal mitochondria and the concentration of NAA corresponds to neuronal energy consumption (Clark, 1998; Moffett et al., 2007), and studies have shown indications of mitochondrial dysfunction in schizophrenia (Anglin et al., 2012; Manji et al., 2012). Additionally, oligodendrocyte morphological abnormalities (Hof et al., 2002) and dysfunction as measured by differential gene expression (Tkachev et al., 2003) have been shown in schizophrenia, which likely contributes to findings of white matter reductions in schizophrenia (Yao et al., 2013). Thus, smaller MEP amplitudes in schizophrenia may also result from decreased neuronal integrity, limiting their maximal output capacities as compared to controls. These effects may not be obvious during normal daily activities, since maximal neuronal output is not typically required for normal movements, however, the ability of high intensity TMS to induce maximal neuronal activity allowed us to measure an upper functional limit in schizophrenia.

Post mortem studies on schizophrenia have found lower pre-frontal cortical pyramidal dendritic spine density in layer III/IV (Glantz and Lewis, 2000). In the ventral medial nucleus (Pakkenberg, 1990; Popken et al., 1998, 2002), as well as the anterior ventral and medial nuclei of the thalamus (Young et al., 2000) lower numbers of total neurons, as well as lower volumes have been found in schizophrenia. Since the ventral medial nucleus of the thalamus projects to DLPFC, and the ventral anterior nucleus of the thalamus project signals from the basal ganglia to layer III/IV

in the cortex (Giguere and Goldman-Rakic, 1988), fewer numbers of neurons in these key areas could certainly contribute to poor cognitive performance in schizophrenia. Fewer neurons in the cortex and the ventral anterior nucleus of the thalamus may also diminish the maximal cumulative output that can be achieved when challenged by TMS for maximal muscular recruitment, thus decreasing MEP size in schizophrenia compared to controls. Similarly, smaller MEP amplitudes in MAP when compared to controls would suggest that MAP may have similarly lower neuronal counts in these brain areas.

The majority of studies related to neuronal integrity with relation to MA have been performed in abusers. In MA abusers, NAA concentrations have been found to be lower in the frontal white matter (Ernst et al., 2000; Sung et al., 2007; Sailasuta et al., 2010) and basal ganglia (Ernst et al., 2000) compared to healthy controls. The NAA/Cr+PCr ratio is similarly used as an indicator of neuronal integrity, and this ratio was found to be lower in the ACC and DLPFC of MA dependent users (Howells et al., 2014), and abusers abstinent from 1 month to 5 years (Nordahl et al., 2002, 2005). Our group also found a lower NAA/Cr+PCr ratio in the ACC and DLPFC in MAP specifically (Howells et al., 2014). The similarities in findings regarding neuronal integrity between MAP and schizophrenia, taken together with similarly smaller MEP amplitudes in both MAP and schizophrenia suggests that a smaller MEP amplitude may also be an indication for neuronal integrity, or at least a crude measure of maximal neuronal function.

Since the CSP paradigm delivers a TMS pulse that interrupts the active and ongoing neural activity required for consistent muscular control, which involves the coordination of (at least) the pre-frontal cortex, motor cortices, basal ganglia as well as thalamic circuits. A key structure that coordinates the activities of the direct, indirect and hyperdirect pathways is the RN, where well-timed DA is required to inhibit specific GP terminals at the RN (Kayahara and Nakano, 1998; Gasca-Martinez et al., 2010; Pazo et al., 2013), to prevent GP dis-inhibition of the RN, and allow the RN to inhibit only the relevant TC neurons that are not required for the target movement, while allowing appropriate signals to go through and activate the cortex for the target movement (Nambu, 2008). DA transmission is hypothesized to be excessive (Seeman and Kapur, 2000; Kapur et al., 2005) and mis-timed in schizophrenia. In healthy participants, smaller MEPs are associated with higher levels of DA by pharmacological DA antagonism (Paulus et al., 2008; Ziemann et al., 2015). NMDAR activity in both TC neurons and RN neurons are also likely to be impaired

in schizophrenia, and NMDA antagonism also associates with smaller MEPs (Paulus et al., 2008; Ziemann et al., 2015). Thus unsynchronized neuronal firing due to poor RN function and excessive DA in schizophrenia could theoretically predict smaller MEP amplitudes in schizophrenia under situations requiring constant voluntary control on hand muscles.

Smaller MEPs have been observed in response to DA, $GABA_A$ and $GABA_B$ receptor agonists, as well as voltage-gated sodium blockers (Paulus et al., 2008; Ziemann et al., 2015). Larger MEP amplitudes have been observed in response to NMDA and NE receptor agonists, as well as DA antagonists (Paulus et al., 2008; Ziemann et al., 2015). These results would suggest that the MAP and schizophrenia participants may have at least four possibilities of neurochemical impairments, including excess DA or excess GABA transmission, or insufficient NMDA or NE transmission; or a combination of these possibilities. NMDA blockade has also resulted in smaller MEPs (Paulus et al., 2008; Ziemann et al., 2015), suggesting there might be an underlying impairment of NMDA receptor activation in the cortex.

No group differences were found in baseline contraction (200 ms pre TMS), suggesting that the level of isometric contractions were comparable between groups. This measure has not been reported by other groups, although it is perhaps implied by specifying a target level of muscle contraction in volunteers. Latency to MEP was similar between groups, suggesting that the rate of signal conduction through the various synapses to the target muscle is not impaired in MAP or schizophrenia (Stetson et al., 1992; Livingston et al., 2010).

There were no significant differences of CSP duration in MAP and schizophrenia groups. These results are in line with other groups that have reported no differences, or longer CSP in schizophrenia compared to controls (Hasan et al., 2012; Radhu et al., 2013), but are in contrast to previous studies have found CSP to be shorter in schizophrenia for some groups; where increasing $GABA_B$ transmission with clozapine treatment lengthens the CSP (Daskalakis et al., 2008b; Daskalakis and George, 2009; Liu et al., 2009). Inconsistencies in CSP duration results in the literature suggest that there are limitations to the CSP methodology due to the inherently variable nature of the technique (Wassermann, 2002).

3.5.1 Limitations

Some limitations require emphasis. First, both MAP and schizophrenia groups were undergoing outpatient treatment. The lack of a difference between the MAP and schizophrenia groups in the cumulative antipsychotic dose expressed as chlorpromazine equivalents suggests a general similarity in antipsychotic treatment between the psychosis groups, however, I was unable to determine any further medication specific effects. For example, a greater proportion of MAP were treated with haloperidol while a greater proportion of individuals with schizophrenia were treated with SGA. Unfortunately, the number of participants treated with each individual medication type and/or combination of medications were too small, and strong covariance of the variables (medications and group) violates statistical assumptions for ANCOVA, and it was not possible to determine conclusively whether MAP and schizophrenia differences were due to group, or medication (Glass et al., 1972).

Second, although the experiments were conducted rigorously, and MEP results are typically the most consistent of measurements with the least variability when using the CSP protocol, the variability for measurements taken using TMS are inherently high (Wassermann, 2002). Thus the novel MEP results from this chapter should be repeated independently for verification. In addition, wile the similar MEP results between MAP and schizophrenia provides evidence to indicate similar impairments in MAP and schizophrenia, this single measure is not sufficient to conclude poor TRN or cortical function in these groups.

The use of EEG frequency power has however had a long and fairly consistent history of being able to measure network functions in different states, and has been widely used in schizophrenia, and even some MA related research. The next chapter will report EEG frequency power findings and provide further characterization of cortical and subcortical connections in MAP, schizophrenia and healthy controls.

4 Electroencephalography: Relative Frequency Power

4.1 Introduction

This chapter explores the resting state EEG rhythmic activity in MAP during and between eyes open and closed states. I first review a brief history of the discovery of frequency band powers, and the review the current knowledge of the associations, and underlying mechanisms that may generate the delta, alpha, theta and beta frequency bands.

4.1.1 Brief history

In the publication of the first EEG measurement from the scalp by Hans Berger in 1929, he included a qualitative analysis of the EEG patterns; the description of alpha waves, and the blocking of the alpha wave by opening the eyes. Berger's colleague G. Dietsch soon produced a paper on quantitative analysis of human EEG using Fourier analysis (Dietsch, 1932). This analysis was improved by the development of the fast Fourier transform (Cooley and Tukey, 1965), which became the most widely used analysis tool for EEG data (Kaiser, 2005).

The Fourier analysis is a mathematical method for representing a complex function as a sum of simpler trigonometric functions (Hamming, 1989). In the context of quantitative EEG, frequency analysis "involves selection of elementary shapes or waveforms which are added together like weights on a scale, until their total matches the pattern under investigation" (Kaiser, 2005). Metaphorically, the original EEG waveform could be viewed as a ray of white sunlight, and the Fourier transform as a prism, which decomposes the sunlight into its sub-components of frequencies - observed as the separate colours of the rainbow. The Fourier transform is used to convert voltage amplitudes over time, to power at each frequency, as mental processes are better reflected in the periodicities I identify, rather than the raw values detected from the equipment

(Kaiser, 2005).

Using Fourier transformation, the raw EEG waveform can be decomposed into functionally relevant sub-component frequency bands, including the delta (0.1 to 4 Hz), theta (4 to 7 Hz), alpha (7 to 14 Hz), beta (15 to 30 Hz) and gamma (30 to 70 Hz), where lower frequency bands have higher amplitudes and vice versa (Başar, 1998; Başar, 1999). Each band of oscillation frequencies reflect summated rhythmic changes between excitatory and inhibitory states of particular neuronal populations. Decades of research in EEG frequency band powers - and their responses to mental states and events - have shown that they are strongly correlated with sensory and cognitive functions (Başar et al., 2001).

4.1.2 Frequency power associations in schizophrenia and MAP

Frequency power in schizophrenia has been widely researched, and has produced relatively consistent patterns of changes in comparison to healthy controls, despite a multitude of methodological variations (Boutros et al., 2008). This EEG frequency band activity literature will be reviewed with consideration of the possible neurobiological origins and physiological associations of each frequency band and proposed consequences of the differences observed in schizophrenia.

Although there are many studies on peripheral, neurochemical and psychological effects of MA, only our group has published on frequency band power in MAP, finding higher delta/alpha power during resting eyes closed (REC), resting eyes open (REO), as well as during active performance of a sustained attention task as compared to healthy controls (Howells et al., 2018).

There are also very few studies relating to frequency power and MA dependence in humans, even those without emphasis on psychosis measures. An old study found no difference in EEG measures between drug users (volatile inhalants and MA), their sibling and healthy controls, although it is unclear whether the EEG were measured with eyes open or closed (Trites and Others, 1976). Three small qEEG studies (n = 9-11) of 4 day abstinent MA dependent individuals reported increased delta and theta power in MA dependent participants during REC (Newton et al., 2003), where increased theta power was correlated to poorer behavioural performance (Newton et al., 2004; Kalechstein et al., 2009). More recently, another qEEG study from an Iranian population, with EEG measured during REO, found that absolute delta power was lower in recently abstinent MA abusers (Shafiee-Kandjani et al., 2019). Relative EEG frequency power was also reported in

the same study, finding lower delta and theta power, and higher beta power in the MA group (Shafiee-Kandjani et al., 2019). In a Korean study, recently abstinent MA dependent participants showed lower absolute and relative theta and alpha powers, and higher beta power during REC (Hwang et al., 2017). The contrasting results between studies could be due to a variety of factors such as duration of MA abuse or dependence, population effects, or whether the eyes were open or closed during the resting state when the EEG were performed in the different studies.

Since it is unclear whether the small body of work on EEG frequency power on MA dependent participants included those with psychosis, the present work will examine individual frequency power bands in MAP in REO and REC states, as well as during the performance of a sustained attention task.

4.1.3 Delta frequency power

The delta band of frequencies (0.1 to 4 Hz) are high amplitude, low frequency oscillations that are particularly characteristic of deep slow wave sleep (Steriade et al., 1993). Extensive basic research has found that delta oscillations are largely generated by the interaction between the cortex, TC neurons, and the GABAergic neurons of the TRN (Destexhe and Sejnowski, 2003; Ulrich, 2014; Herrera et al., 2016). A more detailed review of the TC system was presented previously in Chapter 1, page 22.

During sleep, the lack of excitatory input from cortical, brainstem and basal forebrain (BF) areas cause thalamic neurons to be in a hyperpolarized state. This hyperpolarization activates T-type channels in the TC neurons, and the influx of Ca^{2+} results in depolarization that produces a burst of action potentials to the TRN. Activation of the TRN results in GABA release back onto TC neurons, causing hyperpolarization and perpetuates the bursting cycle. These bursts occur between 0.1-4 Hz, and constitute the spontaneously generated delta rhythm in the thalamus during slow-wave sleep (Destexhe and Sejnowski, 2003; Ulrich, 2014; Herrera et al., 2016).

Delta burst rhythms are also intrinsically generated by cortical neurons, termed regular spiking cortical cells (Kristiansen and Courtois, 1949; McCormick, 1992; Michel et al., 1992, 1993; Steriade and McCarley, 2013). Regular spiking cortical neurons in burst mode shift into tonic spiking mode when K^+ currents within the cells decrease, which decreases the firing threshold of the cells, leading to higher likelihoods of neuronal activation. K^+ currents in cortical cells have

been shown to be decreased by the activation of a variety of receptors, including the muscarinic ACh, glutamate metabotropic, beta-adrenergic, H2, 5-HT and alpha1 receptors (McCormick, 1992). Activation of these receptors leads to decreases in slower rhythms and increased arousal and attentiveness, with an increased ability to respond to excitatory inputs that arrive at high frequencies (McCormick and Feeser, 1990). In contrast, Adenosine, $GABA_B$, $5\text{-}HT_{1A}$ receptor activation in the cortex increases membrane K^+ currents, which is associated with inhibition of the cortical neurons through hyperpolarization of the membrane potential. $GABA_B$-mediated inhibition result in low intensity depolarizations and inhibit small or weak inputs, increasing delta power (Connors et al., 1988b; McCormick, 1989).

Glutamate receptor hypofunction, particularly on critical GABAergic neurons, has long been suggested to contribute to the pathology of schizophrenia (Olney and Farber, 1995; Coyle, 2006). NMDAR blockade by drugs such as ketamine and phencyclidine (PCP) have produced symptoms similar to that of schizophrenia (Luby et al., 1959; Itil et al., 1967; Krystal et al., 1994), and agonism of metabotropic glutamate receptors can attenuate the effects of low dose ketamine (Krystal et al., 2005). Since NMDAR blockade in the TRN generates increased delta range rhythmic bursting (Zhang et al., 2009), and schizophrenia have been found to express lower amounts of NMDARs in the thalamus and PFC (Pakkenberg et al., 2009), NMDAR hypofunction may underlie the increased delta power seen in schizophrenia (Pratt et al., 2017).

An evolutionary perspective of delta posits that, since delta oscillations dominate in the waking states of lower vertebrates such as reptiles, while higher EEG frequencies emerged with further evolution to higher vertebrates with increasing complexity of neural structures (for in depth review please see (Knyazev, 2012)), delta oscillations are predominantly associated with behaviour that are necessary to satisfy the most basic biological needs, which are largely guided by the reward system (Gray, 1990; Knyazev, 2007, 2012). Indeed, in waking animals, direct microelectrode measurements of delta oscillations have been taken from the common brainstem system (Lambertz and Langhorst, 1998), as well as key areas of the reward system nucleus accumbens (NAc) (Leung and Yim, 1993), ventral pallidum (Lavin and Grace, 1996), and the ventral tegmental area (VTA) (Grace, 1995).

DA function also affects RN function. *In vitro* studies on RN slices have shown that delta rhythms can be generated by a synergistic effects between D_2 and NMDAR in the RN, and that a blockade

of NMDARs in the presence of DA can trigger delta bursting. However a blockade of D_2 receptors in the RN prevents the effect of NMDAR blockade to trigger delta bursting (Zhang et al., 2009). The ability for D_2 antagonism to block delta bursting may contribute to the therapeutic action of D_2 antagonists such as haloperidol in schizophrenia (Zhang et al., 2009).

In schizophrenia, research has consistently shown higher cortical delta power during resting wakefulness (Itil et al., 1972; Boutros et al., 2008; Matheson et al., 2014), particularly during resting states with eyes closed, and suggests thalamic and frontal lobe dysfunction (Morihisa et al., 1983; Karson et al., 1988; Miyauchi et al., 1990; Locatelli et al., 1993; Sponheim et al., 1994, 2000; Winterer et al., 2001; Wuebben and Winterer, 2001; Borisov et al., 2005; Di Lorenzo et al., 2015), potentially due to decreased glutamate or NE activity, or increased GABA, 5-HT_{1A} receptor activation in the cortex (Connors et al., 1988b; McCormick, 1989). Impairment of activity in each of these neurotransmitter systems has been associated with decreased sustained attention performance (Beane and Marrocco, 2004; Krystal et al., 2005; Sagvolden, 2006; Wingen et al., 2007; Edden et al., 2012; Goonawardena et al., 2016; Bolden et al., 2017; Kim et al., 2019).

No delta power results have been reported for MAP. Considering the clinical similarities between MAP and schizophrenia, if delta power in MAP is similarly increased as in schizophrenia during REC, there may be similar neuromodulatory impairments underlying sustained attention deficits in both groups.

4.1.4 Theta frequency power

The theta band of frequencies (4 to 7 Hz) are consistently observed in animals at all hippocampal subregions during active exploration, and rapid eye movement (REM) sleep (Vanderwolf, 1969; Colgin, 2013). While theta rhythms occur in many cortical and subcortical regions (Mitchell and Ranck Jr, 1980; van der Meer and Redish, 2011; Yu and Frank, 2015), they are largely thought to be generated by a tri-synaptic circuit between the medial septum (in the BF), and both pyramidal and interneuronal cells of the hippocampus (Colgin, 2016).

In vitro, an isolated whole hippocampus can intrinsically generate theta rhythms without any connections to other structures (Goutagny et al., 2009). Evidence suggests that the intrinsic properties of hippocampal pyramidal neurons may produce theta oscillations by rhythmic activation of pyramidal interneurons (Dickson et al., 2000; Hu et al., 2002; Stark et al., 2013), inducing

post-inhibitory rebound spiking, producing theta synchronized firing across multiple pyramidal cells (Cobb et al., 1995).

However, *in vivo* experiments in behaving animals have consistently shown that inputs from the medial septum, particularly the medial septum-diagonal band of Broca is required as a pacemaker for theta oscillations, where lesions or inactivation of this area disrupts the generation of theta (Green and Arduini, 1954; Petsche et al., 1962; Wang et al., 2015). Cholinergic and GABAergic cells of the medial septum act as theta pacemakers, target dentate gyrus, CA3, and CA1 interneurons (Freund and Antal, 1988). The septal interneurons rhythmically inhibit hippocampal interneurons, and this disinhibits hippocampal pyramidal neurons, promoting theta rhythmic firing of hippocampal pyramidal neurons in behaving animals (Varga et al., 2008; Hangya et al., 2009), while cholinergic inputs to the hippocampus are required to maintain theta oscillations during inactive states (Kramis et al., 1975; Nakajima et al., 1986).

Fundamental studies from the 1970s showed that hippocampal EEG theta power could predict the outcomes of animal learning and memory performance (Landfield et al., 1972; Berry and Thompson, 1978), which has since been supported by many studies relating theta power to mnemonic task performance, and synaptic plasticity (Macrides et al., 1982; Sauseng et al., 2010; Belchior et al., 2014; Hsieh and Ranganath, 2014), providing evidence to the theory that theta plays an essential role in learning and memory. In particular, theta appears to enhance signal to noise ratios and promote learning by linking related signals within a theta cycle, whereas dissimilar, and thus potentially conflicting signals, are segregated on different theta cycles (Jezek et al., 2011; Brandon et al., 2013; Dupret et al., 2013). Thus theta rhythms are vitally involved in temporally coordinating hippocampal-dependent memory functions both within the hippocampus and between the hippocampus and entorhinal and prefrontal areas (Buzsáki and Moser, 2013; Hunt et al., 2017), and ordering information during working memory performance (Skaggs et al., 1996; Dragoi and Buzsáki, 2006; Barr et al., 2017).

Hippocampal theta power has been more difficult to measure in humans due to the difficulty of source localization of EEG signal from deep brain structures (Hunt et al., 2017). In animals, the relationship between theta from frontal-midline and hippocampal locations are yet unclear, since they can be either phase locked or oscillate independently from eachother (Mitchell et al., 2008), however frontal-midline-theta power has been widely studied in humans, with consistent

correlations of higher theta power with decreased anxiety (Mizuki et al., 1992; Suetsugi et al., 2000; Adhikari et al., 2010), and anxiolytic drugs such as clonidine and diazepam have been shown to increase theta power and decrease anxiety scores (Mizuki et al., 1983, 1996).

Theta power has generally been found to be increased in schizophrenia as compared to healthy controls during awake resting conditions (Itil et al., 1972; Elbert et al., 1992; Clementz et al., 1994; Sponheim et al., 1994; Knott et al., 2001; Newson and Thiagarajan, 2019), including higher theta band coherence both intra-hemispherically as well as between cortical hemispheres (Merrin et al., 1989). However other studies have found that schizophrenia participants (both treated and untreated with haloperidol) showed lower theta power in the frontal and central regions, compared to healthy participants that showed increased theta power in frontal and central regions (Westphal et al., 1990); or no differences in theta power between schizophrenia and healthy controls, only a difference in the locations of peak theta power (Basar-Eroglu et al., 2008).

Animal models of schizophrenia have shown decreased theta coupling between the pre-frontal cortex and hippocampus correlated with decreased cognitive performance (Dickerson et al., 2010; Sigurdsson et al., 2010), and early cognitive training using the active place avoidance task in a rat model of schizophrenia improved their long term task performance, which correlated to an increase in inter-hippocampal theta synchrony (Lee et al., 2012). Hippocampal abnormalities in schizophrenia patients have also been widely observed, including morphological abnormalities by magnetic resonance imaging (MRI), neurochemical abnormalities by magnetic resonance spectroscopy (MRS), and metabolic abnormalities but positron emission tomography (PET) (see review (Harrison, 2004)). Even though it is difficult to directly relate underlying pathology to any changes in theta power in people with schizophrenia, deficiencies in hippocampal function could underlie cognitive deficiencies observed in schizophrenia (Mitchell et al., 2008; Colgin, 2013; Hunt et al., 2017).

Slow (∼1Hz) rTMS has been shown to decrease anxiety and increase theta power in the left dorsolateral prefrontal cortex (DLPFC) (Schutter et al., 2001). Neurofeedback training (Enriquez-Geppert et al., 2013, 2014) and meditation (Aftanas and Golocheikine, 2001; Mitchell et al., 2008) have also been shown to increase theta power, and potentially improve cognitive performance in schizophrenia (Surmeli et al., 2012; Feizzadeh et al., 2015). Thus further study into theta power in schizophrenia may provide neurobiological evidence to support such adjunct therapies which

may provide additional benefits above that of first line psychiatric treatment.

Theta power has never been examined in MAP, and few have been reported on MA users. Only a small study in MA dependent individuals found increased theta power was correlated with poorer behavioural performance during memory tests (Kalechstein et al., 2009), and lower relative theta band power during REO (Shafiee-Kandjani et al., 2019), however it is unclear whether these results could be extrapolated for MAP. Should MAP show similar theta power changes as schizophrenia, it would suggest that MAP may also benefit from additional therapies such as rTMS to improve cognitive performance and quality of life.

4.1.5 Alpha frequency power

The alpha band of frequencies (7 to 14 Hz) has a well-defined physiological property known as the "Berger effect", where amplitudes (power) are high when eyes are closed, while amplitudes are low when eyes are open (Berger, 1929; Bazanova and Vernon, 2014; Tenke et al., 2015; Barry and De Blasio, 2017). This expected change in alpha power by the simple shift in state has been suggested to indicate altered allocation of neural resources between brain states (Li, 2010). Further, alpha power typically decreases during cognitive task performance (Salamon and Post, 1965; Merrin and Floyd, 1996; Tenke et al., 2015). This adaptability of alpha band power to environmental situations has been thought to reflect dynamic control of attention in accordance to environmental demands (Klimesch, 2012). In schizophrenia, lower alpha power has been associated with decreased frontal function (Mientus et al., 2002; Knyazeva et al., 2008), poor cognitive performance (Jensen and Mazaheri, 2010), and decreased alpha in the parietal-occipital region reflected dysfunctional top-down processing in schizophrenia compared to healthy controls (Koh et al., 2011).

Studies have consistently suggested that increased alpha synchrony reflects inhibitory neural activity (Palva and Palva, 2007). Cortical regions that are activated during a task show a decrease in alpha power (lowering the inhibition at the required region of activation), while regions that are task-irrelevant or potentially interfering, show an increase in alpha power (increasing the inhibition at those regions to increase signal to noise ratios of the relevant task) (Pfurtscheller and Da Silva, 1999). For example, in spatial cueing and hemifield tasks, alpha power was larger over the hemisphere not presented with stimuli (Worden et al., 2000; Medendorp et al., 2006; Thut et al., 2006; Sauseng et al., 2009), and when both hemispheres were stimulated, the hemisphere in which the

participant was *not attending to* had the higher alpha power (Kelly et al., 2006; Sauseng et al., 2009). Thus higher alpha power is associated with suppressing or filtering non-target external stimuli (Schimke et al., 1990; Gevins et al., 1997; Başar, 1999; Pfurtscheller and Da Silva, 1999; Schürmann and Başar, 1999; Klimesch, 2012; Tenke et al., 2015). Poor thalamic gating of stimuli as associated with lower alpha power has also been associated with poor performance at sustained attention tasks (Salamon and Post, 1965; Merrin and Floyd, 1996; Tenke et al., 2015).

Thus alpha power has been thought to be an indication of the level of thalamic gating, where a higher alpha power is linked to the "closed" state of the thalamic gate and inhibition of external and cortical inputs. Lower alpha power relates to an "open" state of the thalamic and thus more responsive to external and cortical inputs (Pfurtscheller, 2003; Bazanova and Vernon, 2014). The magnitude of alpha power decrease has also been used as an index of cortical activation (Schimke et al., 1990; Laufs et al., 2006), or general arousal, where increased skin level conductance (in general, or with the administration of caffeine as a known arousing agent) is correlated with lower alpha power (Barry et al., 2007). Using optogenetics to directly induce decreases in arousal state by activating cells of the TRN or increasing the arousal state by inhibiting cells in the TRN nucleus (Lewis et al., 2015). Poor thalamic gating of stimuli as associated with excessively lowered alpha power has also been associated with poorer performance at sustained attention tasks (Riccio et al., 2002; Salgado-pineda et al., 2003).

Alpha oscillations are thought to be largely generated by the interaction between the cortex, TC neurons, and the GABAergic neurons of the TRN, and also governed by the activity of low voltage activated T-type Ca^{2+} channels (Destexhe and Sejnowski, 2003). However, alpha oscillations are generated intrinsically by TRN neurons. TRN neurons are interconnected through GABAergic axon collaterals (Bal et al., 1995; Liu et al., 1995; Pinault and Deschênes, 1998), or dendro-dendritic GABAergic synapses (Deschênes et al., 1985; Yen et al., 1985; Pinault et al., 1997), particularly mediated by $GABA_A$ (McCormick and prince, 1986; Spreafico et al., 1988; Bal and McCormick, 1993; Huguenard and prince, 1994; Bal et al., 1995; Ulrich and Huguenard, 1996; Sanchez-Vives et al., 1997; Sanchez-Vives and McCormick, 1997; Zhang et al., 1997; Shu and McCormick, 2002) but also by $GABA_B$ (Ulrich and Huguenard, 1996) and perhaps gap junctions (Landisman et al., 2002). These cells sustain intrinsic oscillations between 7 to 14 Hz through repetitive reciprocal inhibitory rebound (Llinás and Geijo-Barrientos, 1988; Avanzini et al., 1989;

Destexhe and Sejnowski, 2003).

TRN neurons also express subtypes of T-type Ca^{2+} channels ($Ca_v3.3$) on their dendrites which are slower to depolarize and repolarize, and thus distinct from the T-type Ca^{2+} channel subtypes ($Ca_v3.1$) expressed more abundantly on TC neurons (Huguenard and McCormick, 1992; Talley et al., 1999; Destexhe and Sejnowski, 2003). Expression of these $Ca_v3.3$ channels on the dendrites of TRN neurons make them more sensitive to cortical inputs than TC neurons carrying information from the periphery (Destexhe and Sejnowski, 2003). This sensitivity allows the network of TRN neurons to form the so called "thalamic gate", where increased TRN inhibitory neuron activity (higher alpha power), leads to a higher likelihood of the TC neurons being in burst state, "closing" the thalamic gate and inhibiting external and cortical inputs (McAlonan et al., 2000; Destexhe and Sejnowski, 2003). The corollary, decreased inhibitory TRN neuron activity (lower alpha power), leads to a higher likelihood of the TC neurons being in tonic state, "opening" the thalamic gate and allowing external and cortical inputs through the thalamus. Thus, the membrane potentials of the TC neurons, and the TRN neurons control whether TC neurons can switch from oscillatory (high delta and/or high alpha) to transmitting modes (low delta and/or low alpha) (Steriade and McCarley, 1990; Détári, 2000; Steininger et al., 1999; Steriade and McCarley, 2013). Selective blockade of T-type Ca^{2+} channels in the TC and TRN has been shown to abolish burst firing without affecting tonic firing (Dreyfus et al., 2010), suggesting that low $Ca_v3.3$ activity may contribute to lower alpha power.

The membrane potentials of the TC and TRN neurons are in turn, controlled and modulated by all major ascending modulatory systems, including NE, 5-HT, ACh and histamine systems from the brain stem (Berridge and Foote, 1991; Robbins et al., 1998). Stimuli (whether external or internal) activate relevant ascending neurotransmitter systems or CT neurons, which then modulates the TRN and/or TC neuron activity towards the transmitting mode (Trulson and Jacobs, 1979; Aston-Jones and Bloom, 1981; Vanni-Mercier et al., 1984; El Mansari et al., 1989; Jacobs et al., 1990; Steriade et al., 1990a; McCormick, 1992; Engel and Pedley, 1997), preparing the cortex for processing the signals in a manner that can meet behavioural and intellectual demands from the stimulus (McCormick, 1992).

The magnitude of EEG alpha activity decrease has been correlated with more severe negative symptoms (Merrin et al., 1989; Merrin and Floyd, 1996; Knyazeva et al., 2008). In people with

schizophrenia, lower alpha power at rest has been has been observed in all stages of illness, whether during adolescent onset, first-episode, un-medicated or medicated and chronic schizophrenia (Itil, 1977; Fenton et al., 1980; Iacono, 1982; Small et al., 1984; Miyauchi et al., 1990; Kemali et al., 1992; Locatelli et al., 1993; Clementz et al., 1994; Sponheim et al., 1994; Takeuchi et al., 1994; Omori et al., 1995; Sponheim et al., 2000; John et al., 2002; Borisov et al., 2005; Begić et al., 2011). However, few studies have compared alpha power in schizophrenia between states. An understanding of whether schizophrenia have a baseline of lower alpha power in each state compared to controls, but have similar dynamic changes in power between states, or vice versa is important for future research, since raising baseline alpha power across all states may require different therapeutic strategies to to increasing alpha power flexibility/dynamics. Making the brain more responsive to changes in the environment as opposed to increase overall thalamic inhibition.

There are no EEG frequency power studies in schizophrenia between states, but there is one recent paper that focused on test-re-test reliability of magnetoencephalography (MEG) measurements of alpha power as a potential schizophrenia biomarker (Candelaria-Cook et al., 2019). This group looked at both eyes open and eyes closed conditions, and calculated "alpha reactivity" (as $\frac{\text{alpha power eyes closed - alpha power eyes open}}{\text{alpha power eyes closed}}$), finding that alpha reactivity was lower in schizophrenia than healthy participants, and that lower alpha power was correlated with increased PANSS positive symptoms scores (Candelaria-Cook et al., 2019).

If there are similarities in alpha power deficiencies in MAP as in schizophrenia, it may an indication of similarly poor thalamic control for the basis of poor sustained attention performance in MAP.

4.1.6 Beta frequency power

The beta band of frequencies (15 to 30 Hz) are low amplitude, high frequency oscillations that have been classically related to sensorimotor functions (Pfurtscheller et al., 1996; Kilavik et al., 2013), and are thought to signal or promote the current existing state for movement (Pfurtscheller et al., 1996; Crone et al., 1998; Weinberger et al., 2006; Miller et al., 2007), as well as emotional and cognitive processes (Ray and Cole, 1985; Engel and Fries, 2010).

Beta rhythms are thought to be generated in the cortico-basal ganglial networks, although the exact neural mechanisms are yet to be isolated. In one theory, beta rhythms are thought to be

intrinsically generated by the subthalamic nucleus (STN)-globus pallidus externa (GPe) reciprocal connections (Sato et al., 2000; Holgado et al., 2010). Previous *in vitro* experiments had shown that the STN-GPe network can create intrinsic delta, not beta oscillations (Plenz and Kital, 1999), however it was thought that the lack of beta rhythm generation by these two nuclei *in vitro* may be due to a lack of input signals from the cortex during the experiment (Loucif et al., 2005; Wilson et al., 2006). Computational models support this idea, and found that when modeled cortical input to the STN is relatively larger than the striatal inhibition to the GPe, beta rhythms can be generated and maintained (Terman et al., 2002; Bogacz and Gurney, 2007; Holgado et al., 2010). Computational models have also proposed a second theory that beta rhythms can be generated, and sustained by the hyperdirect pathway, consisting of the connections from cortex to STN to globus pallidus interna (GPi) (Nambu et al., 2002; Leblois et al., 2006). This model has been supported by *in vitro* preparation of the hyperdirect pathway, which preserves the cortico-STN connections, it was found that that both the STN and substantia nigra pars reticulata (SNr)/GPi have intrinsic firing rates that corresponds to beta rhythms (Bosch et al., 2012). In addition, studies on PD patients undergoing deep brain surgery also support this model, where inhibition of the STN results in improved movements, possibly by reduced activation of the GPi, and thus the hyperdirect pathway, allowing more thalamic signals to the cortex (Nambu et al., 2002; Leblois et al., 2006; Weinberger et al., 2006; Stein and Bar-Gad, 2013).

Thus, whether beta is generated between the cortex, STN and GPe, indicating an enhancement of the indirect pathway, or generated between the cortex, STN and GPi, indicating an enhancement of the hyperdirect pathway is still unclear. It is clear however, that increased beta rhythms are associated with greater cortical inhibition, with the involvement of the basal ganglia nuclei (Stein and Bar-Gad, 2013).

In terms of cognition, higher beta power in the frontal cortex has been associated with better inhibitory control, and better performance in cognitive inhibition task paradigms (Alegre et al., 2008; Swann et al., 2009; Aron, 2011). Decreased beta power has been widely observed in primarily ADHD studies, and has been associated with increased impulsivity (Barry et al., 2003). Neurofeedback training that specifically increase beta power during performance of a traditional oddball paradigm decreased omission errors and reaction times (Egner and Gruzelier, 2004).

In schizophrenia compared to healthy controls, observations of beta have been inconsistent (Uhlhaas

and Singer, 2010). Some studies showed lower beta power than that of healthy controls (Itil et al., 1972) and beta power having a negative correlations with the severity of negative symptoms according to the BPRS scores (Fenton et al., 1980), and others showing higher power in the occipital regions (Miyauchi et al., 1990). In MA dependent individuals performing an episodic memory task, beta power was not different from healthy controls (Kalechstein et al., 2009). Similarly for MA abuse participants, no changes in beta power were reported during REO or REC conditions (Ahmadlou et al., 2013; Khajehpour et al., 2019a,b), except for one study that found higher beta power was found in the MA abuse group (Shafiee-Kandjani et al., 2019). Beta power has never been studied in MAP, and may provide a useful indication of cortical inhibitory function in this study.

4.2 Aims

Using EEG frequency power measurements, this chapter aims to examine frequency power markers at rest in MAP, which may indicate baseline neural activity which, if similar to schizophrenia, would narrow down potential targets of neural impairment in MAP. In addition, this chapter will examine frequency power changes between states, which has not previously been measured in schizophrenia or MAP, and examine the baseline functioning and adaptability of modulatory systems and cortical-subcortical connectivity in MAP; expecting that there should be a decrease in alpha power in the shift from resting eyes closed to open in a functioning and adapting system. My hypothesis is that MAP will have similar frequency power metrics as schizophrenia such as low alpha and high delta power, and that both groups have poorly adapting TC systems, which will be reflected by a smaller change in alpha power when eyes shift from closed to open.

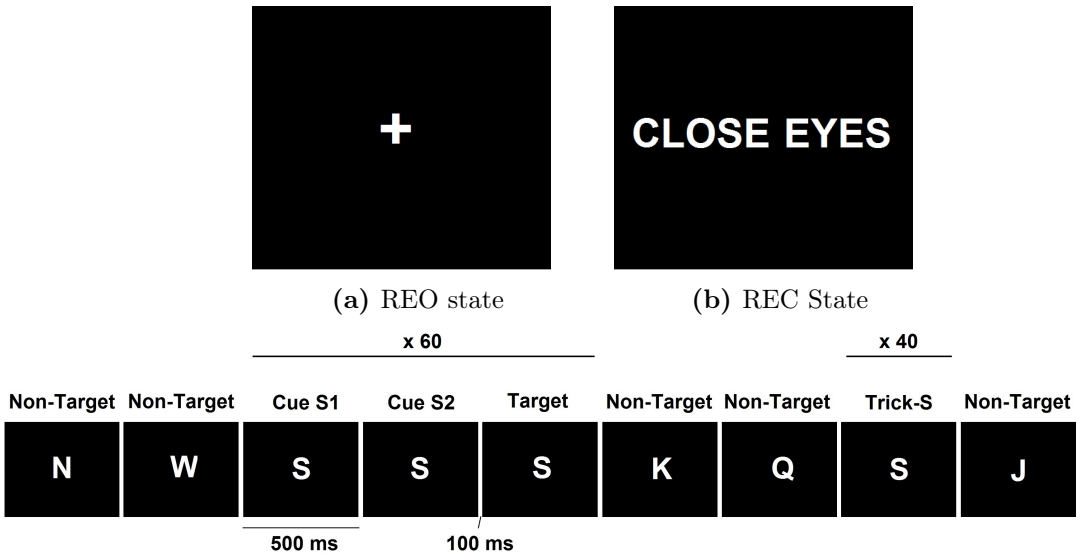
4.3 Methods

4.3.1 EEG testing paradigm

The EEG testing paradigm consisted of three states. Participants underwent REO state for 3 minutes, REC state for 3 minutes and am active task state where participants performed a visual sustained attention task for approximately 5 minutes.

In the active task state, individual non-target consonant letters were displayed in random order,

in the center of the screen for a duration of 500 ms each, with 100 ms interstimulus interval. Participants were asked to attend for instances when 3 consecutive letters of "S" were displayed, and to respond with a single mouse click as soon as the third target "S" appeared. There were a total of 60 instances where 3 consecutive letters of "S" were presented in the 5 minute duration of the task. There were also 40 distractors, single presentations of non-target "S", that occurred between other non-target consonant letters (Figure 4.1).



(a) REO state **(b)** REC State

(c) Sustained Attention Task

Figure 4.1 – **The EEG Task** used to record EEG from three states of neural activity. **a)** resting eyes open (REO) state for 3 minutes, **b)** resting eyes closed (REC) state for 3 minutes. The researcher then asked the participant to open their eyes for the sustained attention task state, where **c)** the participants performed the sustained attention task for approximately 5 minutes. Each letter was displayed for 500 ms, with 100 ms between letters. Non-target consonant letters appeared individually in the middle of the screen in random order. There were 60 instances where two cue "S" letters preceded the target third "S", at which the participant was instructed to respond with a single mouse click as soon as the target was observed. There were 40 instances where single presentations of the letter "S" between consonant letters served as distractors.

4.3.2 Data Processing

Post recording session, electrooculogram (EOG) artifacts were removed from the entire recording of all three states using the automated independent component analysis (ICA) function Acqknowledge 4.0 (BIOPAC Inc.). Then REO, REC and sustained performance (Task) segments of the task were extracted and saved as individual MATLAB files for further batched frequency band analysis of each state.

In-house MATLAB (MathWorks Inc.) scripts (written by David Karpul) and Excel 2010 (Microsoft Inc.) were used for data processing.

The in-house MATLAB script applied an fast fourier transform (FFT) algorithm to all EEG channels. Relative frequency band power was extracted for delta (0.1 to 4 Hz), theta (4 to 7 Hz), alpha (7 to 14Hz), and beta (15 to 30 Hz) bands; for each electrode of each person, for each segments of the task (REO, REC and Task).

4.3.3 Statistical analysis

4.3.3.1 Identification of potential confounding variables

Data were analysed using R version 3.3.0 (R Core Team, 2016). Demographic, clinical and medication variables did not meet linear model assumptions. To determine potential confounding variables, demographic and clinical scale variables were compared between MAP and schizophrenia vs control groups using Kruskal-Wallis tests. Where Kruskal-Wallis tests found a significant main effect, additional multiple comparisons ("nparcomp package") adjusting for Tukey's comparisons were used to include MAP vs schizophrenia comparisons. Since medication and certain clinical scales such as the PANSS were only given to patient groups and not given to the control group, potential clinical confounding variables were assessed between MAP and schizophrenia groups using Kruskal-Wallis tests without additional multiple comparisons.

Since demographic or clinical scale variables that were found to be significantly different between any groups may be potential confounding variables to group differences in relative frequency band measures, these participant variables were correlated against each frequency band measure (delta, theta, alpha, beta), using Spearman's correlations. Significant correlations were identified as potential confounding variables (Appendix tables C.3).

Spearman's correlations of medication count variables against continuous Frequency band measures between MAP and schizophrenia was not statistically appropriate. Each medication count variable that was significantly different between the MAP and schizophrenia groups (for example as in Table 4.6) were considered potential confounding variables for each relative frequency band power result.

The small number of participants in respective subgroups, and the covariate nature of the confounding variables with group differences in frequency power measures, violate ANCOVA assumptions (Glass et al., 1972) and thus could not be effectively corrected for with post-hoc ANCOVA.

4.3.3.2 Group comparisons

Linear models of each frequency power band by Group met statistical assumptions by visual inspection of diagnostic plots. ANOVA by Group were performed for relative delta, theta, alpha and beta frequency band powers separately, for each position on the scalp and for each State independently. Where F-statistic of the ANOVA showed a significant main effect, post-hoc multiple group comparisons with false discovery rate adjustments were performed to determine specific between Group effects.

4.3.3.3 State comparisons

ANOVA by Group and State were performed for relative delta, theta, alpha and beta frequency band powers separately, for each position on the scalp independently. Multiple comparisons with false discovery rate adjustments were performed to determine specific differences between States within each Group (Appendix C).

As per convention in our laboratory, the p-value for significance was set at $p < 0.05$, p-value for tendency was set at $0.05 < p < 0.07$. Adherence to linear statistical assumptions was confirmed by visually inspecting the standard plots of residuals, Normal Q-Q, and Cook's distance plots for each of the models. Where linear statistical assumptions were not met, non-parametric Kruskal-Wallis tests were used for group comparisons.

4.4 Results

4.4.1 Participant demographics, physical attributes, drug use and clinical measures

The schizophrenia participants were significantly older than MAP ($p < 0.01$) and control ($p < 0.05$). MAP reported lower levels of education compared to controls ($p < 0.001$), while schizophrenia reported fewer years at school than control ($p < 0.05$). Physically, schizophrenia reported greater weight ($p < 0.01$) and BMI ($p < 0.001$) compared to controls and MAP. In terms of drug use, MAP reported higher ASSIST scores than control and schizophrenia for tobacco use ($p < 0.01$), cannabis use ($p < 0.05$), MA use ($p < 0.0001$), and ASSIST Total score ($p < 0.0001$).

The schizophrenia group reported longer duration of diagnosis ($p < 0.001$) and had higher PANSS positive subscale scores than MAP ($p < 0.05$). No other significant differences in severity of clinical symptoms was found between MAP and schizophrenia (Table 4.5).

MAP were prescribed more FGAs than schizophrenia ($p < 0.01$), as reflected by more prescriptions of haloperidol ($p < 0.001$), while schizophrenia were prescribed SGAs more than MAP ($p < 0.01$), as reflected by more prescriptions of clozapine ($p < 0.01$) (Table 4.6).

Table 4.1 – Demographics and physical attributes of participants contributing data to the EEG frequency power data.

	CON (N=32)			**MAP** (N=24)			**SCZ** (N=27)		
Demographic Variables	**Median**	**Min**	**Max**	**Median**	**Min**	**Max**	**Median**	**Min**	**Max**
Age on day of testing (yrs)	26	19	40	24.5	19	35	29	20	40
Years at school (yrs)	12	8	14	10	7	12	11	6	14
Years of tertiary education (yrs)	1	0	10	0	0	4.5	0	0	6
Total years of education (yrs)	12.5	8	22	10	7	16.5	11	7	18
Female : Male (N)	14 : 18			10 : 14			12 : 15		
Physical Attributes									
Height (m)	1.75	1.57	1.88	1.71	1.52	1.89	1.72	1.51	1.9
Weight (kg)	68.7	53.5	133	66.55	47.9	98	81.3	50	136
BMI (kg/m^2)	23.26	17.47	38.44	22.48	18.51	30.66	27.47	19.59	47.47
Ambidextrous : Left : Right Handed (N)	1 : 1 : 30			0 : 2 : 22			0 : 3 : 24		

Table 4.2 – Group comparisons of demographics and physical attributes of participants contributing data to the EEG frequency power data.

	Kruskal-Wallis Main Effects			Multiple comparisons		
				CON vs MAP	CON vs SCZ	MAP vs SCZ
Demographic Variables	**Chi-squared**	**df**	**p-value**	**p-value**	**p-value**	**p-value**
Age on day of testing (yrs)	10.22	2	**0.0061***	0.8175	**0.0132***	**0.0091***
Years at school (yrs)	12.82	2	**0.0016***	**0.0006***	**0.0361***	0.7464
Years of tertiary education (yrs)	6.42	2	**0.0401***	**0.0163***	0.7404	0.1822
Total years of education (yrs)	12.29	2	**0.0021***	**0.0002***	0.1242	0.3303
Female : Male (N)	0.04	2	0.9790			
Physical Attributes						
Height (m)	1.32	2	0.5154			
Weight (kg)	12.75	2	**0.0016***	0.6624	**0.0067***	**0.0027***
BMI (kg/m^2)	15.20	2	**0.0004***	0.7665	**0.0007***	**0.0005***
Ambidextrous : Left : Right Handed (N)	0.38	2	0.8239			

* $p < 0.05$;
Significant multiple group comparisons indicate potential confounding participant factors between groups.

Table 4.3 – Subjective ASSIST Scale scores of participants contributing data to the EEG frequency power data.

	CON (N=32)			MAP (N=24)			SCZ (N=27)		
	Median	**Min**	**Max**	**Median**	**Min**	**Max**	**Median**	**Min**	**Max**
ASSIST Subscore Tobacco	0	0	26	18	9	31	6	0	30
ASSIST Subscore Alcohol	2.5	0	25	3	0	21	2	0	26
ASSIST Subscore Cannabis	0	0	6	5.5	0	31	0	0	18
ASSIST Subscore Methamphetamine	0	0	0	8.5	0	38	0	0	26
ASSIST Total Score	9	0	34	34.5	6	127	9	0	94

ASSIST = Alcohol, Smoking and Substance Involvement Screening Test

Table 4.4 – Group comparisons of Subjective ASSIST Scale scores of participants contributing data to the EEG frequency power data.

	Kruskal-Wallis Main Effects			Multiple comparisons		
				CON vs MAP	CON vs SCZ	MAP vs SCZ
	Chi-squared	**df**	**p-value**	**p-value**	**p-value**	**p-value**
ASSIST Subscore Tobacco	24.59	2	**<0.0001***	**<0.0001***	0.3254	**0.0047***
ASSIST Subscore Alcohol	0.78	2	0.6758			
ASSIST Subscore Cannabis	13.48	2	**0.0011***	**0.0016***	0.8714	**0.0341***
ASSIST Subscore Methamphetamine	56.44	2	**<0.0001***	**<0.0001***	0.3379	**<0.0001***
ASSIST Total Score	31.56	2	**<0.0001***	**<0.0001***	0.9547	**<0.0001***

* $p < 0.05$;
ASSIST = Alcohol, Smoking and Substance Involvement Screening Test

Table 4.5 – Clinical Scale scores in MAP and schizophrenia participants contributing data to the EEG frequency power data.

	MAP (N=24)			SCZ (N=27)			Kruskal-Wallis Main Effects		
Clinical Variable	**Median**	**Min**	**Max**	**Median**	**Min**	**Max**	**Chi-squared**	**df**	**p-value**
Duration of Diagnosis (yrs)	1	0.25	13	7	1	22	13.31	1	**0.0002***
Extrapyramidal side effects Score	0	0	9	1	0	6	1.45	1	0.2273
PANSS Total Score	45.5	30	79	48.5	30	103	0.73	1	0.3926
PANSS Positive Subscale Score	8	7	30	12	7	34	4.69	1	**0.0301***
PANSS Negative Subscale Score	13	7	27	13	7	30	0.01	1	0.9224
PANSS General Psychopathology Score	22.5	16	41	23	16	50	0.62	1	0.4304
CDSS Total Score	1	0	9	3	0	8	2.27	1	0.1312
YMRS Total Score	1.5	0	5	1.5	0	19	0.01	1	0.9358
HAMD Total Score	3	0	12	4	0	15	0.91	1	0.3382
Clinical Global Impression Severity Score	2	1	4	3	1	6	2.98	1	0.0841
Global Assessment of Functioning Score	65	31	90	60	30	85	1.14	1	0.2838

* $p < 0.05$;
PANSS = Positive and Negative Syndrome Scale;
CDSS = Calgary Depression Scale for Schizophrenia ;
YMRS = Young Mania Rating Scale;
HAMD = Hamilton Depression Rating Scale

Table 4.6 – Counts of medications prescribed for MAP and schizophrenia participants contributing data to the EEG frequency power data.

	MAP (N=24)		SCZ (N=27)		Kruskal-Wallis Main Effects		
Prescribed medication OR Category of medication (N)	**No**	**Yes**	**No**	**Yes**	**Chi-squared**	**df**	**p-value**
Any Antipsychotic	2	22	5	21	1.20	1	0.2721
First Generation Antipsychotics	6	18	18	9	8.68	1	**0.0032***
haloperidol	9	15	24	2	16.37	1	**<0.0001***
chlorpromazine	22	2	26	0	2.21	1	0.1370
trifluoperazine	24	0	23	3	2.88	1	0.0892
flupentixol (long acting injectable)	22	2	26	0	2.21	1	0.1370
zuclopenthixol decanoate (long acting injectable)	23	1	23	3	0.90	1	0.3420
fluphenazine (long acting injectable)	24	0	25	1	0.92	1	0.3367
Second Generation Antipsychotics	19	5	12	15	6.30	1	**0.0121***
clozapine	24	0	19	7	7.36	1	**0.0066***
olanzapine	24	0	24	2	1.88	1	0.1698
risperidone	19	5	21	5	0.02	1	0.8886
quetiapine	24	0	25	1	0.92	1	0.3367
sulpiride	24	0	25	1	0.92	1	0.3367
Antidepressants							
fluoxetine	23	1	24	2	0.26	1	0.6036
citalopram	24	0	25	1	0.92	1	0.3367
amitriptiline	24	0	26	0			
Mood Stabilizers							
lithium	23	0	19	1	1.15	1	0.2835
sodium valproate	20	4	22	4	0.01	1	0.9027
Anticholinergics							
orphenadrine	15	9	22	4	3.11	1	0.0778
	Median	**Min-Max**	**Median**	**Min-Max**			
Cumulative antipsychotic dose expressed as chlorpromazine equivalents (mg)	112.5	0-450	200	0-1500	0.91	1	0.3404

* $p < 0.05$

4.4.2 Group Comparisons during Resting Eyes Closed state

During REC, compared to controls, delta power in MAP was significantly higher at the F_4, C_3, C_4, P_3 and P_4 electrodes. Compared to controls, schizophrenia had significantly higher delta power at the FP_1 and FP_2 electrodes. There were no significant differences between MAP and schizophrenia groups for delta power (Figure 4.2).

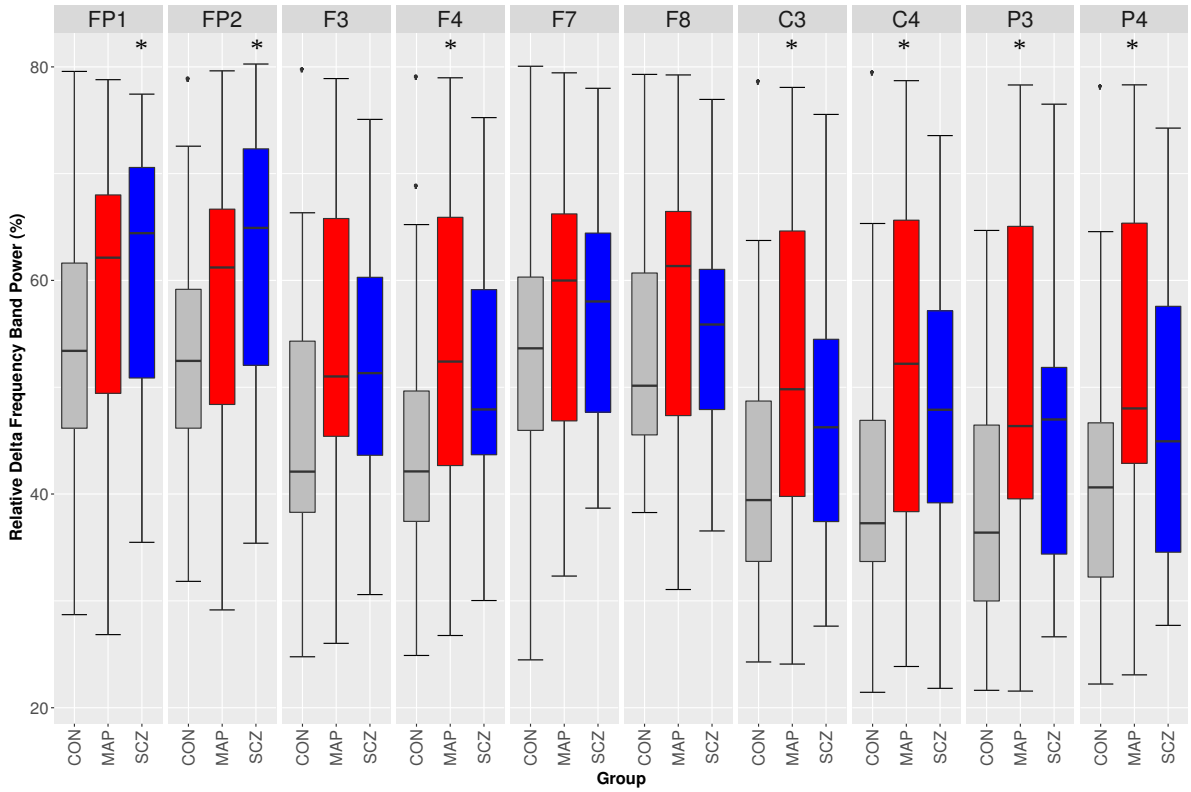


Figure 4.2 – Relative delta frequency band power during REO. Compared to controls, delta power in MAP was significantly higher at the F_4, C_3, C_4, P_3 and P_4 electrodes. Compared to controls, delta power in schizophrenia was significantly higher at the FP_1 and FP_2 electrodes. Multiple comparisons found no significant differences between MAP and schizophrenia groups for delta power. Boxplots denote mean, 95% confidence intervals and SD. * denotes ANOVA of $p < 0.05$ against the control group

For alpha power during REC, compared to controls, MAP had a tendency for lower power at FP_1, and significantly lower power at F_3, F_4, C_3, C_4, P_3 and P_4 electrodes. Alpha power in schizophrenia compared to controls, showed a tendency for lower power at F_3 and C_3, and significantly lower power at FP_1, FP_2, F_4, C_4, P_3 and P_4 electrodes. There were no significant differences between MAP and schizophrenia groups (Figure 4.3).

During REC, schizophrenia showed significantly lower beta power at the FP_1 and FP_2 electrodes compared to controls. There were no significant differences in beta power between MAP and schizophrenia groups (Figure 4.4).

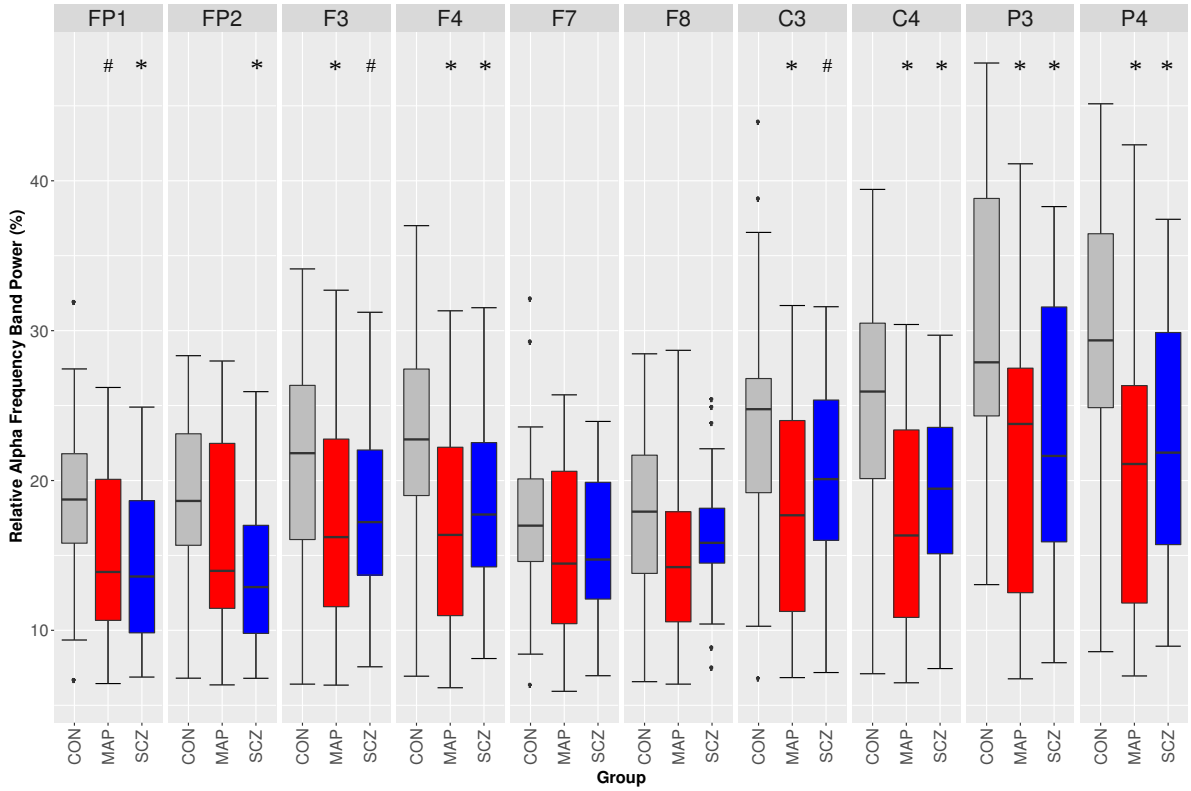


Figure 4.3 – **Relative alpha frequency band power during REC.** Compared to controls, alpha in MAP had a tendency for lower power at FP_1, and significantly lower power at F_3, F_4, C_3, C_4, P_3 and P_4 electrodes. Compared to controls, alpha in schizophrenia showed a tendency for lower power at F_3 and C_3, and significantly lower power at FP_1, FP_2, F_4, C_4, P_3 and P_4 electrodes. Multiple comparisons found no significant differences between MAP and schizophrenia groups for alpha power. Boxplots denote mean, 95% confidence intervals and SD. * denotes ANOVA of $p < 0.05$ and # of $p < 0.1$ against the control group

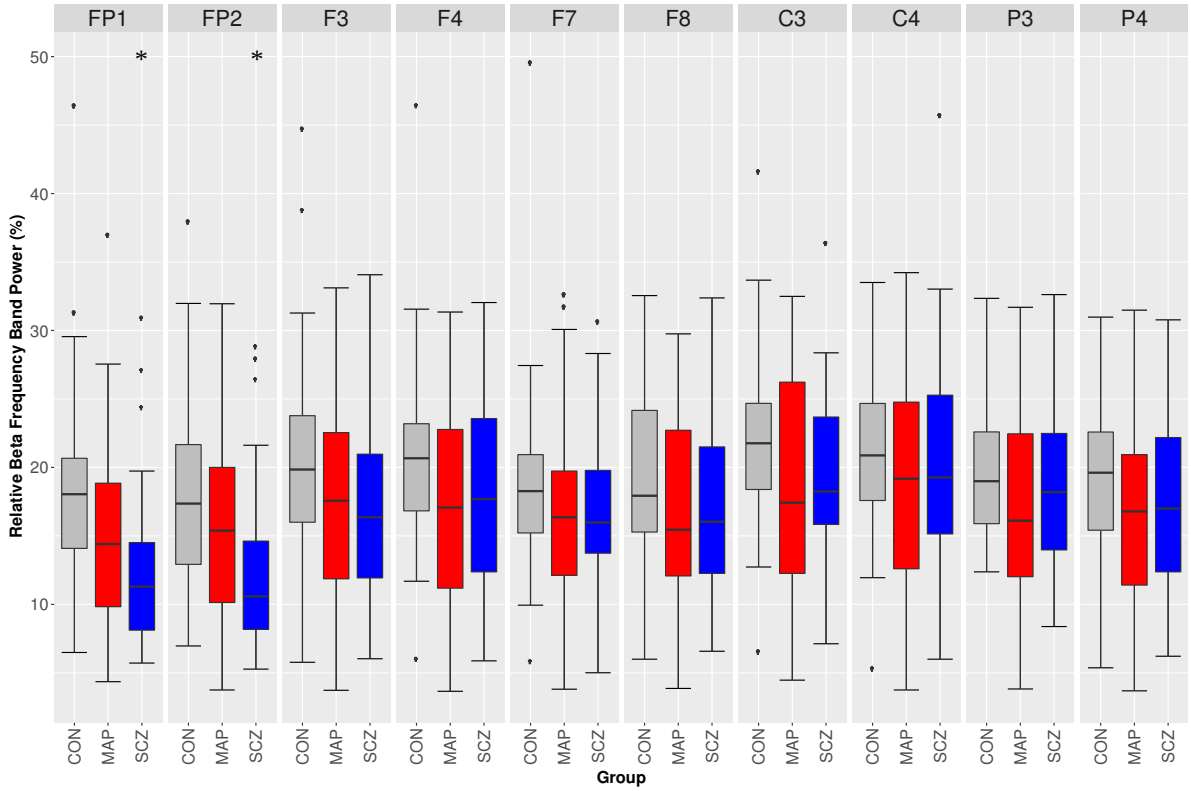


Figure 4.4 – Relative beta frequency band power during REC. Compared to controls, beta power in schizophrenia was significantly higher at the FP_1 and FP_2 electrodes. No differences were found between controls and MAP. Multiple comparisons found no significant differences between MAP and schizophrenia groups for delta power. Boxplots denote mean, 95% confidence intervals and SD. * denotes ANOVA of $p < 0.05$ against the control group

4.4.3 Group Comparisons during Resting Eyes Open state

During REO, only the alpha frequency band showed group differences in power. Compared to controls, MAP showed a tendency for lower alpha power at the F_4 electrode, and significantly lower alpha band power at the C_3, C_4, P_3 and P_4 electrodes. Compared to controls, schizophrenia showed significantly lower alpha band power at C_4, P_3 and P_4 electrodes. There were no differences in alpha power between MAP and schizophrenia groups (Figure 4.5).

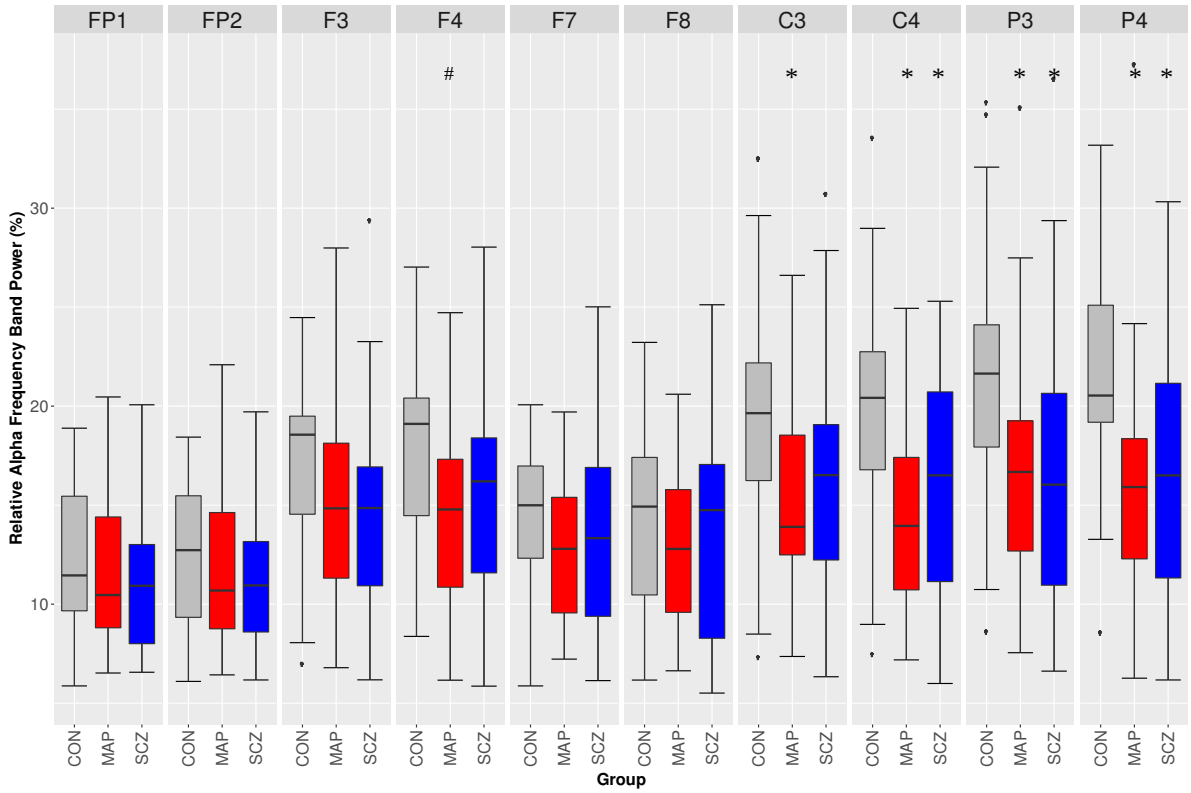


Figure 4.5 – Relative alpha frequency band power during REO. Compared to controls, MAP showed a tendency for lower alpha power at the F_4 electrode, and significantly lower alpha band power at the C_3, C_4, P_3 and P_4 electrodes. Compared to controls, alpha in schizophrenia showed significantly lower alpha band power at C_4, P_3 and P_4 electrodes. Multiple comparisons found no significant differences between MAP and schizophrenia groups for alpha power. Boxplots denote mean, 95% confidence intervals and SD. * denotes ANOVA of $p < 0.05$ and # of $p < 0.1$ against the control group

4.4.4 Group Comparisons during Task state

During the Task state, only the beta frequency band showed group differences. Compared to controls, MAP had significantly lower beta band power at the F_4 electrode. Compared to controls, schizophrenia had a tendency for lower beta band power at the F_4 electrode. There were no significant differences in beta power between MAP and schizophrenia groups (Figure 4.6).

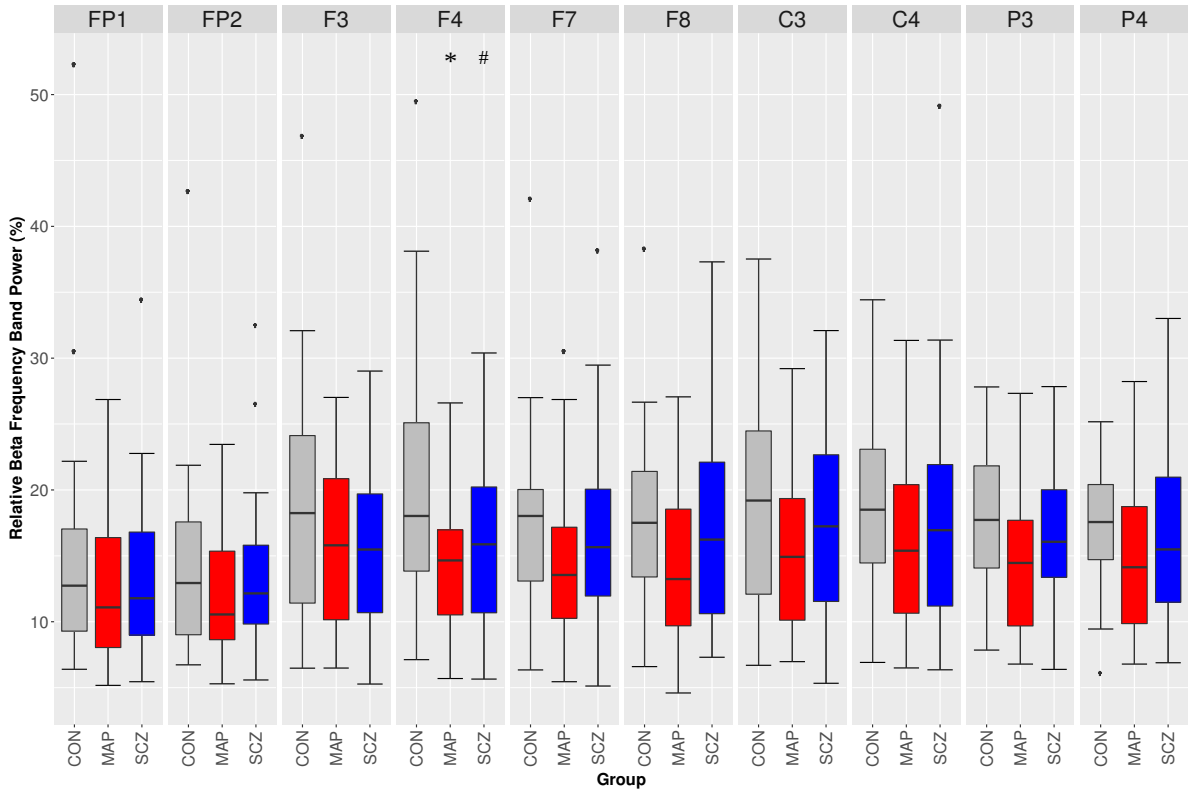


Figure 4.6 – Relative beta frequency band power during Sustained Attention Task. Compared to controls, MAP had significantly lower beta band power at the F_4 electrode. Compared to controls, schizophrenia had a tendency for lower beta band power at the F_4 electrode. Multiple comparisons found no significant differences between MAP and schizophrenia groups for alpha power. Boxplots denote mean, 95% confidence intervals and SD. * denotes ANOVA of $p < 0.05$ and # of $p < 0.1$ against the control group

4.4.5 Comparison between states within control group

Relative delta power in the control group was higher during REO than during REC at FP_1, FP_2, P_3 and P_4, and higher during Task than during REC at FP_1, FP_2, F_3, C_3, C_4, P_3 and P_4 (Figure 4.7). Relative theta power in the control group was higher during REO than REC at FP_1 and FP_2, and also higher during Task than during REC at FP_1 and FP_2 (Figure 4.8). Relative alpha power in the control group was lower during REO and Task than during REC at all scalp locations (Figure 4.9).

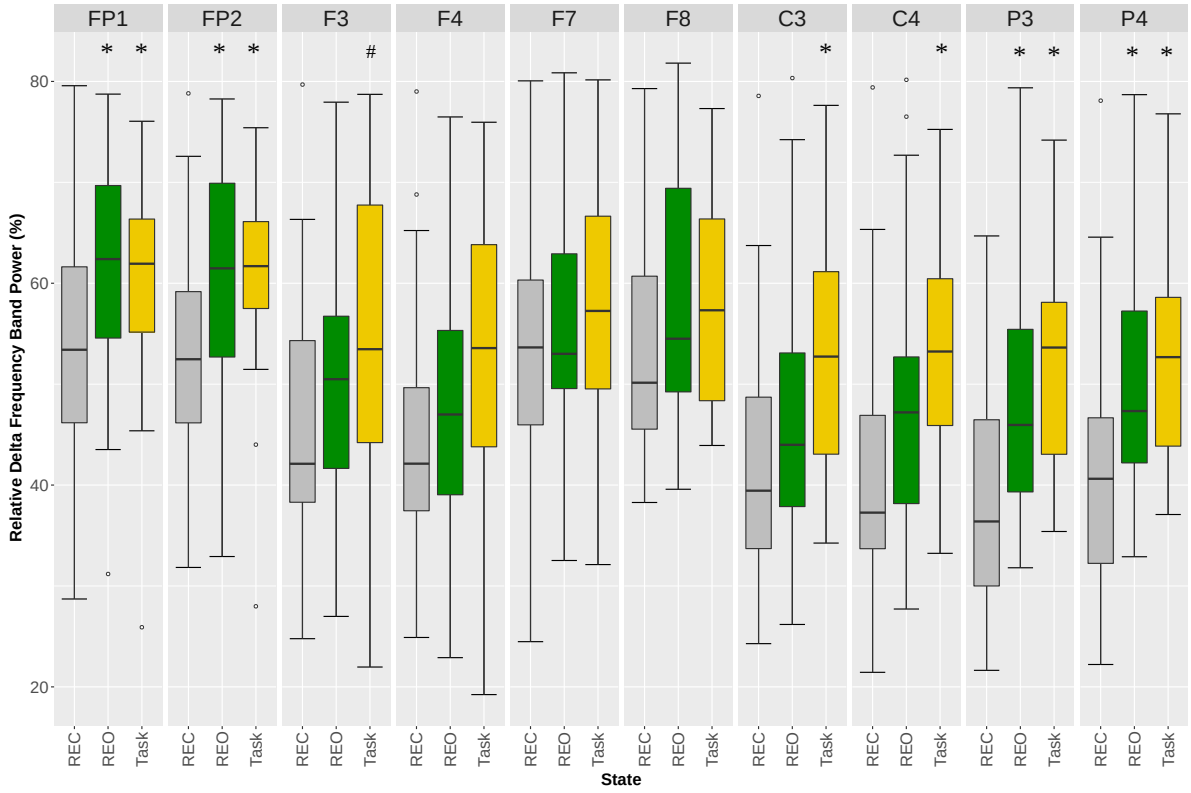


Figure 4.7 – Relative delta frequency band power in the control group between states. There was higher during REO than during REC at FP_1, FP_2, P_3 and P_4, and higher during Task than during REC at FP_1, FP_2, F_3, C_3, C_4, P_3 and P_4 . Boxplots denote mean, 95% confidence intervals and SD. * denotes ANOVA of p <0.05 and # of p <0.1 against the control group

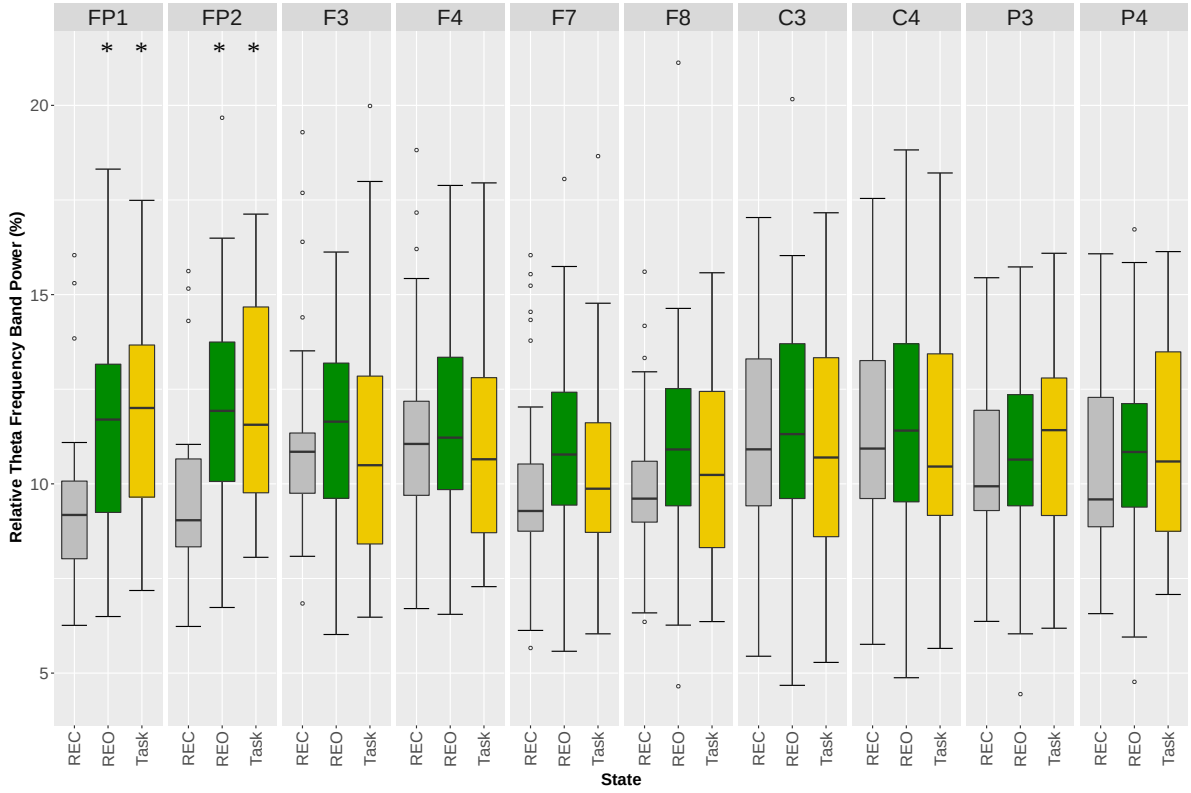


Figure 4.8 – Relative theta frequency band power in the control group between states. There was higher theta power during REO than REC at FP_1 and FP_2, and also higher during Task than during REC at FP_1 and FP_2. Boxplots denote mean, 95% confidence intervals and SD. * denotes ANOVA of p <0.05 against the control group

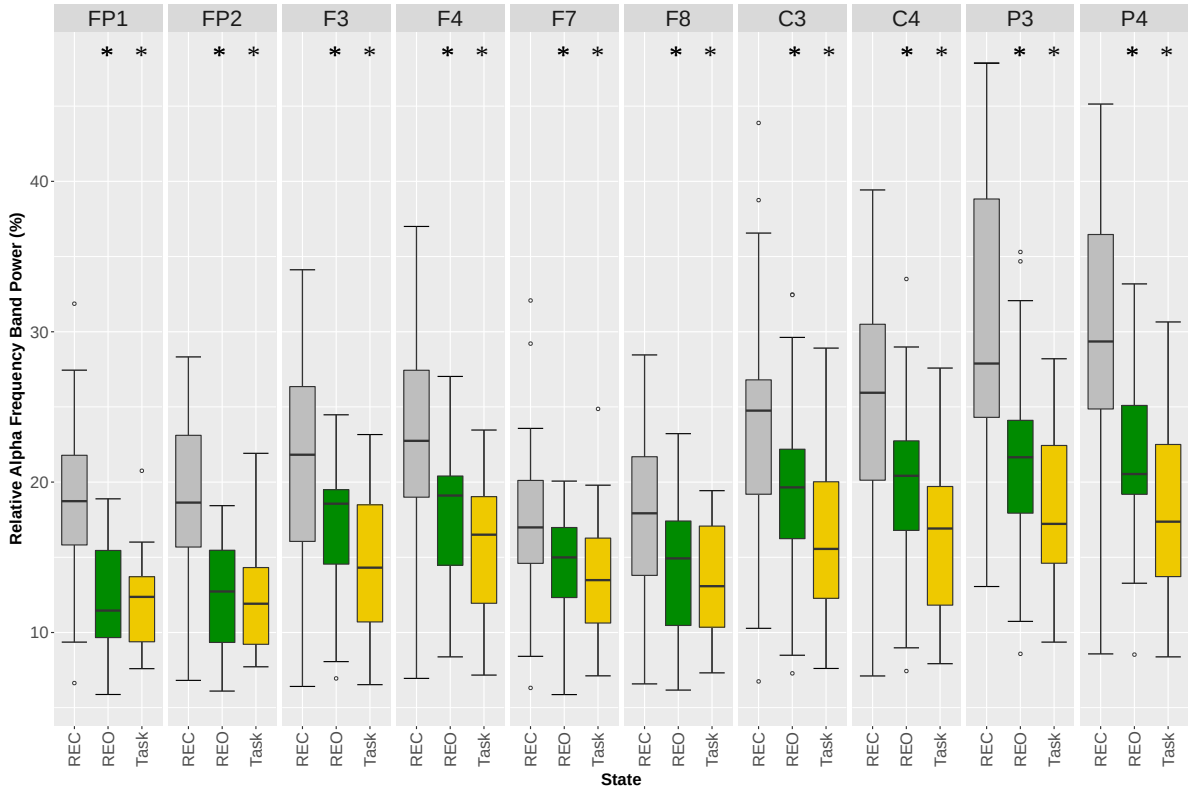


Figure 4.9 – Relative alpha frequency band power in the control group between states. There was lower alpha power during REO and Task than during REC at all scalp locations. Boxplots denote mean, 95% confidence intervals and SD. * denotes ANOVA of p <0.05 against the control group

4.4.6 Comparison between states within MAP and schizophrenia Groups

In MAP, relative alpha power was lower during REO than during REC at FP_1, FP_2, P_3 and P_4, and also lower during Task than during REC at FP_1, FP_2, C_3, C_4, P_3 and P_4 (Figure 4.10).

Importantly, there were no changes for any frequency band power between any states in the schizophrenia group.

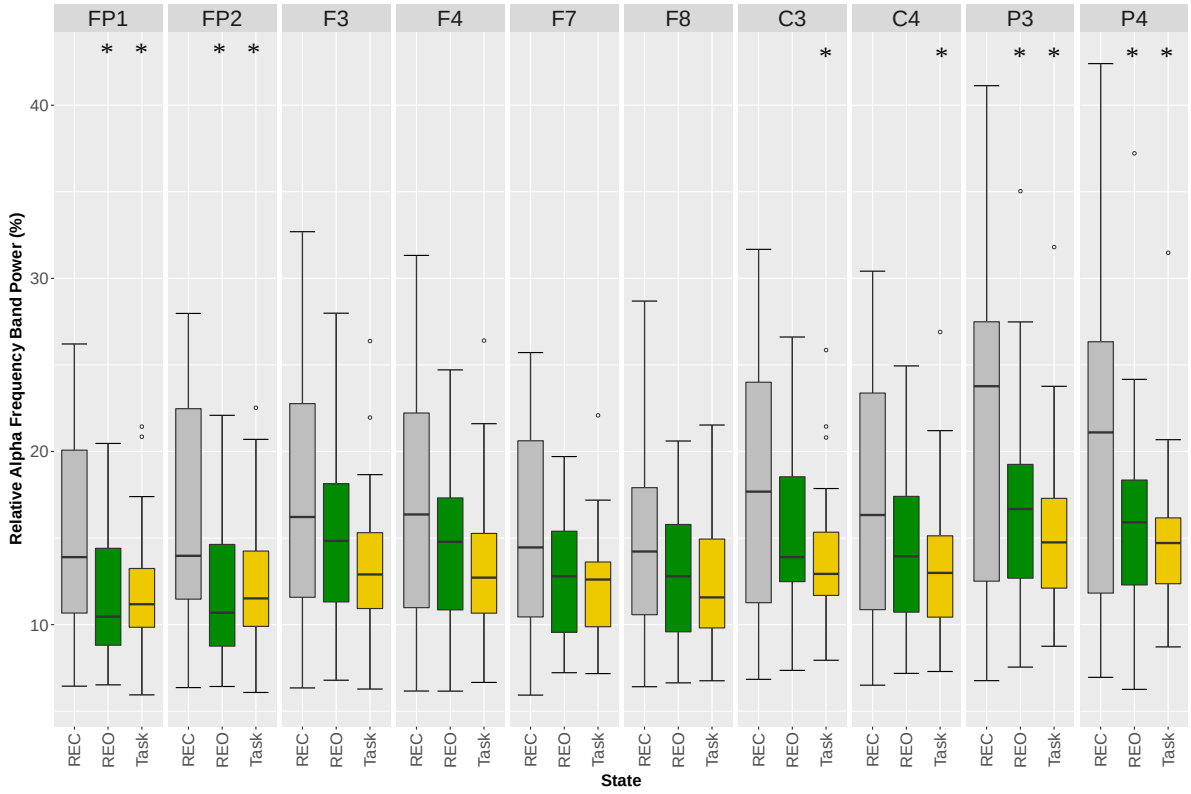


Figure 4.10 – Relative alpha frequency band power in MAP group between states. There was lower alpha power during REO than during REC at FP_1, FP_2, P_3 and P_4, and also lower alpha power during Task than during REC at FP_1, FP_2, C_3, C_4, P_3 and P_4 . Boxplots denote mean, 95% confidence intervals and SD. * denotes ANOVA of $p < 0.05$ against the control group

4.4.7 Summary of Comparisons

In summary, the control group showed dynamic changes in delta, theta and alpha band powers when changing between states. Delta power in controls increased from REC to REO, and REC to Task state at prefrontal, central and parietal electrodes. Theta power in controls increased from REC to REO at the prefrontal electrodes. Alpha power in controls decreased from REC to REO, and REC to Task state over the entire scalp. In contrast, the MAP only showed changes in alpha band power between states, where alpha power decreased from REC to REO, and REC to Task state over the prefrontal and parietal electrodes, and decreased from REC to Task state at

the central electrodes. The schizophrenia showed no significant changes in frequency band powers between states (Figure 4.11).

While schizophrenia did not show changes in frequency power between states like the controls, the schizophrenia showed higher delta power in the prefrontal electrodes than controls during REC. Alpha power was lower in the prefrontal, frontal, central and parietal electrodes during REC, and lower at the central and parietal electrodes during REO in schizophrenia compared to controls. schizophrenia also has lower beta power than controls in the prefrontal electrodes during REC, and lower beta power than controls at the F_4 electrode during task performance (Figure 4.11).

Similar to schizophrenia but over fewer scalp locations, MAP showed higher delta power than controls at the central and parietal electrodes during REC. Alpha power was lower in the prefrontal, frontal, central and parietal electrodes during REC, and lower at the central and parietal electrodes during REO in MAP compared to controls. MAP also had lower beta power than controls at the F_4 electrode during task performance (Figure 4.11).



Figure 4.11 – Summary of Group and State comparisons for all frequency bands at each electrode position. Bars denote average relative powers, SD are not shown; * denotes p <0.05 between REC and the state where the star is located within each Group ; → denotes p <0.05 between Groups within each State

4.5 Discussion

The main findings in this chapter were first, higher delta power in both MAP and schizophrenia groups across the majority of scalp locations compared to controls; second, lower alpha power in both MAP and schizophrenia groups across the majority of scalp locations compared to controls; and third, the lack of expected frequency power changes in delta and alpha power between REO and REC states in both MAP and schizophrenia groups, across the majority of scalp locations. These results confirmed the hypotheses for this chapter.

These findings for higher delta power during awake REC in schizophrenia is consistent with the literature (Itil et al., 1972; Morihisa et al., 1983; Miyauchi et al., 1990; Sponheim et al., 1994, 2000; Winterer et al., 2001; Wuebben and Winterer, 2001; Boutros et al., 2008; Matheson et al., 2014; Di Lorenzo et al., 2015). Higher frontal delta power is also associated with negative symptoms in ultra-high risk [to develop schizophrenia] individuals who eventually transitioned to psychosis (Lavoie et al., 2012). In schizophrenia, higher delta power has been associated with lower frontal cerebral blood flow (Ingvar and Franzen, 1974; Ingvar et al., 1976), anoxia (Steriade et al., 1990b), decreased frontal lobe metabolism (Guich et al., 1989; Alper et al., 1998, 2006), and decreased pre-frontal cortical thickness (Zhang et al., 2015).

In schizophrenia, MRI studies have found decreased volumes in the thalamus and anterior cingulate cortex (ACC) (Pakkenberg, 1990) and lower volume in the medial dorsal thalamus (Pakkenberg, 1992). Several MRS meta-analyses have also consistently found lower concentrations of NAA in schizophrenia thalamus and ACC (Steen et al., 2005; Brugger et al., 2011; Iwata et al., 2018). Lower NAA concentrations in the prefrontal cortex (PFC) has been negatively correlated with symptom severity in schizophrenia (Sigmundsson et al., 2003). NAA levels are an indication of mitochondrial function (Anglin et al., 2012; Manji et al., 2012), and is viewed as a marker of neuronal density, integrity and function (Meyerhoff et al., 1993; Demougeot et al., 2001). In a PET study schizophrenia participants with lower NAA levels in the DLPFC showed increased amphetamine-induced DA release in the striatum, whereas NAA levels in controls or other cortical areas did not correlate with DA release (Bertolino et al., 2000), suggesting that low integrity of the DLPFC leads excessive DA release in the striatum (Bertolino et al., 2000).

NMDA hypofunction in the RN in the presence of DA leads to delta bursting, and D_2 blockade

mitigates the effects of NMDA hypofunction in the RN (Zhang et al., 2009). Thus higher delta power in schizophrenia appears to be explained by excessive DA release in the striatum (due to poor integrity of DLPFC) (Bertolino et al., 2000), and NMDAR hypofunction in schizophrenia (Olney and Farber, 1995; Coyle, 2006; Pakkenberg et al., 2009), At the same time, this could explain the positive effects of D_2 blocking medications on schizophrenia symptoms (Kane et al., 2002).

Mutations coding for the $Ca_v3.1$ and $Ca_v1.2$ channels that are both abundantly expressed in TC neurons and are strongly associated with schizophrenia (Purcell et al., 2014; Heyes et al., 2015), may also lead to a loss of function (Heyes et al., 2015; Yoshimizu et al., 2015) and thus decrease the ability of TC neurons to respond adequately to signals from the TRN, which modulate the TC neurons to send "tonic" or "burst" signals to the cortex (Destexhe and Sejnowski, 2003; Ferrarelli et al., 2007; Herrera et al., 2016)

In MAP, delta power was higher in the central and posterior regions of the cortex during REC (Figure 4.11). This is the first report of delta power in MAP. Previous studies of EEG frequency power relating to MA were performed in MA dependent or abuse individuals, and the results have been inconsistent, showing higher (Newton et al., 2003, 2004; Kalechstein et al., 2009), lower (during REO) (Shafiee-Kandjani et al., 2019), or no difference (Trites and Others, 1976) in delta power compared to non drug controls. It is unknown whether the MA dependent and abuse individuals in these studies exhibited symptoms of psychosis, and whether that may have contributed to the variability in the results found by different groups. We have previously published the only research so far in MAP participants showing higher delta/alpha power during REC, REO, as well as during active performance of a sustained attention task as compared to healthy controls (Howells et al., 2018), suggesting an increased delta power in MAP, now reported in this study.

Anatomical and neurochemical data may reveal other physiological changes in the brain prior to the development of consistent EEG frequency power changes. In frontal white matter, NAA concentrations have been found to be lower in MA abusers compared to healthy controls (Ernst et al., 2000; Sung et al., 2007; Sailasuta et al., 2010). Similarly, in the basal ganglia, NAA concentrations have also been found to be lower in abstinent MA abusers, compared to healthy controls (Ernst et al., 2000). In the ACC, NAA/Cr+PCr ratios were found to be lower in MA

abusers that had been abstinent for 1 to 6 months (Nordahl et al., 2002), and MA abusers that had been abstinent for 1 to 5 years (Nordahl et al., 2005). Another study found no differences between abstinent MA abusers and healthy controls in frontal gray matter, but found significant correlations where increasing cumulative lifetime dose of MA decreased frontal gray matter NAA concentrations, and longer duration of abstinence correlated with higher frontal gray matter NAA concentrations (Sung et al., 2007).

Since MA induced psychosis is diagnosed as persistent psychosis after the withdrawal of MA for a week (American Psychiatric Association, 2013), the above results of persistent neurochemical changes even after long durations of abstinence suggest that they may be relevant to psychosis, even though these studies did not examine psychosis directly. In the only study that has studied NAA levels in both MA dependence and MA psychosis, NAA/Cr+PCr ratios were found to be lower in both MA dependent and psychosis groups compared to healthy controls, in the right ACC and right DLPFC (Howells et al., 2014), confirming that decreases in NAA levels are in fact associated with MAP, and not only in MA dependence. In addition, earlier initial use of MA correlated with lower NAA ratios only in the psychosis group, and not the dependence group - suggesting that those with frontal neuron damage as a result of MA dependence may be more susceptible to developing psychosis (Howells et al., 2014). Compared no non-psychotic MA dependent controls, MAP have also demonstrated lower frontal cortical thickness and white matter abnormalities similar to to that of patients with schizophrenia (Uhlmann et al., 2016a,b).

Higher delta power in schizophrenia may be explained by a combination of factors including excessive DA release in the striatum (Bertolino et al., 2000), NMDAR hypofunction (Olney and Farber, 1995; Coyle, 2006; Pakkenberg et al., 2009), and lower $Ca_v3.1$ channel activity (Bigos et al., 2010; Purcell et al., 2014; Yoshimizu et al., 2015). MA drastically increases the release of DA in the striatum, which may also underlie the higher delta power observed in the MAP group (Bertolino et al., 2000). D_2 receptor blocking medications such as haloperidol are also effective at alleviating MAP positive symptoms (Shoptaw et al., 2009; Wang et al., 2016). NMDAR hypofunction on cortical and subcortical GABAergic neurons in MAP has also been put forward as a potential neurobiological basis for the development of MAP (Wassef et al., 2003; Coyle, 2006; Hsieh et al., 2014). It is unknown whether MAP also have specific T-type Ca^{2+} channel activity deficits as schizophrenia, however studies in cocaine have found that T-type channels mediate increased

delta power (Urbano et al., 2009), and that the effect of cocaine on T-type channel activity may underlie the effects of cocaine on the TC network (Urbano and Bisagno, 2017b). While cocaine and MA have differing mechanisms of action, their similar effects at increasing DA in multiple neuronetworks suggest that further study into the effects of MA T-type channel activity, and the role of the RN in MAP may be warranted.

During REO and task performance, there were no group differences in delta power. However the control group showed increases in delta power during REO, and during task performance, compared to REC. This increase in delta power in the controls when eyes were opened eliminated the group differences previously observed during REC, suggesting that in schizophrenia, the delta power during REC are more similar to the delta power of controls during REO. In fact, these results showed no change in delta power in schizophrenia or MAP between states, suggesting that delta power in MAP and schizophrenia are less dynamic, and less responsive to physiological state changes than controls. It is important that delta would change according to physiological state, it would reflect modifications in the manner in which the brain responds to changes in the environment (Harmony, 2013).

In healthy awake participants, increased delta activity has been correlated with a number of presumably metabolically activating states such as the performance of calculations (Fernández et al., 1995), reaction time tests (Van Dijk et al., 1992), abstract thought (Michel et al., 1993) or an omitted stimulus paradigm (Başar-Eroglu et al., 1992). However, it is important to note that the participants were not performing a strenuous task during REO, and absolute delta power in healthy participants have been shown to decrease in the transition from REC to REO (Barry et al., 2007, 2009). Increased relative delta in controls in the transition between REC and REO could have occurred due to their much greater magnitude of decrease in alpha power, and thus obscuring an absolute decrease in delta power in controls during REO. Despite the potential caveat of the relative delta power metric, both absolute and relative EEG power measures have been found to be similarly reliable, so long as correct comparisons between studies are being made (Gudmundsson et al., 2007). Also, the relative delta power measure does not take away the fact that the MAP and schizophrenia groups showed no changes in delta in response to state changes in the manner that the controls did. That this may have been due to a much greater magnitude of decrease in alpha power in the controls compared to the other groups will be discussed further.

As with delta, findings for lower alpha power over the majority of the scalp during awake REC in schizophrenia, compared to healthy controls is also consistent with the literature (Itil, 1977; Fenton et al., 1980; Abeles and Gomez-Ramirez, 2014; Goldstein et al., 2015). Frequency power research in MAP have not reported changes to alpha power compared to healthy controls, and EEG studies in MA abuse participants during REO have found no changes in alpha power (Shafiee-Kandjani et al., 2019).

Similarly to REC, alpha power in the MAP and schizophrenia are also lower than that of controls during REO, with greatest differences over the central and posterior cortices. However, there were no group differences in alpha power during task performance. These results may present a pattern showing that as the brain becomes more engaged from REC, to REO to task performance, that the alpha power in the MAP and schizophrenia become more similar to that of controls. However, comparison of alpha power between the states within each group showed that, while controls showed the typical and expected decreases in alpha power from REC to REO, and from REC to task performance, the schizophrenia showed no such changes. The alpha power for the schizophrenia group remained static, and lower than controls, at every scalp location, suggesting impaired neural adaptation to opening and closing of the eyes.

Low alpha power is suggested to reflect an inability to inhibit the activity of task-irrelevant cortical structures, or poor thalamic gating of both internal and external stimuli (Jensen and Mazaheri, 2010). As discussed above for delta power, several symptoms of schizophrenia may be explained by a combination of factors including excessive DA release in the striatum due to an impaired DLPFC (Bertolino et al., 2000), and NMDAR hypofunction, particularly on GABAergic neurons (Olney and Farber, 1995; Coyle, 2006; Pakkenberg et al., 2009). The GABAergic neurons of the TRN sustains intrinsic alpha oscillations through repetitive reciprocal inhibitory rebound activity with the cortex and TC neurons (Llinás and Geijo-Barrientos, 1988; Avanzini et al., 1989; Sponheim et al., 1994; Destexhe and Sejnowski, 2003). NMDARs work in conjunction with $Ca_v3.3$ channels in the RN (Huguenard and McCormick, 1992; Talley et al., 1999; Perez-Reyes, 2003), and a mutation in the CACNA1I gene that disrupts $Ca_v3.3$ channel activity has been found to be highly associated with schizophrenia (Irish Schizophrenia Genomics and The Wellcome Trust Case Control C., 2012; Hamshere et al., 2013; Rivas et al., 2015; Schizophrenia Psychiatric Genome-Wide Association Study (GWAS) Consortium, 2014; Xu et al., 2018). Thus alpha power in

schizophrenia may be lower during wake because lower activity of $Ca_v3.3$ channels prevent the adequate depolarization required for the RN to switch the TC neurons from bursting mode to tonic mode and vice versa (Destexhe and Sejnowski, 2003; Murbartian et al., 2004; Astori et al., 2011). This impaired ability of the RN to respond dynamically to environmental changes and switch the thalamic gate "open" or "closed" may underlie the lower alpha power in schizophrenia that has been commonly observed, and the lack of change in alpha power in schizophrenia between REC, REO and during task performance, as per these results.

During REC, there was lower beta power in the schizophrenia compared to controls at the FP electrodes. And during performance of the sustained attention task, both MAP and schizophrenia groups showed lower beta power at the F_4 electrode. This is the first report of beta power in MAP.

Previous research on beta power in schizophrenia have been inconsistent, with some studies showing lower beta power than healthy controls (Itil et al., 1972) and beta power that correlated negatively with the severity of negative symptoms according to BPRS scores (Fenton et al., 1980). However, others had found higher beta power in the occipital regions for schizophrenia (Morihisa et al., 1983; Miyauchi et al., 1990), although increased beta power has been suggested to result from increased muscle tension in schizophrenia participants (Karson et al., 1988). One study found found greater beta power in MA abuse participants compared to healthy controls (Shafiee-Kandjani et al., 2019).

In studies of cognition, higher beta power in the frontal cortex has been associated with better performance in cognitive inhibition task paradigms (Alegre et al., 2008; Swann et al., 2009; Aron, 2011). Decreased beta power has been widely associated with increased impulsivity, most commonly observed in ADHD research (Barry et al., 2003). Thus the findings of lower beta power compared to controls in the frontal cortices of schizophrenia both at rest and during task performance, and in MAP during task performance reflects the impairments in cognitive control that have been widely reported for both MAP (Nordahl et al., 2003; Newton et al., 2004; Potvin et al., 2018) and schizophrenia (Liu et al., 2002; Nuechterlein et al., 2004; Hofer et al., 2005; Parnaudeau et al., 2018), and that schizophrenia may have more problems with cognitive control at rest than MAP.

Beta rhythms could be generated by cortico-basal ganglial networks, driven by intrinsic beta

oscillations between the the STN-GPe reciprocal connections (Sato et al., 2000; Holgado et al., 2010), or GPi (Nambu et al., 2002; Leblois et al., 2006; Weinberger et al., 2006; Stein and Bar-Gad, 2013); the output of the GPe/i are modulated by the RN prior to reaching the thalamus or cortex (Jones, 2010). Excess DA acting on presynaptic D4 receptors on GP terminals at their junction to the RN may lead to inhibition of GABA signalling to the RN (Gasca-Martinez et al., 2010; Erlij et al., 2012). Thus, similarly to lower alpha and higher delta power, lower frontal beta power could also be explained by poor transmission of basal ganglial signals through the RN to the frontal cortex.

There were no group differences for relative theta power at any scalp location. Only the control group showed greater theta power in REO and during task performance when compared with REC. These results are unlike previous studies that found higher theta power in schizophrenia as compared to healthy controls at similar or differing scalp locations (Itil et al., 1972; Elbert et al., 1992; Clementz et al., 1994; Sponheim et al., 1994; Knott et al., 2001; Basar-Eroglu et al., 2008; Newson and Thiagarajan, 2019).

It is possible that the lack of differences in theta power between groups could have been due to minor methodological differences during measurement, analysis, or the particular sample of participants. However, since poor theta/gamma coupling dynamics has been shown to be highly associated with working memory performance (Kirihara et al., 2012; Barr et al., 2017), and gamma frequency power alterations have been found to be prominent in schizophrenia (Basar-Eroglu et al., 2007), the lack of group differences in theta band power between the schizophrenia and controls may be due to relative changes in gamma power which were not recorded or analysed in this study.

4.5.1 Limitations

Several limitations require emphasis. First, sample sizes were too small to delineate drug effects. The majority of MAP participants received FGA medications, while the majority of schizophrenia participants were prescribed SGA medications. Thus whether the differences or similarities observed between the MAP and schizophrenia groups were due to medication effects cannot be determined. There were also too few participants who were not taking any prescribed medications, largely due to the fact that we were recruiting only from hospitals.

Second, the duration of diagnosed illness was significantly longer in the schizophrenia, and it is unclear whether, if the MAP participants had had longer durations of illness, that even more similarities in results between MAP and schizophrenia would have been observed. It was difficult to match duration of diagnosis between MAP and schizophrenia participants since the DSM criteria necessarily re-diagnosed patients with MAP to patients with schizophrenia. Even though we were successful in recruiting some MAP participants with longer durations of psychosis due to MA, the median duration for MAP diagnosis was still only 1 year, while the median duration for schizophrenia was 7 years.

Third, it was also difficult to match participants demographically across all groups. Differences in age and level of education may have been of concern, since both older age (Chiang et al., 2011; Verstraeten and Cluydts, 2002) and lower education levels have been associated with low alpha power. Since the stable schizophrenia patients tended to be older, and the younger MAP patients were also the least likely to have had time to achieve higher levels of education, there is the possibility that the lower alpha observed in the schizophrenia compared to controls may be due to increased age, and the lower alpha in MAP may be due to lower education levels. Post-hoc ANCOVA accounting for age and education levels found that alpha power remained lower at the relevant electrode positions in both the MAP and schizophrenia groups, suggesting that the lower alpha in these groups were not in fact due to age and education levels. However, it is noted that the covariance of groups and education levels inherently violates ANCOVA assumptions (Glass et al., 1972) and thus these results may still not be conclusive.

Fourth, the variability of EEG frequency band power data is very wide, even in the normal population, and over a person's lifespan, and considering the conditions of this study, it is important to note the difficulties of interpreting these data (Newson and Thiagarajan, 2019).

4.5.2 Future Work

I have presented similar observations of higher delta power, lower alpha power, and a lack of change in frequency in the shift between eyes open and closed in both MAP and schizophrenia groups. Several lines of evidence from molecular work performed by others suggest that MAP and schizophrenia likely have some similar anatomical and neurochemical characteristics that indicate similar RN and TC deficits. Considering that some MA abusers never develop MAP regardless of

dosage or duration of usage, there appears to be a genetic pre-disposition for the the development of MAP, or persistent MAP in particular (Kobayashi et al., 2006; Grant et al., 2012). There have been several genetic association studies that have been performed in MAP, and none have so far found associations with T-type channel mutations (Ujike et al., 2003; Kishimoto et al., 2008; Kotaka et al., 2009; Ujike et al., 2009; Ikeda et al., 2013). However, MAP (as with many illnesses) likely results from both genetic and environmental interactions, MA use may lead to persistent MAP due to epigenetic changes, which would not be detectable in typical genetic association studies. An alternative but more expensive study could utilize next generation sequencing (NGS) techniques to firstly determine underlying whole genome sequences, and combine it with data from epigenetic and transcriptome sequencing of samples from the same individuals. The results of this would predict that, if such extensive sequencing work was done, that epigenetic or transcriptome alterations would likely be observed in the sequences involving T-type channels in individuals with MAP.

5 Electroencephalography: Event Related Potentials

5.1 Introduction

This chapter explores the ERPs in MAP during the performance of an in-house CPT. I first review a brief history of the discovery of cognitive ERPs, and then review the current knowledge of the associations, and underlying mechanisms that may generate the N100, P200, N200 and P300 ERPs.

5.1.1 Brief history

Some of the earliest EEG researchers began to characterize the EEG responses evoked as a result of simple auditory (Davis, 1939), or somatosensory stimuli (Dawson, 1947). It was however quite difficult to differentiate these small potentials embedded within the noisy frequencies that have much larger amplitudes. The technique at the time was to superimpose the many traces (approx. 50) on top of one another, which thickened the baseline, but did successfully visualize the time-locked deflections as a result of the stimulations (Dawson, 1947).

Based on an idea suggested by a colleague, Dawson made the first attempt to add and average the EEG traces of successive stimulations, in order to discriminate the regularly evoked waves by the stimuli, from the irregular deflections of the general background waves (Dawson, 1951, 1954). This simple, but effective technique, together with the development of the internationally standardized 10-20 system of electrode placement (Jasper, 1958), made the ERP easier to visualize, and replicate across studies.

The study of ERPs became popularized after Walter discovered the EEG signal for cognitive anticipation before an event, showing that the cognitive activity in preparing for a task can be measured (Walter et al., 1964). A year later, Sutton discovered the P300; not only that it was

endogenously generated by cognitive activity, but that it was also associated with performance accuracy (Sutton et al., 1965). Since then, ERP research increased exponentially, which have characterized several time-locked potentials, associated with particular scalp distributions, and related to particular types of tasks (Woodman, 2010).

The primary step of ERP analysis is to extract the event-related portion of the recorded field potentials. This is achieved by presenting the identical stimulus repeatedly over a certain period of time, with sufficient intervals between stimuli to prevent habituation (or sensory gating) effects, unless habituation is the mechanism that is under study. Each stimulus is thus the beginning of the "event", and when the EEG of each repeated and time locked event is overlaid, the background "noise" of the EEG becomes averaged out, while the averaged of consistent electrical patterns that occurred in response to the presented stimuli remains prominent; this prominent pattern is named the grand average ERP.

The pattern of the ERP has been found to be largely consistent in response to standardized tasks and stimuli, and particular "components" of the ERP, which are characteristic peaks and troughs in the grand average ERP trace that occur within specific time windows post stimulus presentation, have been named and characterized in various studies. The analysis of these components typically involves comparing the *amplitude* (most positive or negative voltage from baseline, within a specified time window for the component under study) and *latency* (time from the end of the stimulus that peak amplitude from baseline occurs, of the component under study) parameters.

There are two main types of nomenclature for the ERP components, and both begin with either the letter "P" for a positive peak, or the letter "N" for a negative peak. The latency method follows the letter with a number that corresponds with the general latency after the stimulus at which that peak occurs, for example, "P100" is a positive peak that occurs approximately 100 ms after stimulus presentation. The ordinal method follows the letter with a number that indicates the order of the appearance of the peak, for example, the "P1" will be the first positive potential observed after stimulus presentation, and an "N2" would be the second negative potential observed after stimulus presentation. The ordinal method sometimes uses a "C1", or "component 1", which is the first small component after the presentation of the stimulus which is either positive or negative depending on the scalp location. This component corresponds with P50 or N50 in the latency method (Woodman, 2010). The present thesis uses the latency method to name

event-related potentials.

The stages of information processing are generally represented by the P50, N100, P200, N200, and P300 components (Figure 5.1). The P50 component associates with the pre-attentive stage of stimulus processing; the N100, P200 and N200 components associates with early stages of attentive processing; the P300 associates with late stage stimulus processing (Jutzeler et al., 2011). Of these components, the P50, N100 and P200 are thought to reflect sensory gating efficiency (Shenton et al., 1989; Polich and Squire, 1993; Rosburg et al., 2008; Williams et al., 2011), the N200 may reflect cognitive discrimination and stimulus categorization, and the P300 appears to reflect the amount of attentional resources available (amplitude) and stimulus processing speed (latency) (Kutas et al., 1977; Magliero et al., 1984; Polich, 2007). The present work extracted data from the N100, P200, N200 and P300 components in order to characterise the ERPs in MAP, in comparison to the schizophrenia and control groups. The following subsections will review these four ERPs within the scope of this study in terms of their proposed biological generators, relevance to attention, and psychosis.

5.1.2 Continuous Performance Task (CPT)

A multitude of cognitive tests have been developed to elicit and assess each of the sub-components of attention that have been identified by the many models of attention that have been proposed. Since sustained attention and behavioural inhibition can encompass several of these sub-components depending on the conditions of the specific task, this section will describe relevant tests which elicit the sub-components of attention which are also required for the performance of some versions of the CPT.

Since the 1950's, the CPT has been used to test for vigilance or alertness, with suggestions that CPT performance could be related to neural events, and could be used as an instrument to diagnose brain damage (Rosvold et al., 1956). The initial CPT, now called an "X-type" CPT, presented letters one at a time, at a fixed interval of 920 ms between letters, for approximately 10 minutes (Rosvold et al., 1956). The participant was asked to press a lever only when a rare and unexpected target, the letter "X", appeared. This group also introduced a second, slightly more difficult variation of the task called the "AX-type" CPT (Rosvold et al., 1956; Mirsky et al., 1960). This was similar to the original task, except that subjects were to press the lever when the

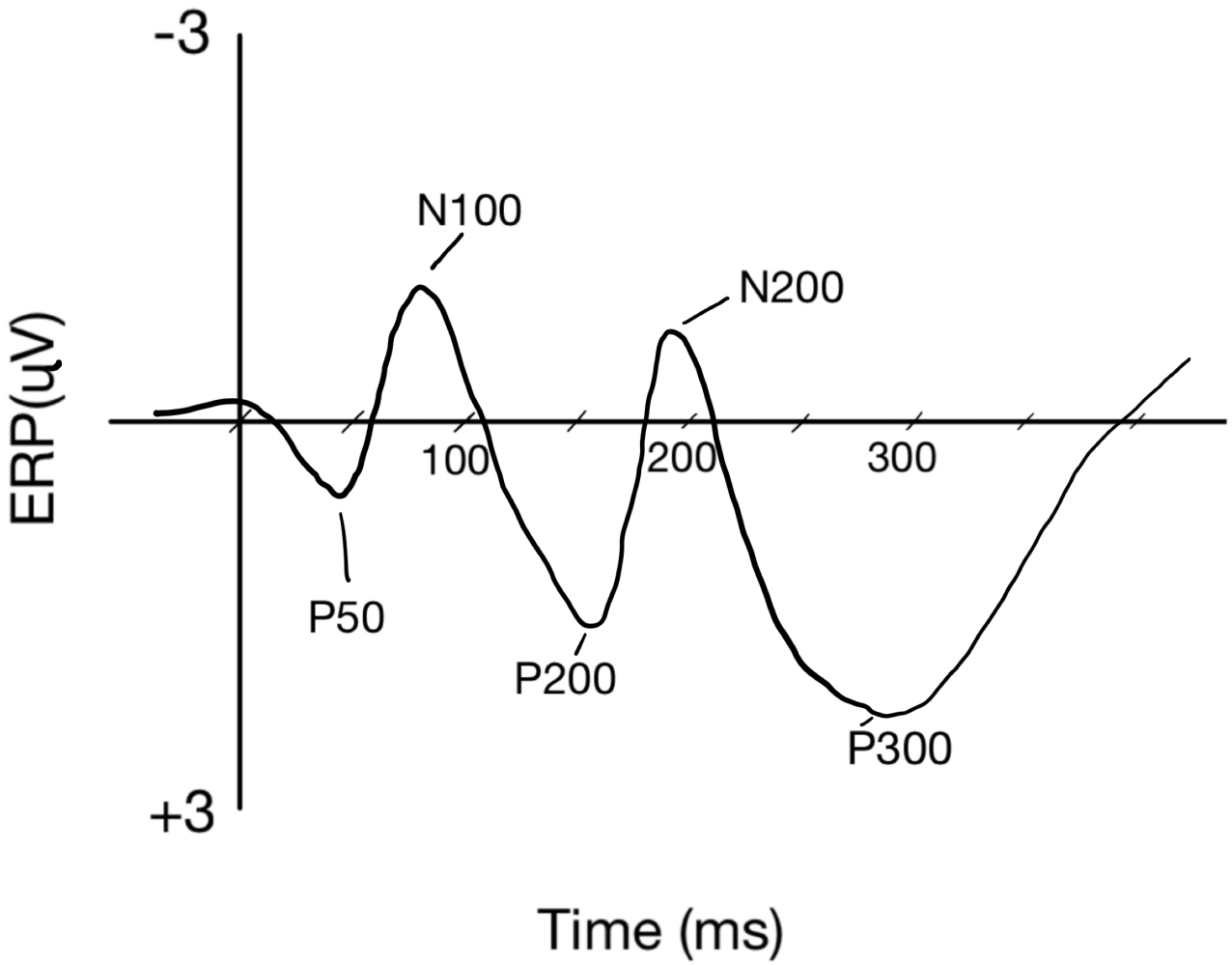


Figure 5.1 – Generic representation of time-locked sequence of the most commonly studied event-related cognitive potentials. Uncommon and unexpected target stimulus presented at Time = 0 ms. Stages of information processing are generally represented by the P50, N100, P200, N200, and P300 components. The P50, N100 and P200 are thought to reflect sensory gating efficiency, N200 may reflect cognitive discrimination and stimulus categorization, and the P300 appears to reflect the amount of attentional resources available (amplitude) and stimulus processing speed (latency). Image adapted from (Eisenbarth, 2018)

letter "X" appeared only if it was preceded by the letter "A". Task performance was measured by the numbers of correct and incorrect responses, and reaction times to correct responses (Rosvold et al., 1956). Presumably these tasks were designed so that responses to unpredictable targets were required to ensure that attention was in fact being maintained through the dull presentation of irrelevant stimuli in the rest of arduous the task. Unbeknownst to Rosvold, this requirement for subjects to respond to infrequent and unpredictable stimuli were ideal for the subsequent discovery of the EEG P300 ERP (Sutton et al., 1965), when the importance of the element of uncertainty in eliciting attentional engagement to a target stimulus was visualized. The P300 will be elaborated further in Section 1.11 and Chapter 5.

The duration between stimuli can be shortened to 500 ms, and overall task length, depending on

difficulty, can be shortened to 5 minutes (Borgaro et al., 2003). Further variations of the CPT have shown to be useful in a variety of different contexts. For example, the X-type CPT can be performed using other forms of unexpected "targets" instead of the target letter "X". Successful variations have utilized different letters, words (Earle-Boyer et al., 1991), numbers (Gordon and Mettelman, 1988), pictures of objects, pictures of a person (Anderson et al., 1969), or different modalities such as auditory tasks with various tones for "targets" (Earle-Boyer et al., 1991).

The auditory "oddball" task, as the auditory equivalent of the X-type CPT is the most widely used paradigm in cognitive neuroscience research. There are some subtle variations to the task but it generally consists of two different tones, one of which is "common", and is presented 80% of the time, while the other tone is the "uncommon" tone, presented only 20% of the time, with at least 2 seconds between presentations of tones. *Passive* oddball tasks require no response from the participant, while *active* oddball tasks require participants to respond to or count the number of uncommon tones through the duration of the task (Boutros and Belger, 1999). This most simple form of the CPT has been most useful for isolating neural correlates of the selective aspects of attention, such as target discrimination and selective attention, and, over a long period, is likely the purest measure of sustained attention (Birkett et al., 2007). However, the X-type CPT may not be sufficiently demanding, and is insensitive to more nuanced cognitive abnormalities, thus other variations to the CPT have also been developed in order to isolate more specific functional impairments in patients (Birkett et al., 2007).

Variations of the AX-type CPT task further engage working memory, cue, and pattern recognition, such as and XX-CPT task, where the target must be followed by itself (Fitzpatrick et al., 1992) and identical pairs type tasks ("IP-type" CPT) where a "target" for response is defined as the second of any two digits in a number series or two letters in a letter series (Cornblatt et al., 1989; S. C. Schulz, 1989). Another interesting modification that prioritizes the study of behavioural and cognitive inhibition, is the Conner's CPT, which asks subjects to respond to *every* letter or number *except* the target letter or number (Conners, 1995; Conners et al., 2003).

The core of the CPT version used in the present work was developed in 2010 (Howells et al., 2010), and combines the strengths of other CPT tasks. Our task consists of individual presentations of random consonant letters on a screen, interspersed with sequences of three presentations of the letter "S" in a row. Participants were asked to respond to the target letter "S" only on the third

presentation of the letter. In addition to the task developed in 2010, single presentations of the letter "S" were added to the task used in the present work. Thus, like the X-type CPT, our task requires an appropriate response to an infrequent target, in the form of a physical button press; like the AX- and IP-type CPTs, it requires working memory in order to remember the cues prior to the target; like the AX-type and other Go/No-go tasks, it requires inhibition on the first two presentations (or a single presentation) of a target letter, while counting, and only pressing on the third presentation of the target letter; and lastly, sustained over a period of 5 minutes, it requires sustained attention. Studies have shown that a variety of CPT types are able to discriminate between schizophrenia and healthy controls based on behavioural performance criteria (Rosvold et al., 1956; Borgaro et al., 2003; Kahn et al., 2012). Behavioural performance on the CPT is determined by measures such as reaction time of the response after target presentation, number of targets responded to correctly, number of targets missed and number of non-targets responded to (van den Bosch et al., 1996).

5.1.3 Event Related Potentials (ERP)

Each ERP component has been associated with cognitive characteristics or attentional construct. The following subsections will review the five components within the scope of this study in terms of their proposed biological generators, relevance to attention, and psychosis.

5.1.3.1 N100

The N100 component is a pre-attentive sensory evoked potential that typically occurs between 80 to 100 ms post stimulus presentation. Like the P50, it can be elicited by any form of stimuli, whether or not the participant exerts attention on the presented stimuli, however its amplitude and latency are sensitive to attention and stimulus encoding variables (Rosburg et al., 2008). It has been shown to reflect selective attention to targets (Hillyard et al., 1973), increased conscious effort to respond to targets as quickly as possible (Mulert et al., 2005) and inhibition of behaviour to target stimuli (Potts et al., 2004).

ACC activity is typically increased in situations requiring an inhibition of prepared behaviour (Pardo et al., 1990; Paus et al., 1993, 1998; Potts et al., 2004). Larger N100 amplitudes have been associated with increased ACC activity as seen by increased fMRI BOLD signal in the the area during effortful decision making (Mulert et al., 2008), and PET studies have found increased ACC

metabolism during tasks requiring inhibition, or attentional conflict paradigms such as Stroop tasks (Pardo et al., 1990; Paus et al., 1993, 1998). Larger N100 amplitudes have also been observed with the inhibition of the M1 mACh receptor, by administration of biperiden (Caldenhove et al., 2017). Activation of M1 receptors strongly inhibits $Ca_v3.3$ T-type Ca^{2+} channels (Hildebrand et al., 2007), which is necessary to close K^+ channels and depolarises membrane potential (Bista et al., 2012), and allow TC neurons to switch from burst mode to tonic firing mode (McCormick and Bal, 1997). These studies implicate the ACh system, as well as the TC loop, particularly involving the ACC in the cortical aspect of the loop, for the generation of the N100.

Smaller N100 amplitudes to auditory oddball have also been previously observed in both schizophrenia (Mulert et al., 2005, 2008). The smaller N100 amplitude has indicated aberrant sensory processing of stimulus evaluation and salience detection in patients (Rosburg et al., 2008; Brenner et al., 2009). In two tone discrimination oddball tasks, the N100 amplitude was found to be smaller in schizophrenia patients for all stimuli, whether they were common non-targets, or uncommon targets (Ogura et al., 1991; Brown et al., 2002), and showed significant reductions from before until after psychosis onset (van Tricht et al., 2011). Since larger N100 amplitudes are associated with increased ACC activity (Mulert et al., 2008), smaller N100 amplitudes could indicate poor ACC activity in schizophrenia. Indeed, function and integrity of the DLPFC and ACC regions are consistently impaired in schizophrenia (Glahn et al., 2005; Fusar-Poli et al., 2007; Minzenberg et al., 2009; van der Meer et al., 2010; Kraguljac et al., 2012). Taken together, the smaller N100 characteristics found in schizophrenia literature point towards a dysfunction of the ACC within the TC loop, that likely involves ACh transmission.

Only two studies have measured the N100 component in MAP, using an auditory oddball task, with different trains of common and uncommon stimuli in each ear (Iwanami et al., 1993, 1995). Healthy control and MAP participants were asked to attend to the uncommon stimuli in one or the other ear, and N100 amplitudes and latencies were measured for both the common and uncommon stimuli, in both the attended and non-attended ears. This study measured area under the curve of the N100 (μV x ms), and found a smaller N100 in MAP participants for all stimuli, and at all scalp positions (Fz, Cz and Pz); the largest amplitudes were at Fz and smallest amplitudes at Pz (Iwanami et al., 1993). The authors suggest that this reduced N100 area indicated a possibility of impaired auditory information processing in MAP that is similar to that of people

with schizophrenia (Iwanami et al., 1993, 1995).

5.1.3.2 P200

The P200 is a positive component that usually occurs between 150 to 250 ms post stimulus, whether target or non target, and by any means (auditory, visual, or somatosensory) (Roth and Cannon, 1972; Oades et al., 1995; Potts et al., 1998; Crowley and Colrain, 2004). Like the N100, the amplitude and latency of the P200 is sensitive to changes in aspects of selective attention or stimulus encoding processes (Crowley and Colrain, 2004; Ferreira-Santos et al., 2012), and may index cognitive matching between sensory inputs and stored memory (Luck and Hillyard, 1994; Freunberger et al., 2007). It is however not as well studied compared to the other ERP components (Crowley and Colrain, 2004). Localization studies have suggested that the P200 may be generated in the vicinity of the auditory cortex in the temporal lobe (Elberling et al., 1980; Shenton et al., 1989; Hari et al., 1980; Perrault and Picton, 1984; Hari et al., 1990; Godey et al., 2001), the inferior parietal lobe (Knight et al., 1988), the frontal cortex (McCarley et al., 1989, 1991), and the left caudate nucleus (Kiat et al., 2016).

The majority of research elicit the P200 ERP using the auditory oddball task. In healthy volunteers, larger P200 amplitudes in response to uncommon stimuli have been associated with higher education and intelligence scores (Lijffijt et al., 2009). P200 amplitudes also increased in response to both common and uncommon stimuli after training on the task and improving task performance, which the authors attribute to improved perceptual sensitivity and behavioural reaction times (Tong et al., 2009). Administering sulpiride before the task decreased P200 latency for common stimuli in a double-blind randomized study of healthy volunteers (Takeshita and Ogura, 1994), and administering biperiden decreased P200 amplitude (Caldenhove et al., 2017). Using a visual oddball task in a study of the effect of age on ERPs, P200 amplitudes were larger in older participants for the target, and P200 latencies were shorter in younger participants for targets (Bourisly and Shuaib, 2018). Using the Balloon Analogue Risk Task (BART) with Low Resolution Brain Electromagnetic Tomography (LORETA), P200 amplitudes, which were localized to the left caudate nucleus (striatum), were larger in trials where there was more risk taking and a greater reward (Kiat et al., 2016). Taken together, even though the neural generators of the P200 are difficult to determine because there are many overlapping processes that occur within the 150 to 250 ms window (Ferreira-Santos et al., 2012), these studies suggest that the P200 is at least be

partly generated by the basal ganglia (BG), and is affected by both DA and ACh systems.

There is further evidence to support the contribution of both the DA and ACh systems in the generation of the P200. In PD, P200 latencies have been shown to be longer than healthy controls (Hansch et al., 1982). Motor symptoms in PD used to be treated by M1 mAChR blockade (Clarke, 2004), indicating the important role played by ACh . Over and above motor symptoms, cognitive symptoms in PD is also thought to result from degradations in DA and ACh interactions, particularly within the striatum, but also involving the BF nuclei and PFC areas, including the DLPFC (Calabresi et al., 2006). Further research on ACh and DA interactions in PD have increased interest in mAChRs for the treatment of cognitive symptoms in PD (Ztaou and Amalric, 2019). P200 amplitudes are also larger in people with MDD, with slower and more variable behavioural response times (Kemp et al., 2009), and more exaggerated P200 characteristics in treatment resistant MDD (Vandoolaeghe et al., 1998). Interestingly, MDD has long been associated with increased ACh levels, and scopolamine, an mAChR blocker, can be used to treat MDD, as shown in a randomized placebo-controlled clinical trial (Furey and Drevets, 2006), many MDD researcher are also targeting the ACh system for developing further therapies (Dulawa and Janowsky, 2019). Administration of biperiden in healthy participants decreased P200 amplitudes during the performance of an auditory oddball task (Caldenhove et al., 2017). These lines of evidence supports the particular involvement of M1 mAChRs in the generation of the P200.

Studies of the P200 in schizophrenia also largely use the two tone discrimination oddball task. Some studies agree that the P200 amplitude is larger in schizophrenia than healthy controls (McCarley et al., 1989; Ogura et al., 1991; Brown et al., 2002), but differ in whether it is in response to only rare stimuli (Brown et al., 2002; Ferreira-Santos et al., 2012), or to both rare and common stimuli (Ogura et al., 1991). The most recent (albeit limited) meta-analysis of P200 literature for schizophrenia found that common stimuli produced smaller P200 amplitudes in schizophrenia, and uncommon target stimuli produced larger amplitudes than controls (Ferreira-Santos et al., 2012). Similarly, latency were shorter for common stimuli, but longer for uncommon stimuli in schizophrenia (Ferreira-Santos et al., 2012). The P200 characteristics in schizophrenia may reflect dysfunction of the ACh system in the performance of a cognitive task.

As of this writing, there have been no published literature on P200 components in MAP, or MA substance abuse. Examining this component could provide an indication of whether dysfunction

in the ACh system in MAP should be targeted for further research.

5.1.3.3 N200

The N200 potential has both involuntary and active processing aspects, that typically occurs between 180 to 325 ms post stimulus presentation (Patel and Azzam, 2005; Polich, 2007). The amplitude of the N200 is typically increased by presentation of uncommon stimuli (compared to common stimuli) in oddball paradigms, or by the no-go trials (compared to go trials) in response inhibition tasks such as go/no-go paradigms (Pfefferbaum et al., 1985; Salisbury et al., 1994; Potts et al., 2004; Patel and Azzam, 2005). The increase in amplitude has been thought to reflect mental effort to control incorrect response preparation, conflict monitoring (Donkers and Van Boxtel, 2004), or "effortful control" (Lo, 2018).

In various adaptations of the go/no-go task, the N200s are found to be larger when the flanker stimuli are different from the target stimulus, but amplitudes are not affected where the target and flanker signals were congruent, regardless of whether these occurred in go or no-go trials (Groom and Cragg, 2015). The authors had contrasted this finding with those of the P300, which shifted frontally and were larger during no-go trials regardless of whether the flanking stimuli were congruent with the target or not, concluding that, while the P300 reflected neural activity related to response inhibition, the N200 reflected activity related to conflict detection (Heil et al., 2000; Donkers and Van Boxtel, 2004; Van Veen and Carter, 2002; Groom and Cragg, 2015). Larger N200 amplitudes also occur in response to high arousal stimuli, and not impacted by positive or negative valence of the stimulus (Rozenkrants and Polich, 2008). In children and adolescents with functional neurological disorder performing an auditory oddball task, higher levels of arousal may explain the observation of larger N200 amplitudes in response to the target stimulus (Kozlowska et al., 2017). Also in an auditory oddball task, where participants had larger N200 amplitudes prior to sulpiride treatment, sulpiride decreased the N200 amplitude, however in participants who lad smaller N200 amplitude prior to drug administration, then the N200 amplitude increased post treatment (Takeshita and Ogura, 1994).

The N200 latency was also found to be longer than healthy controls for uncommon target stimuli, but not for the common non-target stimuli (Ogura et al., 1991). The N200 latency has been correlated with behavioural reaction times during inhibition tasks (Heil et al., 2000). In these

tasks, unsuccessful trials are associated with longer N200 latencies, suggesting that the cognitive process to evaluate the stop signal took too long, and the subject was not able to fully process the stop signal enough in order to inhibit a motor response (Schwartz, 1982; Azizian et al., 2006). Interestingly, sulpiride administration in healthy volunteers increased N200 latency in response to the target (Takeshita and Ogura, 1994).

In detailed studies combining fMRI and ERP responses to carefully designed go/no-go tasks that differentiate between conflict monitoring and behavioural inhibition have found that the ACC plays a key role for detecting conflict and signals other systems involved with top-down control (such as the DLPFC) to resolve this conflict (Heil et al., 2000; Donkers and Van Boxtel, 2004; Van Veen and Carter, 2002; Groom and Cragg, 2015). This evidence suggests the involvement of the DA system, particularly at the level of the ACC, in the generation of the N200 component.

In schizophrenia patients, during a two tone discrimination oddball tasks, the N200 amplitude (using the subtraction waveform of target ERP – standard ERP) was found to be smaller than that of healthy controls (Ogura et al., 1991; O'Donnell et al., 1993) in both first episode and chronic schizophrenia patients (Brown et al., 2002). In on study, schizophrenia participants produced almost non-existent N200 peaks, which the authors believe reflect abnormal neural activity during stimulus classification in schizophrenia (Salisbury et al., 1994). Smaller N200 amplitudes were correlated with lower neocortical and medial temporal lobe volumes in schizophrenia (O'Donnell et al., 1993). It is however not known whether the N200 alterations in schizophrenia is a result of damage to these areas, or due to performance and motivational factors (O'Donnell et al., 1993; Salisbury et al., 1994).

In users of illicit stimulants who are otherwise healthy, administration of MA prior to performance of an auditory oddball task reduced the N200 amplitude response to the target, compared with the placebo response, without affecting reaction time or accuracy. The authors suggest that acute MA administration alters stimulus evaluation mechanisms, where methamphetamine reduced the amplitude of the N200 (Silber et al., 2012), further supporting the involvement of DA in the generation of the N200. As of this writing, there have been no published literature on N200 component characteristics in MAP. My hypothesis is that, if there are similar impairments between MAP and schizophrenia, N200 amplitudes in MAP will be smaller in response to the relevant stimuli in the CPT.

5.1.3.4 P300

The P300 component was discovered in the 1960's (Sutton et al., 1965), and is still the most widely studied ERP to date. The P300 can be elicited from any task that requires stimulus discrimination, and usually occurs between 250∼500 ms after the presentation of an unexpected stimulus or target, over a background of expected stimuli, or non-targets, although the time window may vary depending on the task. The P300 has been subdivided into P3a and P3b components. The P3a is earlier, with a frontal scalp distribution, and generally occurs during tasks where it is not required for the subject to respond to any presented stimuli during a task. The P3b occurs approximately 25∼100 ms later, with a more parietal distribution, and occurs when subjects are required to respond (physically or mentally) to particular target stimuli during a task, although some tasks elicit a combined P300 (Polich, 2007).

The P300 has been widely used for studying cognitive deficits in schizophrenia (Jeon and Polich, 2003; Bramon et al., 2004; Fusar-Poli et al., 2011), and evaluating individual task behaviours (Leitman et al., 2010; Rissling et al., 2010; Pan et al., 2014). P300 amplitude reduction in schizophrenia was related to abnormal assessments of related social functioning and social personal adjustment, and compared to the N100 or P200, the reduced P300 amplitudes were the best predictor for the psychosis in the ultra high risk group (van Tricht et al., 2010). Although, others believe that the P300 latency may be a more reliable metric when determining endophenotype for schizophrenia than the P300 amplitude (Martın-Loeches et al., 2001; Bramon et al., 2005; Kim et al., 2017).

P300 characteristics for MAP have apparently only been studied by one other group of researchers, who compared behavioural and P300 responses to the target stimulus during the performance of an auditory oddball task, in participants with MAP, schizophrenia and healthy controls. The Iwanami group found that the P300 amplitudes in MAP were lower over the Fz and Cz positions, while the schizophrenia groups showed lower P300 amplitudes over a larger scalp area, in the midline frontal, central and parietal (Fz, Cz and Pz) locations (Iwanami et al., 1991, 1993, 1994a).

A vast body of research has found that the generation of a P300 requires an ensemble of diverse neuronal groups to coordinate their activity with both temporal and spatial precision. Many neuronal systems are involved and necessary to produce a "normal" P300. These systems include the LC-NE (Pineda et al., 1989; Pineda, 1995; Nieuwenhuis et al., 2005; Polich and Criado, 2006; Polich, 2007), DA (Braver and Cohen, 2000; Polich, 2007), ACh (Ahnaou et al., 2018; Khedr et al.,

2020), the thalamus (Katayama et al., 1985; Kropotov and ponomarev, 1991; Mochizuki et al., 2001; Horovitz et al., 2002; Klostermann et al., 2006), and key areas in the cortex, i.e. DLPFC and ACC (Bachiller et al., 2015; Li et al., 2018).

There is strong evidence that LC-NE system likely contributes to making the P300 that has been well reviewed (Swick et al., 1994; Nieuwenhuis et al., 2005; Walz et al., 2013; Wostyn et al., 2017; Waterhouse and Navarra, 2019). In brief summary, the the timing and distribution of LC-NE system activity match both intracranial and scalp recorded P300 activity. Lesioning and pharmacological manipulation studies have shown that inhibition or over excitation of the NE system alters the characteristics of the P300. The conditions required to generate a P300, such as novelty or salient stimuli, are also required for activation of the LC (Pineda et al., 1989; Pineda, 1995; Nieuwenhuis et al., 2005; Polich and Criado, 2006; Polich, 2007).

It is however clear that the conditions for the activation of the NE system overlap with those required for activating the DA system. Indeed, there is also much evidence that shows DA system is required to generate the P300 (Braver and Cohen, 2000; Polich, 2007). PD patients with low DA levels had longer P300 latency in standard auditory odd-ball paradigms compared to healthy controls (Hansch et al., 1982; Stanzione et al., 1991), and DA monotherapy was able to normalize P300 latency (Stanzione et al., 1991). Administration of the DA antagonist sulpiride in healthy subjects increased P300 amplitude in subjects that initially had lower P300 amplitude, decreased P300 amplitude in subjects that initially had higher P300 amplitude, and also lengthened P300 latency (Takeshita and Ogura, 1994). Risperidone, a D_2 and 5-HT antagonist, decreased latency to P300 during an auditory oddball in schizophrenia (Umbricht et al., 1999).

ACh is also crucial for a multitude of cognitive function constructs, including working memory, signal detection, and inhibiting inappropriate behaviours (Sarter and Bruno, 1997; Levin and Simon, 1998; Condy et al., 2007; Parikh et al., 2007; Croxson et al., 2011; Berry et al., 2014; Gritton et al., 2016; Verma et al., 2018), functions which have also been associated with changes in the P300 (Ahnaou et al., 2018; Khedr et al., 2020). In addition, ACh modulates DA via both nAChRs and mAChRs. The higher prevalence of smoking in schizophrenia compared to the normative population (de Leon, 1996; Winterer, 2010) has been considered as potential self-medication (Mitchell and Dahlgren, 1986; Nisell et al., 1995), because it can improve attention in schizophrenia (Nisell et al., 1995; Brunzell and McIntosh, 2012).

Poor thalamic and TRN function have been related to many schizophrenia symptoms (Ferrarelli and Tononi, 2010; Pergola et al., 2015; Pratt and Morris, 2015; Young and Wimmer, 2017), and direct measurements from electrodes placed in specific thalamic nuclei have shown P300-like ERP in patients (Yingling and Hosobuchi, 1984; Kropotov and ponomarev, 1991; Rektor et al., 2001). In fact, the P300 is measured in the thalamus about 150ms prior to it being measure in the central-parietal cortex (Klostermann et al., 2006). This study was performed on 8 PD patients without cognitive impairment, who had externalized deep brain stimulation (DBS) electrodes placed bilaterally in the ventral intermediate nucleus (VIM) of the thalamus, in preparation for future implantation of a DBS-stimulator for treatment of tremors. Patients performed an oddball task consisting of three types of stimuli, a common non-target, a rare non-target, and a rare target. As expected, the cortical P300 was small for the common non-target, larger for the rare non-target, and the largest for the rare target, with a latency of ∼490 ms. However the thalamic electrodes responded only to the targets, consistently occurring ∼340 ms post stimulus. These are clear results indicating that 1) the thalamus is sensitive to the purpose of the stimulus (i.e. target vs non-target), and likely transmits this signal to the central-parietal cortex, 2) that the central-parietal cortex must receive information from another area about stimulus probabilities, resulting in its response to the rare non-target, and that 3) thalamic activity contributes directly to P300 latency and speed of cognitive processing (Van Der Werf et al., 2001; Klostermann et al., 2006).

That the thalamus only generated a P300 in response to the target stimulus suggests that cortical sensory templates may have primed the thalamus for sensory features related to the target through CT projections (Ferrarelli and Tononi, 2010; Pergola et al., 2015; Pratt and Morris, 2015; Young and Wimmer, 2017), i.e. top-down control. Both DA and NE systems are sensitive to rare stimuli regardless of whether they are targets. This suggests the hypothesis that that the rare stimuli may trigger bottom-up sensory signals, which project to both the thalamus and frontal cortex. In the thalamus, where cells were already primed by the cortex for target features would then be preferentially activated (∼340 ms), and transmitted to the association area in the central-parietal cortex. In the frontal cortex, the bottom up DA/NE signal is processed and subsequently sent to the central-parietal cortex, where it integrates with the thalamic signal to produce the P300 at the central-parietal cortex ∼490 ms.

In addition to the influence of these modulators through the thalamus, each of these systems also modulate and/or stimulate cortical activity. In a fMRI-ERP combination study of the P300 generators using a modified oddball task, the group segmented the P300 into 3 intervals post stimulus, from 250-345 ms, 345-419 ms and 419-560 ms, which corresponded to the beginning, exponential, and peak of the P300. The authors found that the somatosensory association area was the first to reach peak activation in the first interval, followed by the medial frontal area near the orbital frontal cortex in the second interval, and finally the bilateral cingulate gyri during the peak of the P300 ERP (Rusiniak et al., 2013).

Considering the use of different groups and study designs between the Klostermann and Rusiniak studies, it wouldn't be entirely appropriate to directly combine these results to claim anything concrete, however it is interesting that the timing of thalamic activation in the Klostermann study falls within the first window, immediately prior to the start of the P300 in the Rusiniak study. In addition, the Klostermann study reported a frontal P3a measured soon after the thalamic peak, but before the central parietal P300. The timing of this frontal P3a coincides with the timing of the second interval in the Rusiniak study, which they also located to a frontal origin.

The ACC, DLPFC and intraparietal sulcus (IPS) have also been repeatedly identified through source modelling studies to be crucial generators of the P300. During the processing of a standard visual oddball task, where a finger press was required on the target stimuli, a study using dynamic causal modelling (DCM) has proposed a sequence of cortical activities from the activation of the visual cortex, to the generation of the P300 (Li et al., 2018).

The proposed sequence of cortical transmission in the controls begins at the primary visual cortex (V1) (Figure 5.2); after processing of the visual stimulus, the signal is sent to the IPS, then simultaneously to the DLPFC and ACC. The ACC then also sends the signal to the DLPFC, after which it is sent back to the ACC and then to the IPS. The authors found that in schizophrenia, the magnitude of the signalling was lower, and the sequence of signalling was different. The schizophrenia data preferred the model starting from the V1, to IPS, which sends to only the ACC, which only then sends to the DLPFC. It is not known whether the DLPFC send the signal on to the IPS at this point, or whether the DLPFC returns the signals back to the ACC, which then returns the signal again to the DLPFC prior to it sending to the IPS (Li et al., 2018).

In sum, the P300 measured at the cortex reflects the culmination of neuro-electrical events resulting

from the co-operation of a multitude of brain areas and systems. Changes to the characteristics of the P300 could thus point to a wide range of possible neural impairments. However, a more specific area or system that may be dysfunctional in MAP could be identified by examining potential changes in the characteristics of the other ERPs in combination.

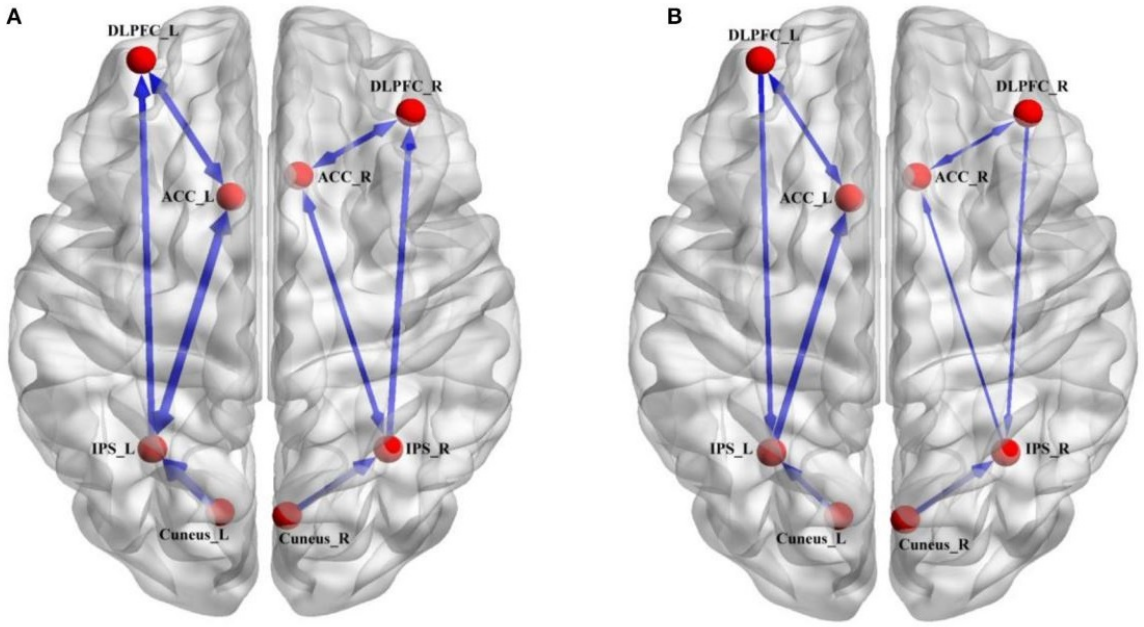


Figure 5.2 – Comparison of dynamic causal models between healthy control and schizophrenia participants. a) Proposed sequence of cortical transmission from target detection to behavioural decision in healthy controls. **b)** Proposed sequence of cortical transmission from target detection to behavioural decision in schizophrenia. Blue arrow denote direction of information flow. Thickness of lines denote strength of connection. Cuneus = V1, IPS = intraparietal sulcus, ACC = anterior cingulate cortex, DLPFC = dorsolateral pre-frontal cortex. Diagram sourced from figure 5 (pg 7) in (Li et al., 2018)

5.2 Aims

Using the amplitude and latency characteristics of the N100, P200, N200 and P300 ERPs, this chapter aims to examine neural activity related to cue, target, and distractor stimuli presented in a CPT task in MAP. Changes in amplitude and latency characteristics of these ERPs may identify a more specific neural region (frontal, central, parietal) or neurotransmitter mechanisms (e.g. ACh, DA or NE) that may be dysfunctional in the attention system of MAP. Considering the similarities between MAP and schizophrenia, my hypothesis is that P300 characteristics will be similar between these groups.

5.3 Methods

The MP150 acquisition system (Biopac System Inc.) was used with 10 EEG amplifiers (EEG100C), 1 EOG amplifier (EOG100C) and 1 EMG amplifier (EMG100C), connected to the recording computer.

The EEG100C amplifiers were set on normal mode, with low pass filter on 35 Hz and high pass filter on 0.1 Hz, with a gain of 1000. The sampling frequency of the Acqknowledge software (Biopac System Inc.) was set at 500 Hz. Each of the 10 amplifiers were connected via a ribbon cable (1 m long), that fans into the international 10/20 montage EEG electrode cap (CAP100C). The scaling parameters of the software were set as follows: CAL1 input value at 10 with scaling value of 10, and CAL2 input value at -10 with scaling value of -10. The number of coefficients was set to 4000, all as per Biopac manufacturer application notes (www.biopac.com). The EMG100C amplifier was set with low pass filter on 5 kHz, and high pass filter on 1 Hz. The EOG100C amplifier was set on normal mode with low pass filter on 35 Hz and high pass filter on 0.05 Hz.

Electrodes linking ear lobes were used as reference through jumpers attached to the EEG100C modules. Two EOG electrodes were secured near the right eye, and connected through the EOG amplifier to the recording computer. The EMG ground electrode attached to the inner forearm as in the CSP chapter served as the overall ground for this system. The remainder EMG electrodes were also attached to the APB belly and tendon positions, and served as back-up analogue recording of behavioural responses.

EEG was recorded from 10 channels, at the following scalp locations: Fp1, Fp_2, F_3, F_4, F_7, F_8, C_3, C_4 , P_3 and P_4.

All EEG were performed at the EEG Suite of the Education Centre, Valkenberg Hospital.

5.3.1 EEG participant protocol

Alcohol swabs were used to clean two parts of the forehead corresponding to the FP electrode locations, adhesive sponges were secured at these locations. Alcohol swabs were used to clean two points on the side of the right eye, where EOG electrodes filled with isotonic EOG gel were then placed.

The EEG cap was placed on the participant's head, with the FP electrode sponges securing the front end, and the two sides of the cap stretched over the ears and tied with a soft strap under the participant's chin. Isotonic EEG gel was then injected into each of the 10 recording electrodes with a syringe and blunt needle. A reference electrode was then secured onto each earlobe. The system was grounded peripherally through the EMG amplifier.

As the signals began transmitting to the recording computer, the researcher explained the requirements for the sustained attention paradigm (below) to the participant, after which the participant performed a practice task. The practice task was identical to the full task, except each element was shortened, and served to familiarize the participant with exact expectations of the full task. The practice task was repeated as necessary for the participant to grasp the requirements of the paradigm.

The EEG and EOG signals from all channels were checked, and the sources of any electrical noise removed. The main lights were then turned off, leaving only peripheral light from an adjacent room, and the participant completed the full task while the experimenters sat quietly in the room.

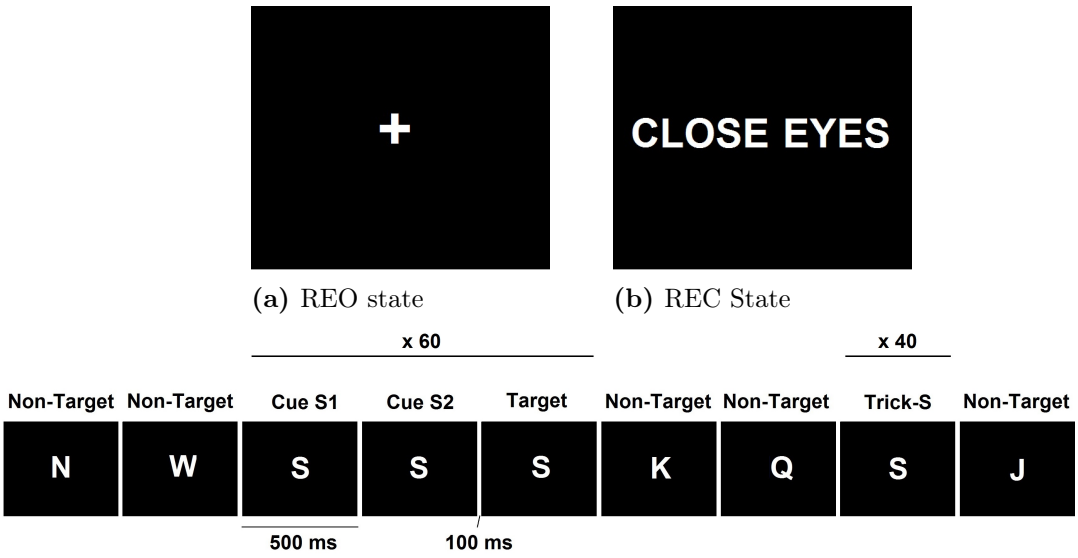
Following the completion of this task, all of the equipment and gel was removed from the participant, and they were allowed a break, pending the next stage of the Test-day protocol. Data were backed up onto a separate memory drive.

5.3.2 Sustained attention paradigm

The CPT was programmed using E-Prime (Psychology Software Tools, Inc.). The participant was in semi-darkness, with peripheral lighting from an adjacent room. The paradigm consisted of 3 parts, recording two resting states and one active task state. The first resting state had the participant look at a white "+" sign in the middle of a dark screen, blinking as often as necessary (resting state eyes open, or "REO"), for 3 minutes. The second resting state asked the participant to keep their eyes closed for 3 minutes (resting state eyes closed or "REC"), after which the researcher would ask them to open their eyes and begin the third, active task state of the paradigm (active task state, or "ERP") for approximately 5 minutes. The total duration of the paradigm was approximately 11 minutes.

In the 5 minute active task, individual non-target consonant letters were displayed in random order, in the center of the screen for a duration of 500 ms each, with 100 ms between letters. Participants were asked to attend for instances when 3 consecutive letters of "S" were displayed, and to respond with a single mouse click as soon as the third target "S" appeared. Single presentations of a distractor "S", also termed "Trick S" were also presented (Figure 5.3).

Digital triggers of each letter were recorded and used for extraction of ERPs, which will be detailed in the next chapter. The present chapter focuses on the relative frequency power during each of the three states of the task.



(a) REO state **(b)** REC State

(c) Sustained Attention Task

Figure 5.3 – **The sustained attention task paradigm** was used to record EEG from three states of neural activity. **a)** resting eyes open (REO) state for 3 minutes, **b)** resting eyes closed (REC) state for 3 minutes. The researcher then asked the participant to open their eyes for the final task state (ERP), where **c)** the participants performed the sustained attention task for approximately 5 minutes. Each letter was displayed for 500 ms, with 100 ms between letters. Non-target consonant letters appeared individually in the middle of the screen in random order. There were 60 instances where two cue "S" letters preceded the target third "S", at which the participant was instructed to respond with a single mouse click as soon as the target was observed. There were 40 instances where single presentations of the letter "S" (or "Trick S") between consonant letters served as distractors.

5.3.3 Data Processing

In-house MATLAB (MathWorks Inc.) scripts (written by David Karpul at the Sports Science Institute of South Africa) and Excel 2010 (Microsoft Inc.) were used for data processing. Statistical analyses were performed using R, version 3.3.0 (R Core Team, 2016).

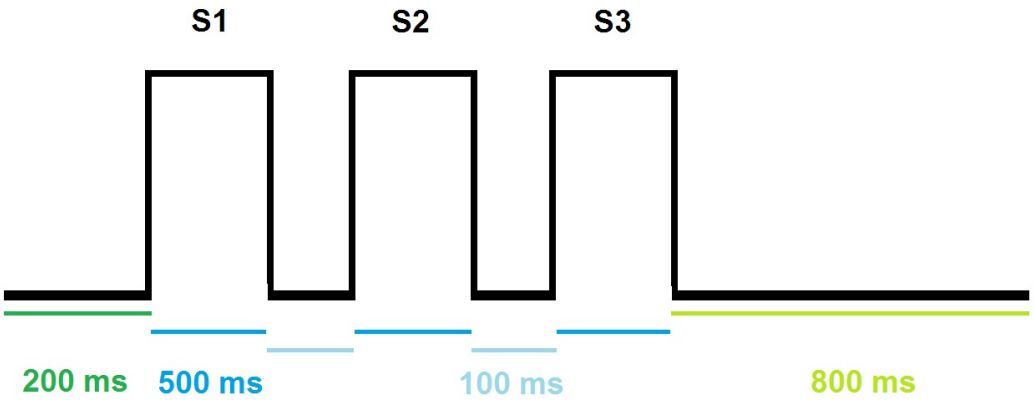
Post recording session, EOG artifacts were removed from the entire recording using the automated ICA function Acqknowledge 4.0 (BIOPAC Inc.). Then REO, REC and ERP states of the task were separated and saved as individual MATLAB files for further batched analysis of each state.

This section details the ERP extraction and processing method for each electrode from the active ("ERP") state of the sustained attention paradigm.

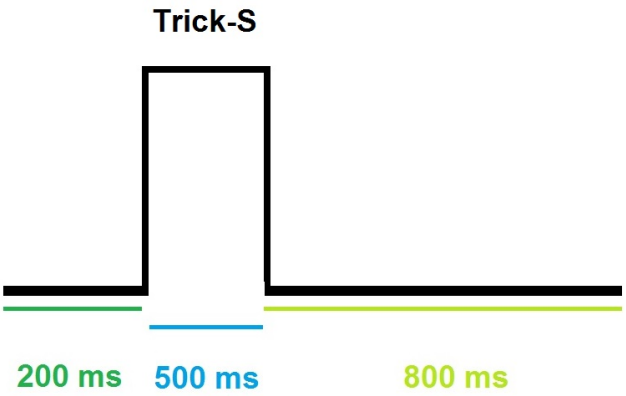
A finite impulse response (FIR) band pass filter with a Hamming window was applied, with low frequency cut-off at 0.5 Hz and high pass frequency cut-off at 30 Hz, for each EEG channel. For the 60 instances of the target S3, data was extracted from 200 ms prior to each S1 cue, until 800 ms after each S3 target, then averaged for each channel. Baseline correction was performed on

the entire duration, from the value averaged from 200 ms prior to presentation of the S1 cue. For the Trick-S, data was extracted from 200 ms prior to each of the 40 distractor "S" presentations, and 800 ms after the stimulus presentation, and averaged for each channel (Figure 5.4). Baseline correction was performed on the entire Trick-S duration from the value averaged from 200 ms prior to Trick S presentation. Artifact rejection was set at $\pm 100\ \mu V$, and digital signals associated with such artifacts were not used. Those channels where less than half of the digital signals were used were excluded from further analysis. Manual artifact rejection was performed on those electrodes which consisted of mainly artifact. This was usually as a result of voluminous hair or excessive movement, as noted on the particular participant's day of testing.

Grand average ERPs from the presentation of the S1 cue were taken 200 ms prior and 600 ms post the presentation of S1. This data was baseline corrected during the initial ERP extraction process. Prominent ERPs in the FP, Frontal and Temporal electrodes included the P300 (150-400 ms) and N100 (75-150 ms) components. Prominent ERPs in the Central electrodes included the P100 (50-140 ms), P200 (150-300 ms), P300 (300-550 ms) and N100 (100-150 ms) components.



(a) S1, S2 and S3 extraction



(b) Trick S extraction

Figure 5.4 – Stimulus extraction diagrams. a) Time ranges for the extraction of S1, S2 and Target (S3) stimuli. **b)** Time range for the extraction of Trick S stimuli

Prominent ERPs in the Parietal electrodes included the P100 (50-150 ms), P200 (150-250 ms), P300 (300-550 ms), N100 (120-180 ms) and N200 (200-320 ms) components.

Grand average ERPs from the presentation of the S2 cue were taken 200 ms prior and 600 ms post the presentation of S2. This data was further baseline corrected for the 200 ms prior to the presentation of the S2 cue. Prominent ERPs in the FP, Frontal and Temporal electrodes included the P100 (0-150 ms), P300 (150-450 ms) and N100 (75-200 ms) components. Prominent ERPs in the Central electrodes included the N100 (40-120 ms), P300 (250-500 ms) and N200 (100-250 ms) components. Prominent ERPs in the Parietal electrodes included the P300 (250-500 ms) and N200 (100-300 ms) components.

Grand average ERPs from the presentation of the S3 target were taken 200 ms prior and 800 ms post the presentation of S3. This data was further baseline corrected for the 200 ms prior to the presentation of the S3. Prominent ERPs in the FP, Frontal and Temporal electrodes included the P100 (50-180 ms) and P300 (200-350 ms) components. Prominent ERPs in the Central electrodes included the P100 (75-175 ms), P300 (200-650 ms) Nc (0-100 ms), and N200 (120-220 ms) components. Prominent ERPs in the Parietal electrodes included the P200 (100-180 ms), P300 (200-650 ms), N100 (50-110 ms) and N200 (150-250 ms) components.

Grand average ERPs from the presentation of the Trick-S distractor were taken 200 ms prior and 800 ms post the presentation of Trick-S. Prominent ERPs in the FP, Frontal and Temporal electrodes included the P100 (75-150 ms), P300 (200-450 ms) and N100 (100-200 ms) components. Prominent ERPs in the Central electrodes included the P100 (50-150 ms), P200 (175-300 ms) and P300 (300-600 ms) components. Prominent ERPs in the Parietal electrodes included the P100 (100-200 ms), P200 (200-300 ms), P300 (300-650 ms), N100 (50-150 ms) and N200 (150-250 ms) components.

Finally, the latency to peak (ms) and baseline-to-peak amplitudes (μV) were extracted from each of these windows for each component, for each channel, of each participant.

5.3.4 Statistical Analysis

The set of participants and electrode positions used in this chapter were identical to that of the previous chapter, thus the results of comparisons of participant demographics, physical attributes, drug use and clinical measures can be found in the EEG: Frequency Power Band Chapter, Results

section 4.4.1 on page 92.

Data were analysed using R version 3.3.0 (R Core Team, 2016). Visual analysis of statistical diagnostic plots for each latency-to-peak (ms) and baseline-to-peak amplitude (μV) ERP measure by linear Group comparison, showed that linear model assumptions were not met. Thus Kruskal-Wallis tests were used for Group comparisons of each ERP measure, followed by non-parametric multiple comparisons ("nparcomp" package), where Kruskall-Wallis effects were significant, to identify between group effects.

As per convention in our laboratory, the p-value for significance was set at $p < 0.05$. Unless other wise specified, results for this chapter are reported in the format of: median(minimum, maximum). Adherence to linear statistical assumptions was confirmed by visually inspecting the standard plots of residuals, Normal Q-Q, and Cook's distance plots for each of the linear models. Where linear statistical assumptions were not met, non-parametric Kruskal-Wallis tests were used for group comparisons.

Only results that showed significant differences are presented in the Results section.

5.4 Results

5.4.1 Behavioural responses

In general, the MAP and schizophrenia groups performed more poorly at the sustained attention task than the control group. The control group had significantly more correct responses to the Target (S3) stimuli, shorter reation times, fewer ommissions of targets, and fewer responses to non-target stimuli, as reported in Table 5.2.

Table 5.1 – Behavioural responses to Sustained Attention Task stimuli

	Descriptive Statistics											
	CON				MAP				SCZ			
Behavioural Response Measure	**N**	**Median**	**Min**	**Max**	**N**	**Median**	**Min**	**Max**	**N**	**Median**	**Min**	**Max**
Target Responses (count)	32	57	14	60	23	41	11	58	26	37.5	0	60
Delayed Target Responses (count)	30	1	0	28	24	5	0	41	24	9.5	0	47
Total Correct Responses (count)	30	56.5	16	60	24	36.5	13	58	24	31	0	60
Reaction Times (ms)	32	222.5	84	516	24	291	105	676	25	388	61	1089
Omission of Target <500ms (count)	32	3	0	46	23	19	2	49	26	22.5	0	60
Omission of Target <1s (count)	30	0	0	24	24	0	0	21	24	3	0	33
S2 Responses (count)	30	0	0	28	24	3.5	0	44	24	5	0	33
Trick S Responses (count)	32	0	0	12	23	0	0	3	26	0	0	13
Other Non-Target Responses (count)	32	0	0	19	23	4	0	32	26	6.5	0	48

Table 5.2 – Group comparisons for behavioural responses to Sustained Attention Task stimuli

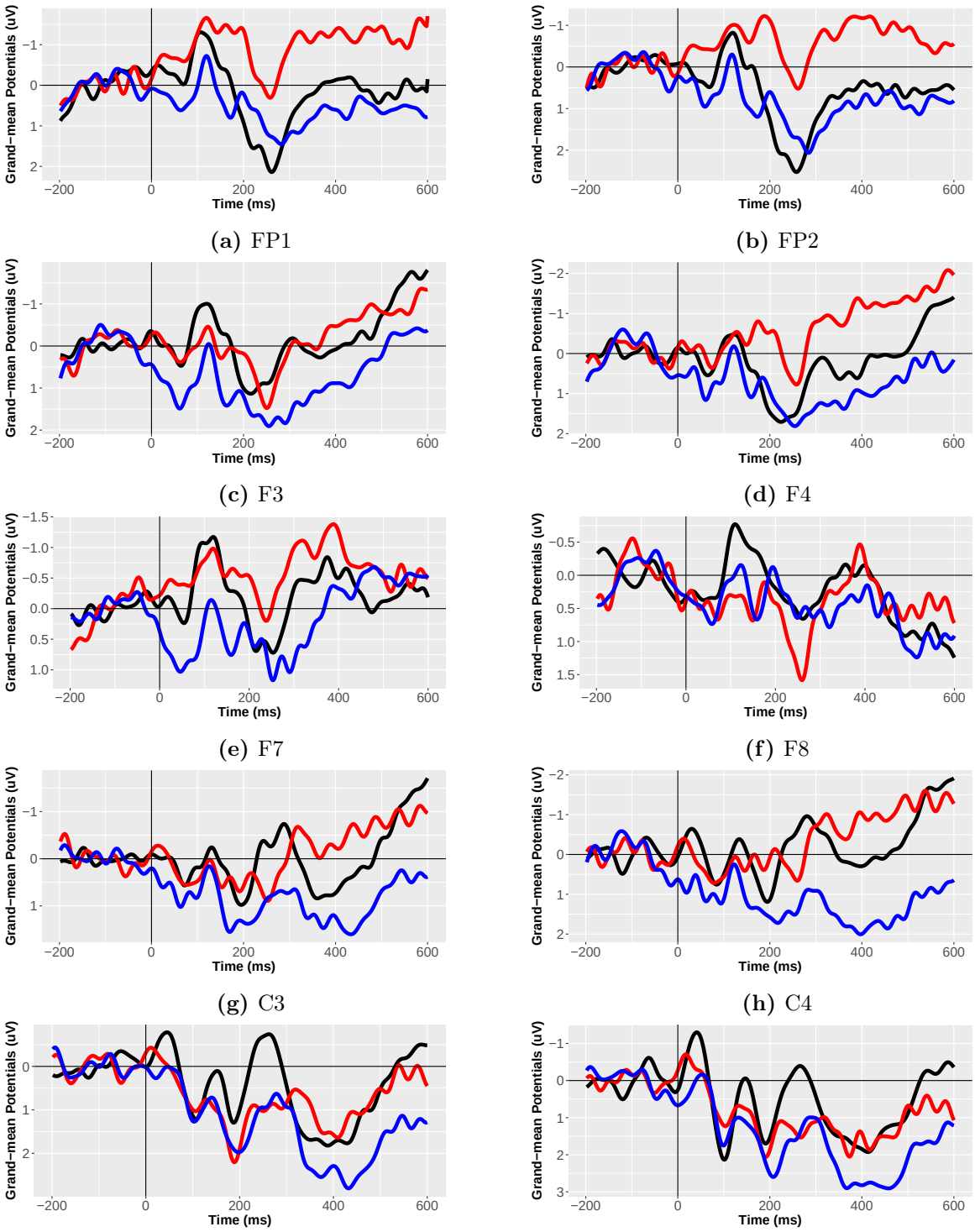
	Kruskal-Wallis Main Effects			Non-parametric multiple comparisons					
				CON vs MAP		CON vs SCZ		MAP vs SCZ	
Behavioural Response Measure	**Chi-squared**	**df**	**p-value**	**Statistic**	**p-value**	**Statistic**	**p-value**	**Statistic**	**p-value**
Target Responses (count)	15.073	2	**0.0005***	**-3.87**	**0.0008***	**-3.65**	**0.0021***	-1.10	0.5397
Delayed Target Responses (count)	13.683	2	**0.0011***	**3.63**	**0.0022***	**3.49**	**0.0029***	0.61	0.8456
Total Correct Responses (count)	18.206	2	**0.0001***	**-4.88**	**<0.0001***	**-4.03**	**<0.0001***	-0.99	0.6108
Reaction Times (ms)	13.815	2	**0.0010***	**2.76**	**0.02406***	**3.88**	**0.0012***	1.26	0.4337
Omission of Target <500ms (count)	15.073	2	**0.0005***	**3.87**	**0.0008***	**3.65**	**0.0015***	1.10	0.5396
Omission of Target <1s (count)	12.147	2	**0.0023***	0.99	0.6000	**4.04**	**0.0005***	2.19	0.0850
S2 Responses (count)	7.6106	2	**0.0222***	**2.93**	**0.0145***	1.97	0.1335	-0.69	0.7799
Trick S Responses (count)	4.47	2	0.1069						
Other Non-Target Responses (count)	17.746	2	**0.0001***	**4.36**	**0.0001***	**4.17**	**0.0003***	0.58	0.8635

* $p < 0.05$

5.4.2 S1 ERP Measures

For the S1 stimulus, the traces for grand-mean potentials are presented in Figure 5.5.

In response to the S1 stimulus, the schizophrenia group showed significantly less negative prefrontal N100 amplitude (response window 75∼150ms) than the MAP and control group at FP2 (MAP: -2.59μV(-8.38μV, 3.99μV); schizophrenia: -0.39μV(-4.37μV, 2.05μV); $p < 0.05$) (Figure 5.6),



(a) FP1 (b) FP2

(c) F3 (d) F4

(e) F7 (f) F8

(g) C3 (h) C4

(i) P3 (j) P4

Figure 5.5 – Grand mean averages in response to S1 stimuli. Averages for all groups 200ms before S1 stimulus presentation at Time=0ms and 600ms after stimulus presentation are presented for each electrode position individually. controls=black, MAP=red, schizophrenia=blue

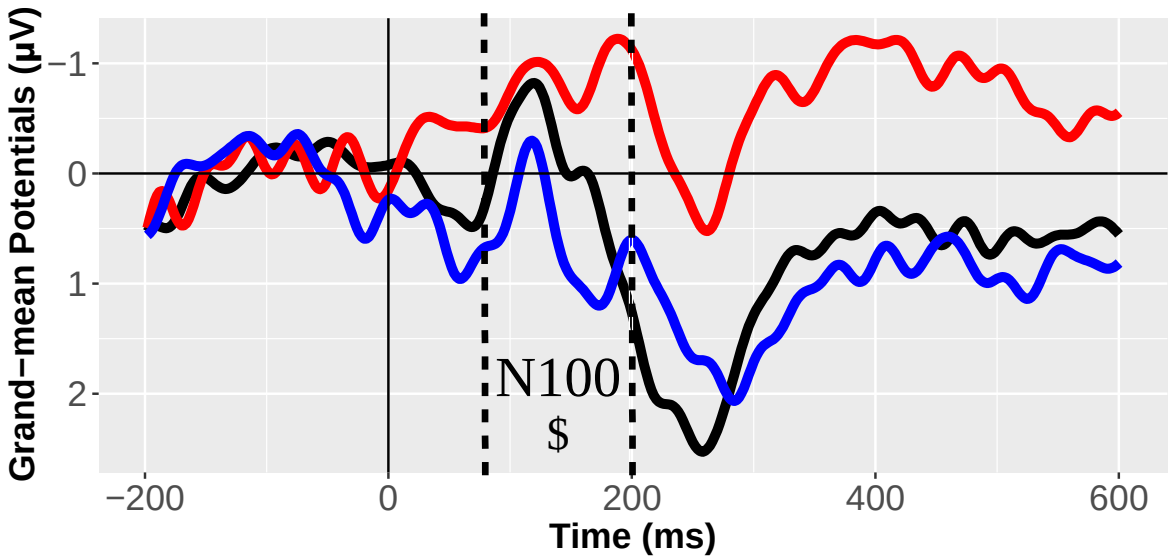
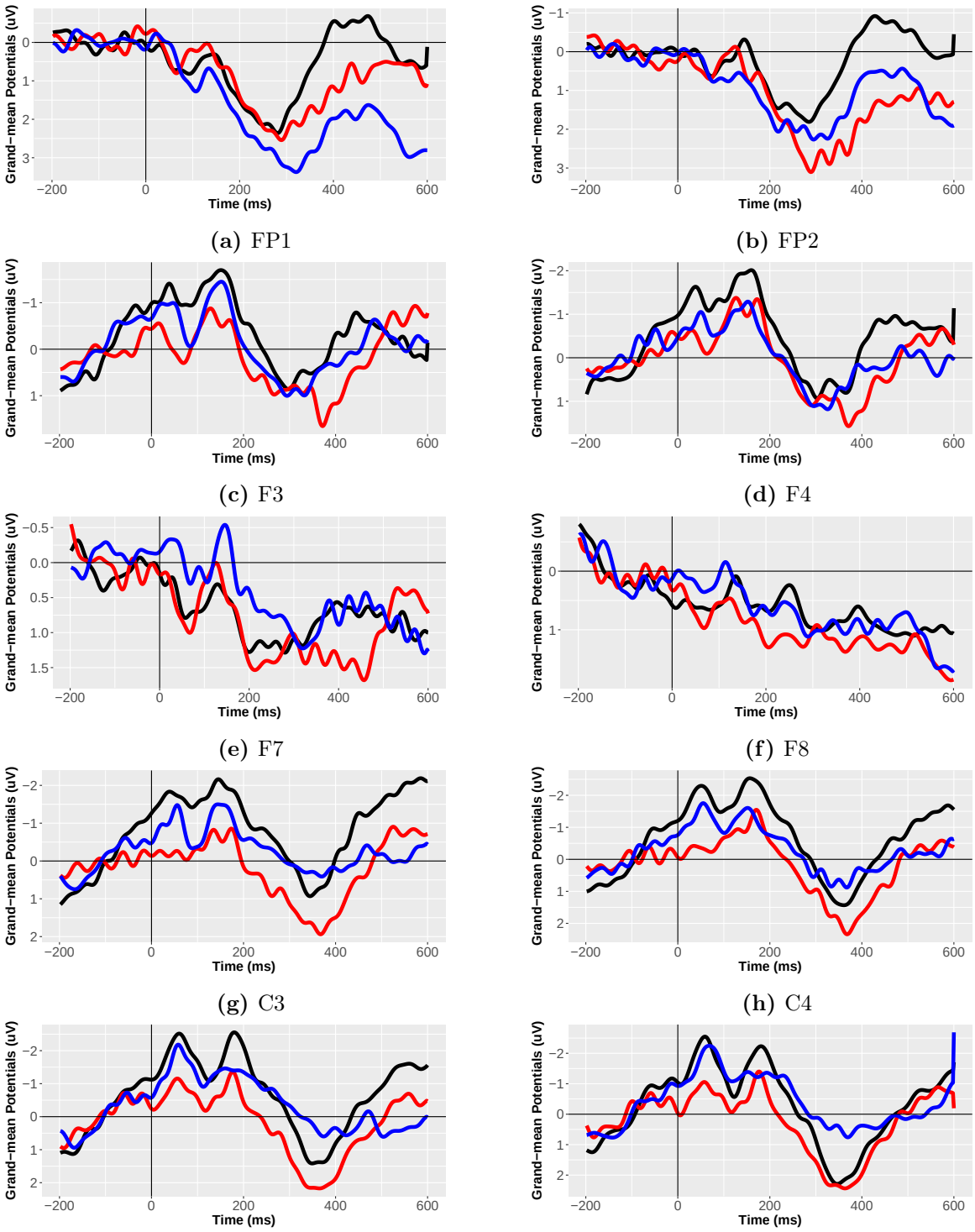


Figure 5.6 – Prefrontal N100 Amplitudes (μV) in response to S1 stimuli. Base-to-peak amplitude in the window from 75∼150ms at FP2, where schizophrenia had significantly less negative amplitude than MAP and controls; * indicates schizophrenia vs controls p <0.05; $ indicates MAP vs schizophrenia p <0.05. controls=black, MAP=red, schizophrenia=blue

5.4.3 S2 ERP Measures

For the S2 stimulus, the traces for grand-mean potentials are presented in Figure 5.7.

In response to the S2 stimulus, the MAP group showed a significantly less negative N100 amplitude (response window 40∼120ms) than controls at C3 (controls: -2.88μV(-6.16μV, 0.59μV; MAP: -1.5μV(-4.67μV, 2.11μV); p <0.05) (Figure 5.8) and a significantly shorter P300 latencies-to-peak (response window 250∼500ms) compared to the schizophrenia group at P3 (MAP: 352ms(250ms, 488ms); schizophrenia: 437ms(250ms, 500ms); p <0.05), with the pattern indicating a shorter latency for MAP and a longer latency for schizophrenia as compared to the control group (Figure 5.9).



(a) FP1 (b) FP2

(c) F3 (d) F4

(e) F7 (f) F8

(g) C3 (h) C4

(i) P3 (j) P4

Figure 5.7 – Grand mean averages for S2 stimuli. Averages for all groups 200ms before S2 stimulus presentation at Time=0ms and 600ms after stimulus presentation are presented for each electrode position individually. controls=black, MAP=red, schizophrenia=blue

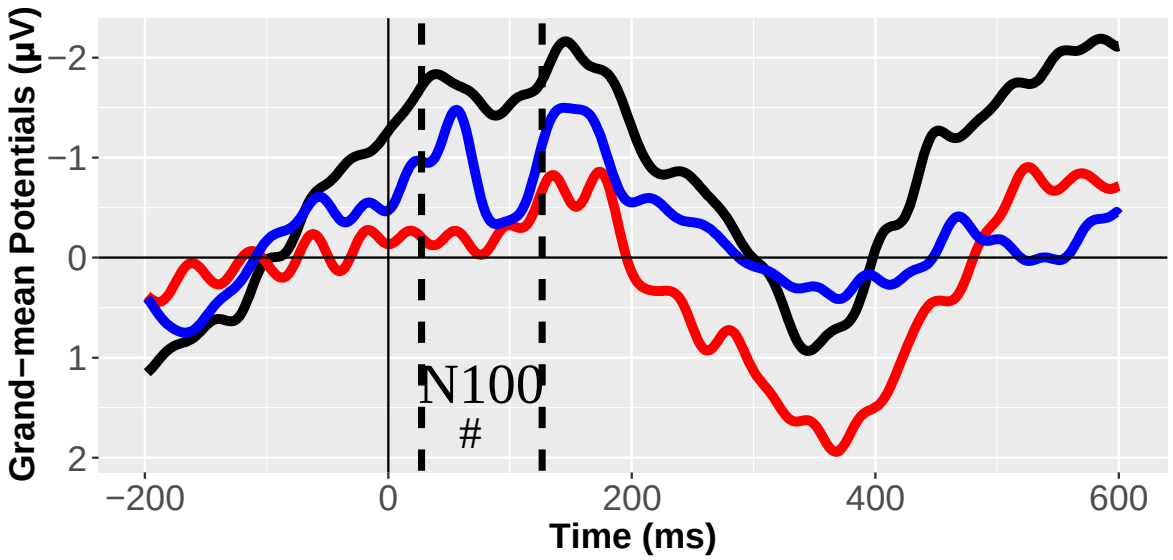


Figure 5.8 – N100 Amplitude (μV) in response to S2 stimuli. Base-to-peak amplitude in the window from 0∼120ms at C3, where MAP had significantly less negative amplitude than controls; # indicates MAP vs controls p <0.05. controls=black, MAP=red, schizophrenia=blue

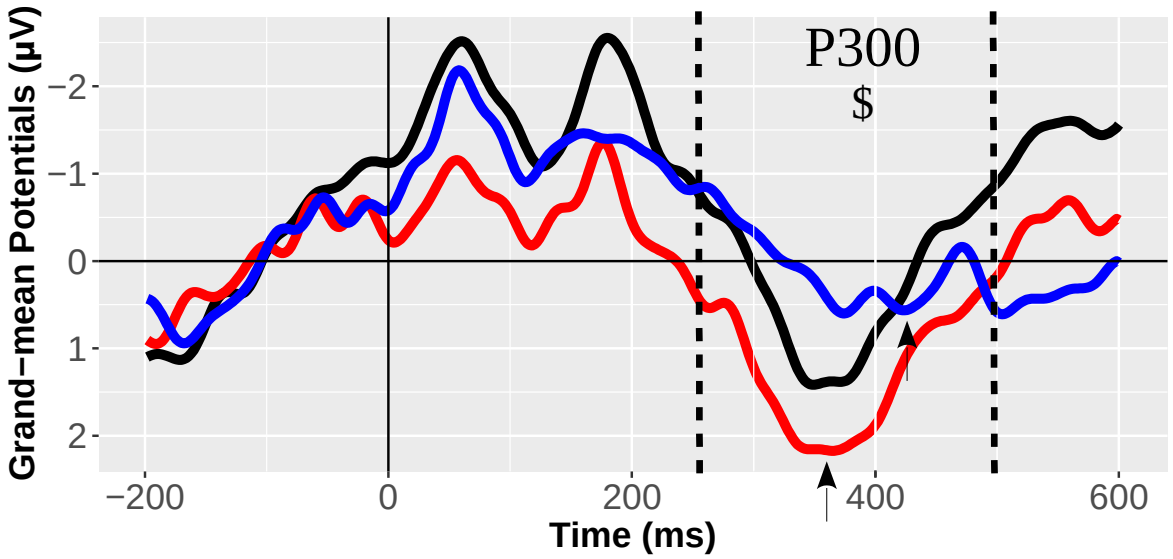
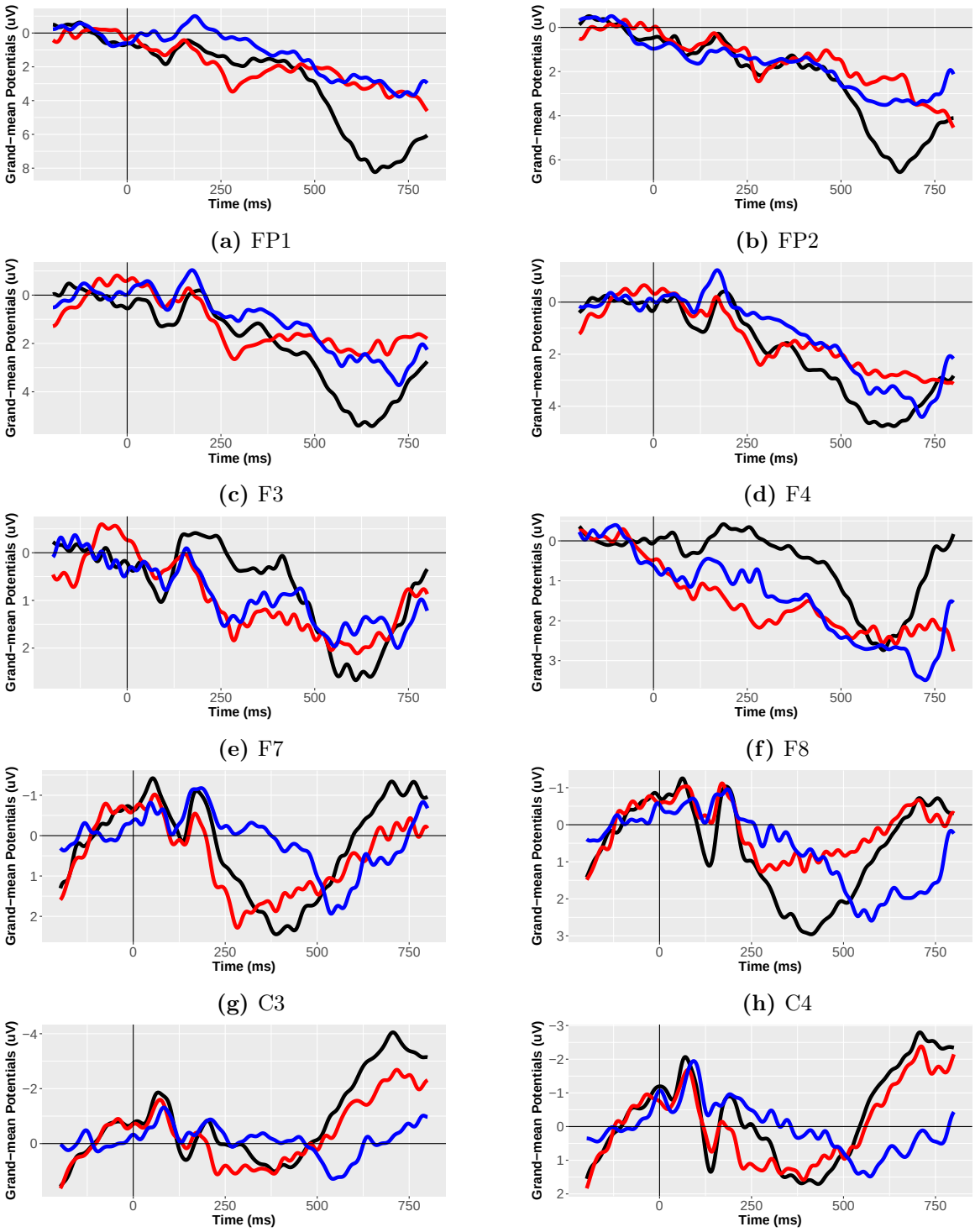


Figure 5.9 – P300 latencies (μV) in response to S2 stimuli. Base-to-peak latencies in the window from 250∼500ms at P3 , where schizophrenia had significantly longer latencies than MAP, and a tendency for a longer latency than controls (p=0.069); $ indicates MAP vs schizophrenia p <0.05. controls=black, MAP=red, schizophrenia=blue

5.4.4 S3 ERP Measures

For the S3 stimulus, the traces for grand-mean potentials are presented in Figure 5.10.

In response to the Target S3 stimulus, parietal N100 latencies (response window 50∼110ms) were significantly longer in the schizophrenia compared to both MAP and controls at P4 (controls: 72ms(50ms, 110ms), controls vs schizophrenia p <0.05; MAP: 75ms(50ms, 110ms), MAP vs schizophrenia, p <0.05; schizophrenia: 90ms(50ms, 110ms)(Figure 5.11).



(a) FP1 (b) FP2

(c) F3 (d) F4

(e) F7 (f) F8

(g) C3 (h) C4

(i) P3 (j) P4

Figure 5.10 – Grand mean averages for S3 stimuli. Averages for all groups 200ms before S3 stimulus presentation at Time=0ms and 800ms after stimulus presentation are presented for each electrode position individually. controls=black, MAP=red, schizophrenia=blue

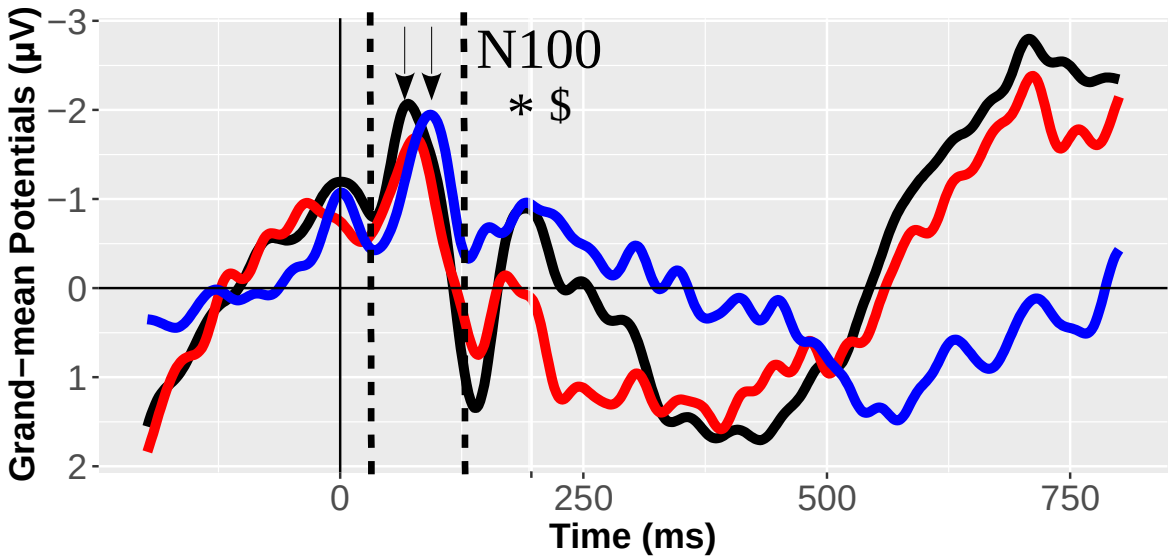


Figure 5.11 – N100 latency (ms) in response to S3 stimuli. Base-to-peak latencies in the window from 50∼110ms at P4, where schizophrenia had significantly longer latencies than MAP and controls; * indicates schizophrenia vs controls p <0.05; $ indicates MAP vs schizophrenia p <0.05. controls=black, MAP=red, schizophrenia=blue

5.4.5 Trick S ERP Measures

For the TS stimulus, the traces for grand-mean potentials are presented in Figure 5.12.

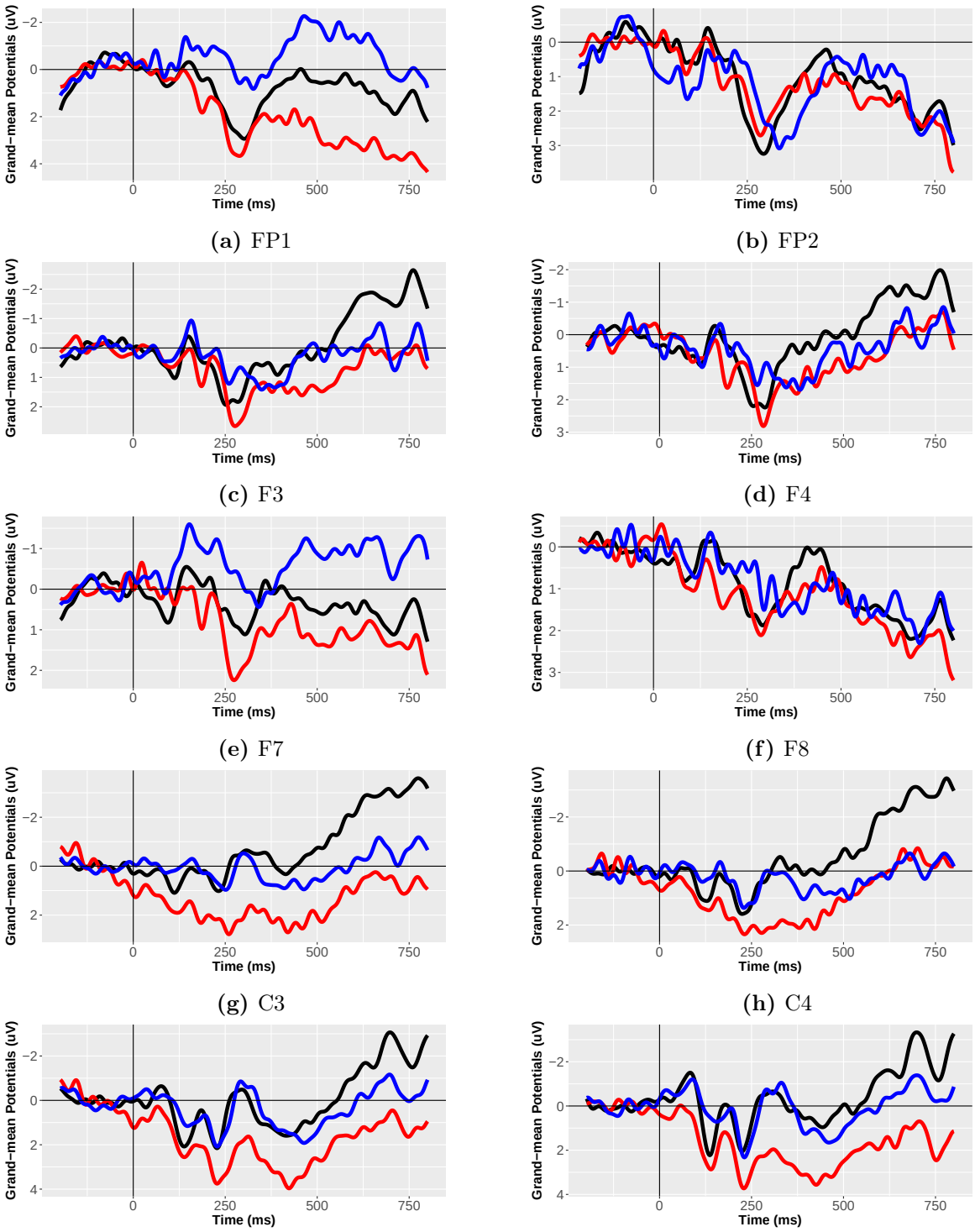
In response to the Trick S stimulus, the MAP group showed a significantly less negative N100 amplitude at P4 (response window 50∼150ms) than schizophrenia at P4 (MAP: -1.01μV(-5.24μV, 2.54μV); schizophrenia: -2.71μV(-7.52μV, 3.15μV); p <0.05), and significantly shorter latency in the MAP compared to schizophrenia (MAP: 63ms(50ms, 106ms; schizophrenia: 90ms(50ms, 138ms, p <0.05) (Figure 5.13).

N100 latencies at FP1 (response window 100∼200ms) were also significantly shorter in MAP than both controls and schizophrenia (controls: 150ms(100ms, 200ms); MAP: 132ms(100ms, 132ms), controls vs MAP, p <0.05; schizophrenia: 148ms(128ms, 200ms), MAP vs schizophrenia p <0.001) (Figure 5.14).

P200 amplitudes (response window 175∼300ms) in MAP were significantly more positive than both controls and schizophrenia at C3 (MAP: 0.3μV(0.28μV, 10.32μV); controls: 1.47μV(-0.96μV, 6.94μV); schizophrenia: 1.89μV(-1.78μV, 10.13μV); p <0.05). P300 amplitudes (response window 300∼650ms) were also significantly more positive in MAP than controls (MAP: 3.78μV(-1.05μV, 11.61μV); controls: 2.09μV(-4.11μV, 6.38μV); p <0.05) (Figure 5.15). Similarly at P4, P200 and P300 amplitudes were significantly more positive in MAP than controls (Figure 5.16).

N200 amplitudes (response window 150∼250ms) in MAP were significantly less negative than schizophrenia at P3 (MAP: 0.3μV(-1.81μV, 3.74μV); schizophrenia: -1.3μV(-6.91μV, 6.72μV); p <0.05) (Figure 5.17).

P300 amplitudes at FP1 (response window 200∼450ms) were significantly higher in MAP than schizophrenia (MAP: 5.07μV(-0.19μV, 10.95μV); schizophrenia: 1.82μV(-3.1μV, 12.61μV); p <0.05) (Figure 5.18). P300 latencies at FP2 (response window 200∼450ms) were significantly longer in schizophrenia than controls (controls: 292ms(230ms, 450ms); schizophrenia: 336ms(208ms, 450ms), p <0.01) (Figure 5.19).



(a) FP1 (b) FP2

(c) F3 (d) F4

(e) F7 (f) F8

(g) C3 (h) C4

(i) P3 (j) P4

Figure 5.12 – Grand mean averages for Trick S stimuli. Averages for all groups 200ms before Trick S stimulus presentation at Time=0ms and 800ms after stimulus presentation are presented for each electrode position individually. controls=black, MAP=red, schizophrenia=blue

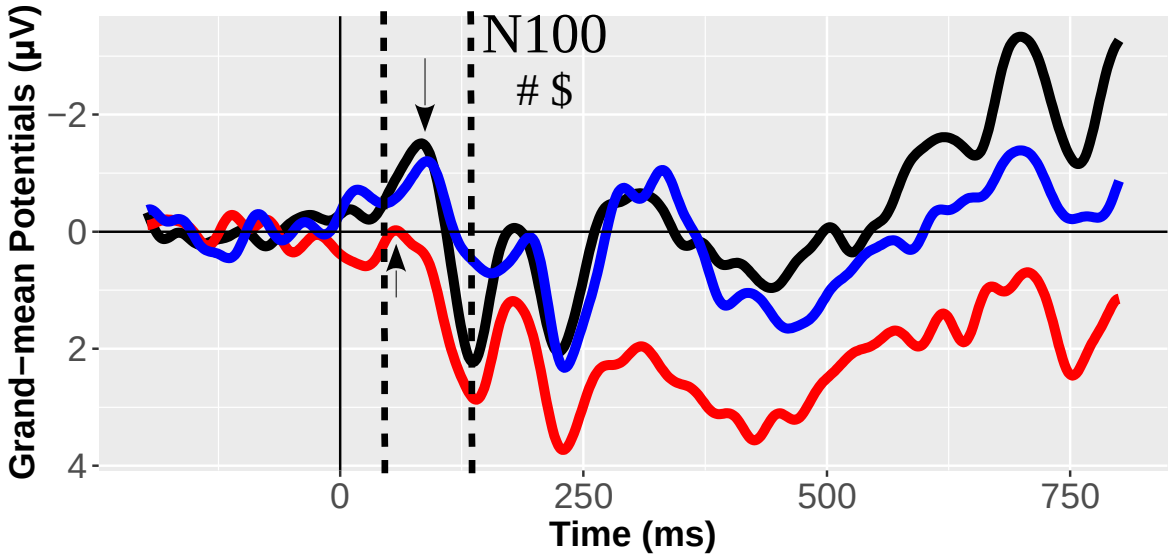


Figure 5.13 – N100 amplitude (μV) and latency (ms) in response to Trick S stimuli. In the window from 50∼150ms at P4 shows MAP had significantly less negative amplitudes than schizophrenia, and a tendency for less negative amplitudes than controls (p=0.061), as well as significantly shorter latencies than schizophrenia; # indicates MAP vs controls p <0.05; $ indicates MAP vs schizophrenia p <0.05. controls=black, MAP=red, schizophrenia=blue

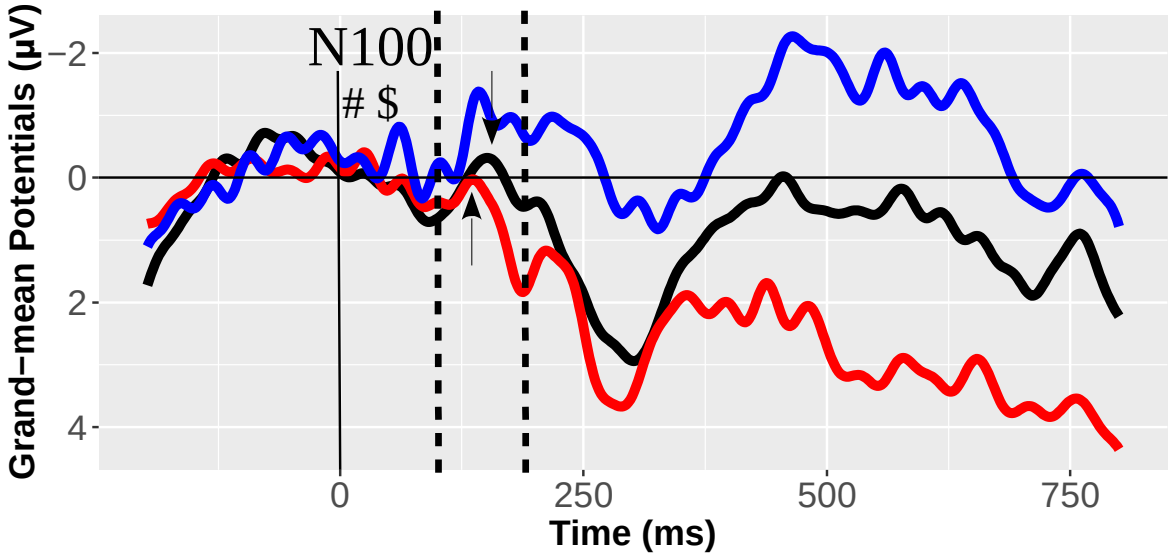


Figure 5.14 – N100 latencies (ms) in response to Trick S stimuli. Base-to-peak latencies in the window from 100∼200ms at FP1, where MAP had significantly shorter latencies than both controls and schizophrenia; # indicates MAP vs controls p <0.05; $ indicates MAP vs schizophrenia p <0.05. controls=black, MAP=red, schizophrenia=blue

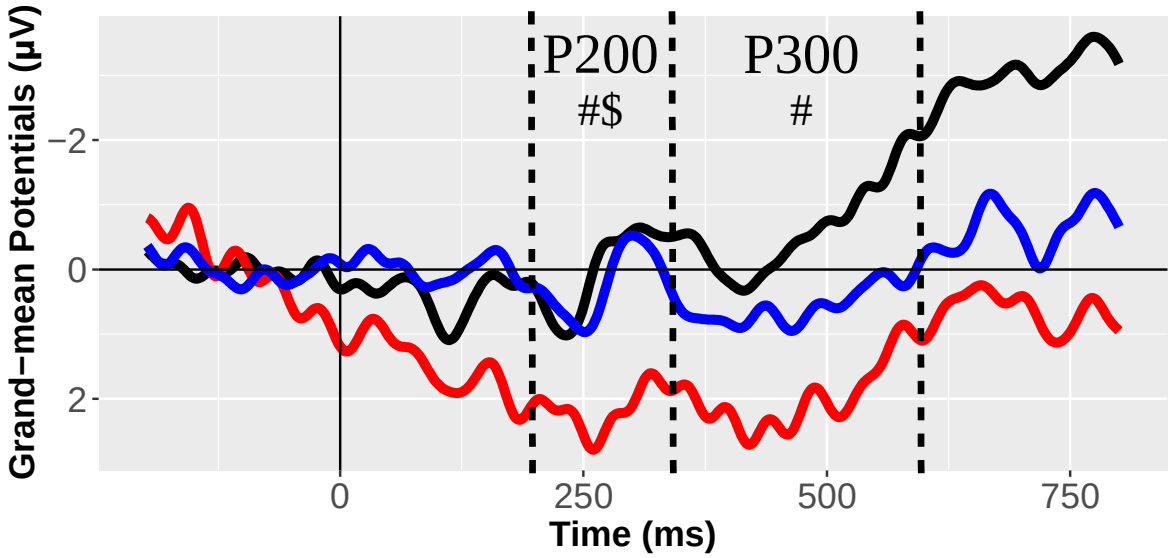


Figure 5.15 – P200 amplitudes (μV) in response to Trick S stimuli. Base-to-peak amplitudes in the window from 175∼300ms at C3, where MAP had significantly more positive amplitudes than schizophrenia and controls. P300 amplitudes (μV) in the window from 300∼600ms were also significantly more positive in MAP than controls; # indicates MAP vs controls p <0.05; $ indicates MAP vs schizophrenia p <0.05. controls=black, MAP=red, schizophrenia=blue

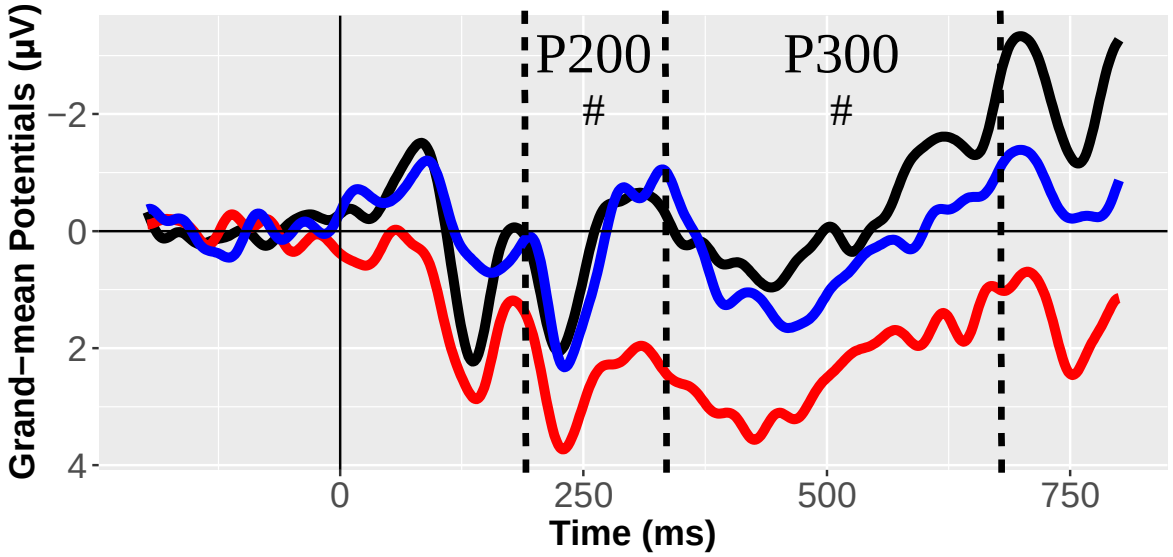


Figure 5.16 – P200 amplitudes (μV) in response to Trick S stimuli. Base-to-peak amplitudes in the window from 200∼300ms at P4, where MAP had significantly more positive amplitudes than controls. P300 amplitudes (μV) in the window from 300∼650ms were also significantly more positive in MAP than controls; # indicates MAP vs controls p <0.05. controls=black, MAP=red, schizophrenia=blue

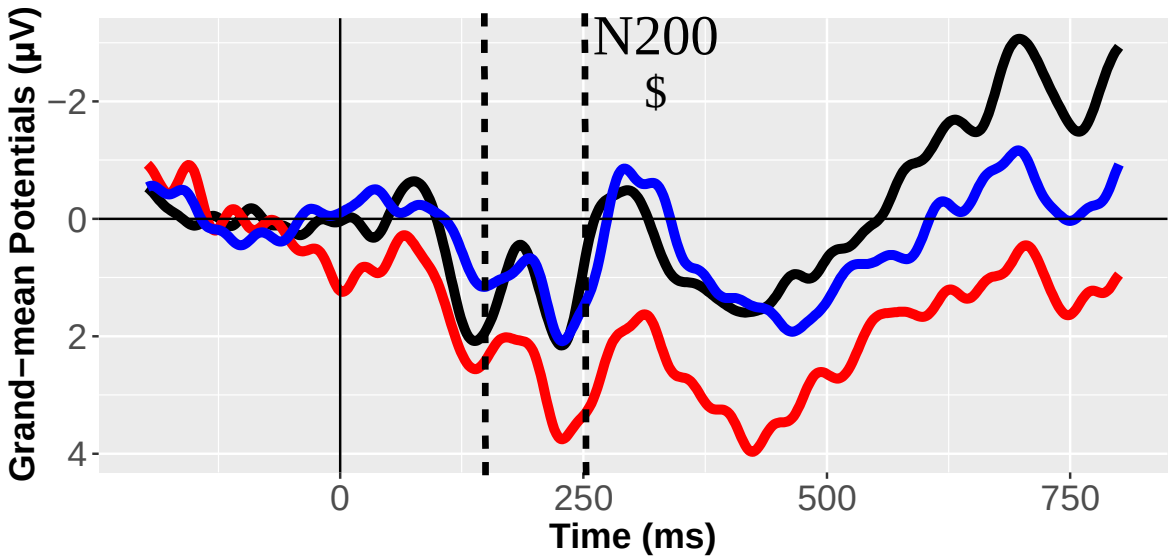


Figure 5.17 – N200 amplitudes (μV) in response to Trick S stimuli. Base-to-peak amplitudes in the window from 150∼250ms at P3, where MAP had significantly less negative amplitudes than schizophrenia, and a tendency for less negative amplitudes than controls (p=0.063); $ indicates MAP vs schizophrenia p <0.05. controls=black, MAP=red, schizophrenia=blue

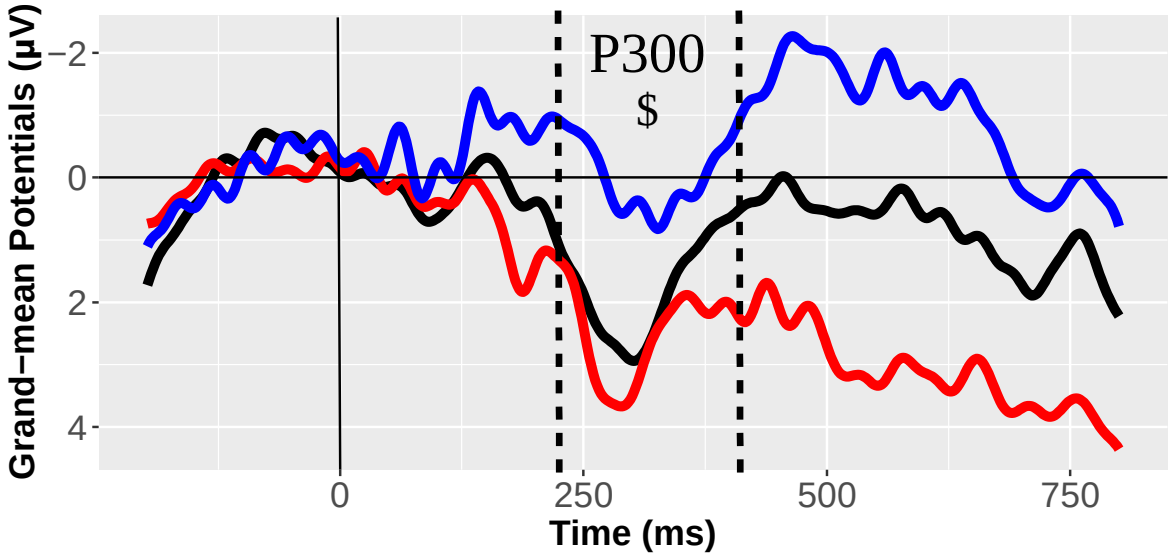


Figure 5.18 – P300 amplitudes (μV) in response to Trick S stimuli. Base-to-peak amplitudes in the window from 200∼450ms at FP1, where MAP had significantly higher amplitudes than schizophrenia; $ indicates MAP vs schizophrenia p <0.05. controls=black, MAP=red, schizophrenia=blue

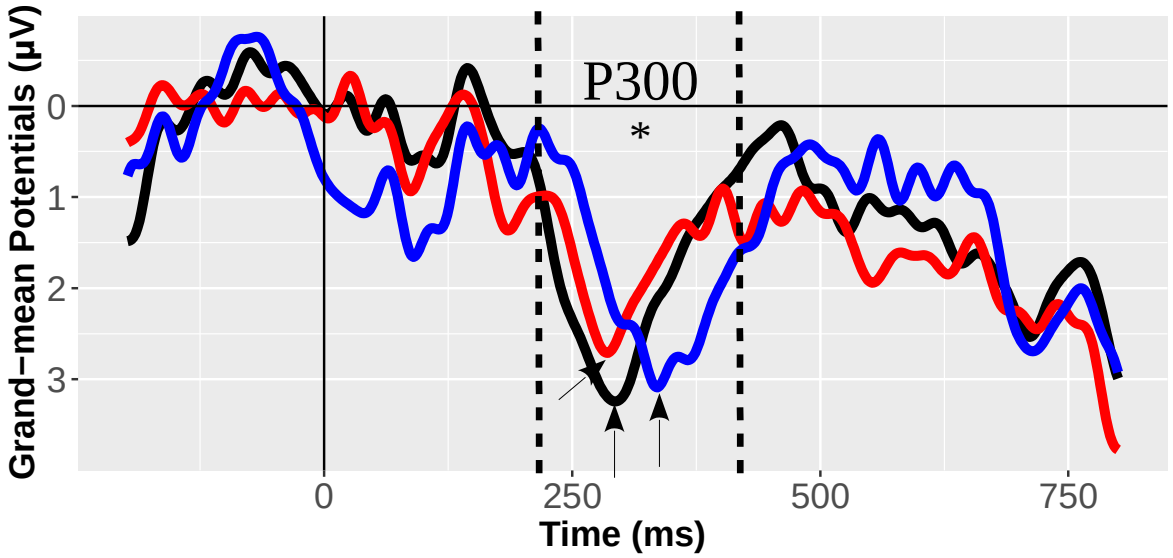


Figure 5.19 – P300 latencies (ms) in response to Trick S stimuli. Base-to-peak latencies in the window from 200∼450ms at FP2, where schizophrenia had significantly longer latencies than controls; * indicates schizophrenia vs controls p <0.05. controls=black, MAP=red, schizophrenia=blue

5.5 Discussion

The main findings in this chapter were first, poorer behavioural performance in both MAP and schizophrenia groups compared to controls; second, smaller N100 amplitudes in both MAP and schizophrenia groups compared to controls; third, larger P200, N200 and P300 amplitudes in MAP compared to the other two groups; and fourth, longer P300 latencies in the schizophrenia group compared to the other two groups. The results showed more differences in ERP characteristics between the MAP and schizophrenia groups than initially hypothesized.

5.5.1 CPT Behavioural Performance

There was poorer behavioural performance on the CPT in both MAP and schizophrenia groups compared to the controls. Both MAP and schizophrenia groups gave fewer on-target responses, while giving more delayed, omitted and non-target responses. These results are consistent with wide literature reporting CPT performance in schizophrenia, and auditory oddball task performance in MAP, already reviewed in the Introduction section of this chapter (Iwanami et al., 1993; Chen et al., 1997; Liu et al., 2000; Birkett et al., 2007; Demeter, 2011; Sepede et al., 2014). Our CPT task however included a second repeated cue (S2) prior to the target (S3), which has not been used to study MAP in comparison with schizophrenia. MAP responded significantly more often to the S2 stimulus than controls and schizophrenia groups. These behavioural results suggest that, while both groups may have deficiencies in target detection, and/or producing appropriate behavioural responses to targets, MAP may have a more severe deficit of impaired inhibition control than schizophrenia.

5.5.2 N100

The main observations for the N100 component are smaller N100 amplitudes for the MAP in response to the S2 at the C3 electrode and Trick S at the P4 electrode, and also a smaller N100 amplitude for schizophrenia group in response to S1 at the FP2 electrode.

The results in the MAP group support previous studies that found smaller area under the curve of the MAP N100 in comparison to controls, in response to the target of a standard auditory oddball task, with the authors suggesting similar sensory processing difficulties in MAP and schizophrenia

(Iwanami et al., 1993, 1995). Even though the target of a standard auditory oddball task is not directly comparable to any of our stimuli, there were smaller N100 amplitudes to the Trick S, and a striking loss of any N100 deflection in response to the S2 in MAP, indicating a more severe decrease in N100 in MAP than SCZ when compared to controls. Since larger N100 amplitudes have been associated with greater ACC activity (Pardo et al., 1990; Paus et al., 1993, 1998; Mulert et al., 2008), and poor DLPFC and ACC integrity have been reported in both acute MA abuse and MAP (Howells et al., 2014; Burger et al., 2018); the lack of an N100 deflection in the MAP group, along with increased behavioural response to S2, provides further evidence for lower ACC activity in MAP. Results in the schizophrenia group also support that of previous studies that had also found smaller N100 amplitudes (Ogura et al., 1991; Brown et al., 2002; Mulert et al., 2005, 2008; Rosburg et al., 2008; Brenner et al., 2009; van Tricht et al., 2011), suggesting that both the MAP and schizophrenia groups may have a dysfunction of the ACC within the TC loop, that likely involves ACh transmission (Mulert et al., 2008; Caldenhove et al., 2017).

Larger N100 amplitudes have also been observed with the inhibition of the M1 mACh receptor, by administration of biperiden (Caldenhove et al., 2017), suggesting the corollary that the activation of M1 receptors may result in smaller N100 amplitudes. Activation of M1 receptors strongly inhibits $Ca_v3.3$ T-type Ca^{2+} channels (Hildebrand et al., 2007), which is necessary to close K^+ channels, depolarise membrane potential (Bista et al., 2012), and allow TC neurons to switch from burst mode to tonic firing mode (McCormick and Bal, 1997). TC neurons in tonic firing mode are more sensitive to stimuli and promote alertness. Alternatively, $Ca_v3.3$ channel activity could also be intrinsically lower in schizophrenia due to mutations in the CACNA1I gene (Perez-Reyes, 2006; Irish Schizophrenia Genomics and The Wellcome Trust Case Control C., 2012; Hamshere et al., 2013; Schizophrenia Psychiatric Genome-Wide Association Study (GWAS) Consortium, 2014; Monteil et al., 2015; Xu et al., 2018). Thus, whether by increased M1 receptor activation or genetic predisposition, lower $Ca_v3.3$ activity may be associated with a smaller N100 amplitude, and a poorer inhibition control. It is unknown whether MAP may have similar mutations in T-type channels as schizophrenia, and this finding suggests that it may be a constructive line of future research.

5.5.3 P200

This is the first report of P200 results in MAP. The main observation is a larger amplitude in the MAP than controls and/or schizophrenia, at C3 and P4 electrodes, in response to the Trick S. Previous studies of P200 performed in schizophrenia compared to healthy controls have found larger P200 amplitudes in response to either only rare stimuli (Brown et al., 2002; Ferreira-Santos et al., 2012), or to both rare and common stimuli (Ogura et al., 1991). The results show that MAP P200 amplitudes are even larger than that of schizophrenia.

The particular involvement of the M1 mAChRs in the generation of the P200 ERP was proposed in the P200 subsection of this chapter's introduction (page 121). The same study that had administered biperiden and found increased in N100 amplitude by M1 mAChR *blockade*, also found decreased the P200 amplitude response to uncommon stimuli (Caldenhove et al., 2017). These observations would thus suggest increased M1 mAChR *activation* in MAP, considering the smaller N100 and larger P200 amplitudes.

There has not been any research about M1 receptors in MAP, but animal studies have shown that MA has a strong and direct influence on the ACh system. For example in mice i.p. injections of 2 and 5mg/kg of MA produces a strong but short duration increase in DA as measured by microdialysis in the VTA, and also a prolonged increase in ACh, of which only ACh was dose dependently associated with locomotor activity. The increase of extracellular ACh in the VTA is thought to originate from the PPN (Dobbs and Mark, 2008). Long term MA exposure of 5mg/kg from post natal day 11 to day 21 in mice found decreased cognitive performance in a variety of behavioural measures, and also an increase in M1 mAChR expression in the hippocampus (Siegel et al., 2010). MA exposure of mice while in utero increased the density of ACh neurons in the BF and hippocampus, and increased mAChR expression in the hippocampus (Siegel et al., 2011).

Since MAP develops as a result of MA exposure, the animal studies showing increased M1 receptor expression in the hippocampus (Siegel et al., 2010, 2011) suggests that this may be the site where ACh activity occurs in excess in MAP. Of course mouse studies are not directly translatable to humans, MA exposure in utero can also cause hippocampal-dependent cognitive deficiencies in children (Little et al., 1988; Chang et al., 2004, 2009; Piper et al., 2011), and patients with MAP

may have smaller hippocampal volumes (Orikabe et al., 2011). Thus the P200 results would support further research toward M1 receptors in the hippocampus of MAP.

5.5.4 N200

This is the first report of N200 results in MAP. The main observation is a smaller amplitude in the MAP than schizophrenia and control groups at the P3 location in response to the Trick S.

Smaller N200 amplitudes have been observed in schizophrenia (O'Donnell et al., 1993; Salisbury et al., 1994; Brown et al., 2002), as well as acute MA administration (Silber et al., 2012), as compared to healthy controls and placebo respectively. This finding of an even smaller N200 amplitude in MAP as compared to the schizophrenia group suggests a more severe dysfunction in conflict monitoring for MAP.

The smaller N200 amplitude in MAP suggests D_2 receptor (Takeshita and Ogura, 1994) and ACC (Heil et al., 2000; Donkers and Van Boxtel, 2004; Van Veen and Carter, 2002; Groom and Cragg, 2015) dysfunction, which is consistent with the implications of ACC dysfunction from the N100 results above.

5.5.5 P300

The main observations for the P300 component are first, larger P300 amplitudes in MAP in response to Trick S at FP1, and second, longer latency in schizophrenia in response to the S2 stimulus at P3 and Trick S stimulus at FP2.

The larger P300 amplitude in MAP in the pre-frontal area in response to Trick S found in this study appears to be in contrast with results from 3 previous studies, which had observed smaller P300 amplitudes in MAP compared to healthy controls (Iwanami et al., 1991, 1993, 1994a). However, those studies were performed using the standard oddball task, which does not activate inhibition networks that Trick S would, and thus these results may not be entirely contradictory. The results of the N100 amplitudes above had been similar to those performed by the Iwanami group in MAP, however since N100 is more involved with conflict detection, and P300 more involved with response inhibition, it is plausible that the requirement for inhibition to a stimulus may result in a different P300 profile in MAP than to the target of an oddball task.

Larger P300 amplitudes have generally been associated with increased arousal (Rozenkrants and Polich, 2008), and increased stress (Kozlowska et al., 2017), which could suggest that MAP experienced a higher level of stress or arousal than the other groups. This is however unlikely, since the frequency power results between the MAP and schizophrenia groups were almost identical in the previous chapter, and has been attributed largely to to NE, DA and TC effects.

The combination of ERP results for MAP however, considering a smaller N100, larger P200 and larger P300 are the exact opposite pattern of what occurs after healthy participants were administered biperiden, an M1 mAChR blocker (Caldenhove et al., 2017). In addition, ACh agonist administration resulted in larger P300 amplitudes (Münte et al., 1988). Thus, perhaps the larger P300 amplitude in MAP could be due to increased M1 activity.

The larger P300 occurred at a left frontal electrode in MA. A study in macaques showed that M1 stimulation led to consistently poor performance of a working memory task requiring maintenance of rule representations in the PFC (Vijayraghavan et al., 2018). In the DLPFC of macaques, M1 receptors are largely expressed in the pyramidal neurons of layers III, V and VI, which largely receive signals from TC neurons or other cortical neurons, and not cholinergic cells. In fact, few ACh synapses actually terminate directly onto dendritic spines in the cortex (Beaulieu and Somogyi, 1991; Aoki and Kabak, 1992). However, ACh released by a nearby neuron may diffuse, and activate post synaptic of M1 receptors, which increases the excitability to the cortical cells to their thalamic and cortical inputs (McCormick, 1992; Mrzljak et al., 1993). This is interesting because larger P300 amplitudes have been associated with neural compensation for cognitive decline in participants with high risk of developing AD in an oddball task (Boutros et al., 1995). It is possible that the DLPFC in MAP may also be compensating for cognitive decline.

For the schizophrenia group, these results agree with the literature which has largely found longer P300 latencies in schizophrenia as compared to healthy controls (Roth, 1977; Begleiter et al., 1986; McCarley et al., 1991; Yamaguchi and Knight, 1991; Martın-Loeches et al., 2001; Daffner et al., 2003; Jeon and Polich, 2003; Bramon et al., 2004; Ertekin et al., 2017). P300 amplitudes were not smaller in response to any stimuli for schizophrenia as compared to controls, which is also often reported in the literature (Jeon and Polich, 2003; Bramon et al., 2004; Fusar-Poli et al., 2011), however P300 latency has been shown to be a more reliable metric when determining endophenotype for schizophrenia than the P300 amplitude (Martın-Loeches et al., 2001; Bramon

et al., 2005; Kim et al., 2017). Longer P300 latencies likely reflects decreased cognitive processing speeds (Kutas et al., 1977; Magliero et al., 1984; Polich, 2007), potentially due to impaired function in the thalamus (Klostermann et al., 2006) and/or TRN (Ferrarelli and Tononi, 2010; Pergola et al., 2015; Pratt and Morris, 2015; Young and Wimmer, 2017), and/or decrements in the DA, NE and ACh networks in schizophrenia as detailed in the introduction chapter.

5.5.6 Limitations

Several limitations require emphasis. First, similar to the previous two chapters, with the main drawback was small sample numbers and the inability to perform adequate statistical corrections for potentially important variables such as individual medication combinations, and the inability to match MAP and schizophrenia participants for duration of illness, and thus violating ANCOVA assumptions for such statistical corrections. These were performed, but only presented in the appendices.

Second, the in-house CPT task developed by our group has not been used by others, and thus direct comparison with results from other studies may not be possible. For example, the S3 target in this study is unlike the target for the oddball task, since the oddball target is inherently different from the other standard stimuli, while the target in our task is the third repetition of the same stimulus, which results in habituation, which is associated with smaller P300 amplitudes than those generated by an odd/rare stimulus. This study did not however examine the change in P300 amplitudes between different stimuli, and can thus not make any conclusions regarding the effect of habituation. The focus of the study however was not on the target, but rather on the inhibitory responses to the other stimuli which was most optimally generated by making the target and distractor stimuli identical.

Third, the different ERP patterns between S1 and Trick S is very difficult to explain. The main observation of difference in neural response was a smaller N100 amplitude in the schizophrenia compared to other groups, while the Trick S elicited N100, P200, N200 and P300 amplitude changes in the MAP group. However, both stimuli are the first presentation of a salient stimulus following a string of irrelevant stimuli. Even though S1 was followed by S2, and Trick S was followed by another irrelevant stimulus, these next stimuli appear 600 ms post the initial presentation of S1 and Trick S. I would have expected that the group differences in response to each of these

stimuli to be identical, however this was not observed, and it is unclear as to why this may be the case. In a study of P50 sensory gating, it was found that a single presentation of the stimulus produced a larger P50 amplitude compared to the P50 elicited by either S1 or S2 of a paired click task (Guterman et al., 1992). Even though the P50 was not included as part of this thesis, this study is relevant for its finding where a single presentation of the stimulus produces a different response to the same stimulus when it is presented as the first of a pair. The authors of this study were interested in the effect of task manipulation on single and paired presentations of stimuli, and found that the P50 amplitude for single presentations were not task dependent, while the amplitude for the paired P50 amplitudes changed depending on whether or not a behavioural response was required for S2. However, the authors did not provide a possible explanation for the larger P50 amplitude compared to the S1 stimulus, even though (like the Trick S and S1 stimuli in the case of the thesis) these stimuli were preceded by the same irrelevant tones (Guterman et al., 1992). This is an interesting question, since it suggests that the neural response to a given stimulus may be influenced by the *subsequent* stimulus, which brings into question the timing of what the EEG may be recording compared to what may have already occurred elsewhere in the brain in response to the previous, current, and subsequent stimuli.

6 Conclusions

This study compared overlaps and differences in cortical and subcortical mechanisms of attention networks between MAP and schizophrenia. I used TMS with the CSP paradigm, EEG frequency power at rest and in the change between resting states, and EEG with concurrent CPT performance to record ERP data in response to salient stimuli. These techniques allowed me to examine cortical inhibition and excitation, resting neural rhythmic activity, and adaptability of modulatory systems and TC loop, as well as neural activity related to behavioural activation and behavioural inhibition, respectively.

The main findings in this thesis were 1) MAP and schizophrenia groups showed similar MEP amplitude, alpha and delta power, as well as the lack of change in frequency band powers between resting states, as compared to controls, and 2) MAP and schizophrenia groups showed different characteristics for the N100, P200, N200 and P300 ERPs, most notably in response to the Trick S stimulus, compared to controls, as well as each other. I will first discuss the similarities, then differences.

The similar MEP and EEG frequency power results between the MAP and schizophrenia groups pointed towards similar impairments in the CT-basal ganglial-TRN-TC loop of both groups. Smaller MEPs generated from an active hand suggests a loss of neuronal integrity and/or synchronization in this circuit, lowering the effect of a suprathreshold TMS pulse to influence the periphery. Alpha and delta rhythms are perpetuated between the thalamus and cortex through reciprocal interactions, and the rhythms are altered by other inputs into the system, i.e. ascending sensory systems impacting on FO TC, CT, and/or TRN neurons, descending CT inputs impacting on HO and TRN neurons, or modulatory systems influencing all these areas. In particular, the DA, NE and ACh modulatory systems are implicated since they alter the excitability of regular spiking cells in the cortex, as well as the TC cells and TRN neurons, and influence the probabilities of these cells to be in tonic or burst modes (Kristiansen and Courtois, 1949; McCormick, 1992; Michel et al., 1992, 1993; Destexhe and Sejnowski, 2003; Steriade and McCarley, 2013). Little is known about the TC-TRN loop in MAP, however cocaine exposure has been shown to

disrupt TRN function in animals (Urbano and Bisagno, 2017a). It is not known whether the T-type channels are involved in the dysregulation of GABA transmission due to cocaine exposure, but it is highly likely the case, since the T-type channels are fundamental to the function of the GABAergic TRN neurons.

Importantly, this study also found a lack of the expected decrease in alpha power from the shift between eyes closed to open in both MAP ad schizophrenia. This finding suggests an impaired neural response to a fundamental shift in resting state, and thus a likely impairment in the ability of the systems to switch between tonic mode to burst mode (Steriade and McCarley, 1990; Détári, 2000; Steininger et al., 1999; Steriade and McCarley, 2013). The smaller MEP may also reflect a lack of flexibility in the system from being able to respond to a sudden change in cortical activity, since a large TMS pulse produced a lower MEP deviation from baseline in the MAP and schizophrenia than for the controls.

Although this thesis did not investigate the specific molecular underpinning of the frequency power changes, rigorous research on the cellular and molecular basis of EEG frequency power has highlighted the importance of T-type channels to generate both alpha and delta power, and the ability of the regular spiking cells in the TC loop to switch between tonic mode to burst modes is highly governed by the functioning of T-type Ca^{2+} channels (Destexhe and Sejnowski, 2003). Many effects of the DA, NE and ACh modulatory systems are exerted either directly, or indirectly through the activity of these T-type channels. Furthermore, specific mutations in the CACNA1H and CACNA1I genes have been highly associated with schizophrenia (Irish Schizophrenia Genomics and The Wellcome Trust Case Control C., 2012; Hamshere et al., 2013; Schizophrenia Psychiatric Genome-Wide Association Study (GWAS) Consortium, 2014; Xu et al., 2018).

Evidence for differences between the MAP and schizophrenia groups arose during the performance of the CPT, particularly in response to the stimuli that required behavioural inhibition. MAP showed smaller N100, larger P200, larger N200 and larger P300, whereas the schizophrenia showed a longer P300 latency. In addition, MAP responded to S2 (which required inhibition) more frequently than either schizophrenia or controls. These results indicate that MAP may have difficulties inhibiting neural pathways that had already been primed to fire (salience of the stimulus that is identical to the target). On the other hand, in schizophrenia, longer P300 latency in response

to target and Trick-S indicate that the schizophrenia may have difficulties with the initiation of behavioural execution pathways, and reflect difficulty in responding to cues appropriately.

Again, the literature sheds light on the particular molecular mechanisms which may underpin this finding. Referring to the discussion section of the previous chapter (Section 5.5), the combination of amplitude alterations in MAP strongly suggest over activity of mACh receptors (Caldenhove et al., 2017). Since Increased M1 activity decreases $Ca_v3.3$ activity (Hildebrand et al., 2007), which is also associated with lower alpha power. It is possible that the lower alpha power observations in MAP were a result of excessive M1 activation. These results show for the first time that the ACh system may play a larger role in MAP than research has shown thus far.

6.1 Limitations

The sample size for each group were too small to allow for statistical corrections of potential confounding factors, such as medications, and combinations of medications prescribed to the participants with psychosis, as well as a multitude of clinical scale variables that were collected from these participants, including PANSS and ASSIST scores. For example, while there were patients in both groups that were prescribed both FGA and SGA, the majority of MAP participants received FGA medications, while the majority of schizophrenia participants received SGA medications, resulting in a strong covariance of medications with group and violates ANCOVA assumptions. ANCOVA could be appropriately performed on the variable "cumulative antipsychotic dose expressed as chlorpromazine equivalents", which found no difference between groups, and suggested a general similarity in antipsychotic treatment between the psychosis groups, however it was not possible to determine conclusively whether MAP and schizophrenia differences were due to group, or medication (Glass et al., 1972).

It was also not possible to completely match the subjects for age, race and education levels to such an extent that would produce no significant statistical differences between groups, since, for example, the participants with MAP were younger than those with schizophrenia, and I was already very limited to the number of patients that were eligible to participate. Fortunately ANCOVA corrections showed that there was no effect of age within the range that was selected for all participants, which was similar to the ANCOVA results for other demographic variables individually. However, it would have been preferable to include all demographic variables in a

single model, instead of performing a multitude of individual tests, which then did not account for multiple comparisons.

Some of the clinicians who identified some of the participants were part of this study team. This may have caused a selection bias. Even though the majority of the participants were identified through patient files and confirmed via SCID by trained nurses and were not treated by the clinicians in this study. In addition, we had such difficulty achieving sufficient numbers that any patient who met the requirements were included in the study. In this case, it was unlikely for selection bias to have occurred on the part of the clinicians. This potential confounding factor could have been quantified by contrasting the number of participants that were identified through patient files instead of through the clinicians that were treating the same patients, however I no longer have access to the source files from before the patients were coded for anonymity.

The TMS with CSP paradigm is an inherently variable technique (Wassermann, 2002), and while useful, a larger sample size would be required to overcome and incorporate the variability of both the technique, and of the subjects, in order to verify the results of the novel finding for smaller MEPs in MAP and schizophrenia.

The TMS-EMG and EEG techniques used in this study can reveal broadly aggregated electrical patterns on the surface of the hand and scalp, but are poor determinants of the originating location of particular signals. This thesis relied heavily on the literature to infer network and molecular mechanisms to explain the observed results, however direct molecular research would be required to confirm several of the mechanisms proposed in this work. For example, it would be necessary to study T-type channel activity in the cortex, thalamus and TRN in MAP (or rather in animal models of MAP) in order to confirm the hypothesis that their activity may in fact underly the changes in frequency power patterns that were observed in this study.

6.2 Research implications

The findings of this work implicate impaired function of T-type channels and/or M1 mAChRs in MAP, and since there is also likely a genetic contribution in the development of MAP, it further implies possible genetic mutations, or epigenetic dysregulation in related genes. The literature in schizophrenia suggest that the CACNA1H and CANA1I may be interesting candidate genes. Much

future work would be required to confirm whether the frequency power dynamics in MAP are in fact due to changes T-type channel, and M1 mAChR activity. This may be possible with use of a pharmaco-EEG study in humans, or animals for compounds that are not yet FDA approved.

In terms of genetic associations, there have been several genetic association studies that have been performed in MAP, but none have so far found associations with T-type channel mutations, although the literature on the genetics of MAP is considerably weaker than those for schizophrenia. Also, the development of MAP and schizophrenia depends on genetic and environmental interactions, and MA use may lead to persistent MAP due to epigenetic changes, which would not be detectable in genetic association of GWAS studies. One could utilize next generation sequencing (NGS) techniques to firstly determine underlying whole genome sequences, and combine it with data from epigenetic and transcriptome sequencing of samples from the same individuals.If such extensive sequencing work was done, the results of this study would predict that epigenetic and/or transcriptome alterations would likely be observed in the sequences involving T-type channels and mAChRs in individuals with MAP.

I had previously published a hypothesis paper that had focused on GABA neuron damage in the cortex for MAP, and proposed a mechanism through which prolonged MA use may lead to such damage, resulting in desynchronized cortical signalling and symptoms of MAP (Hsieh et al., 2014). The findings of this study has pointed toward GABA neuron dysfunction in the TRN. It is possible that both GABA neurons in both the cortex and in the TRN are compromised because connections between cortical and TRN neurons are strong, translaminar GABAergic interneurons in the cortex, particularly those between layers IV and VI, very quickly and strongly, affects cortex to TRN functioning (Thomson, 2010). Further work to study the GABAergic system, particularly between the cortex and the TRN, possibly with the use of ^{1}H-MRS with the ROI set in the DLPFC, ACC and TRN could help to address this hypothesis.

In summary, this work found 1) smaller MEP amplitudes in both MAP and schizophrenia using TMS with the CSP paradigm, 2) the MAP had largely similar frequency power characteristics as schizophrenia such as lower alpha power and higher delta power globally, 3) both MAP and schizophrenia showed no change in alpha or delta power in the shift between eyes open and closed, 4) the ERP results revealed that neural responses to stimuli requiring behavioural inhibition during MAP attention function is likely quite different from that in schizophrenia. This type of

study combining several techniques has never been performed in MAP, and the findings show that, while there is considerable overlap in cortical-subcortical inhibition and connectivity in MAP and schizophrenia, there are also important differences; findings that emphasize both the continuities and discontinuities that are seen clinically. These findings suggest the involvement of the CT-TRN-TC loop and its interaction with the ACh system, and ultimately support work on pharmacological interventions to alter T-type channel and/or M1 mAChR function.

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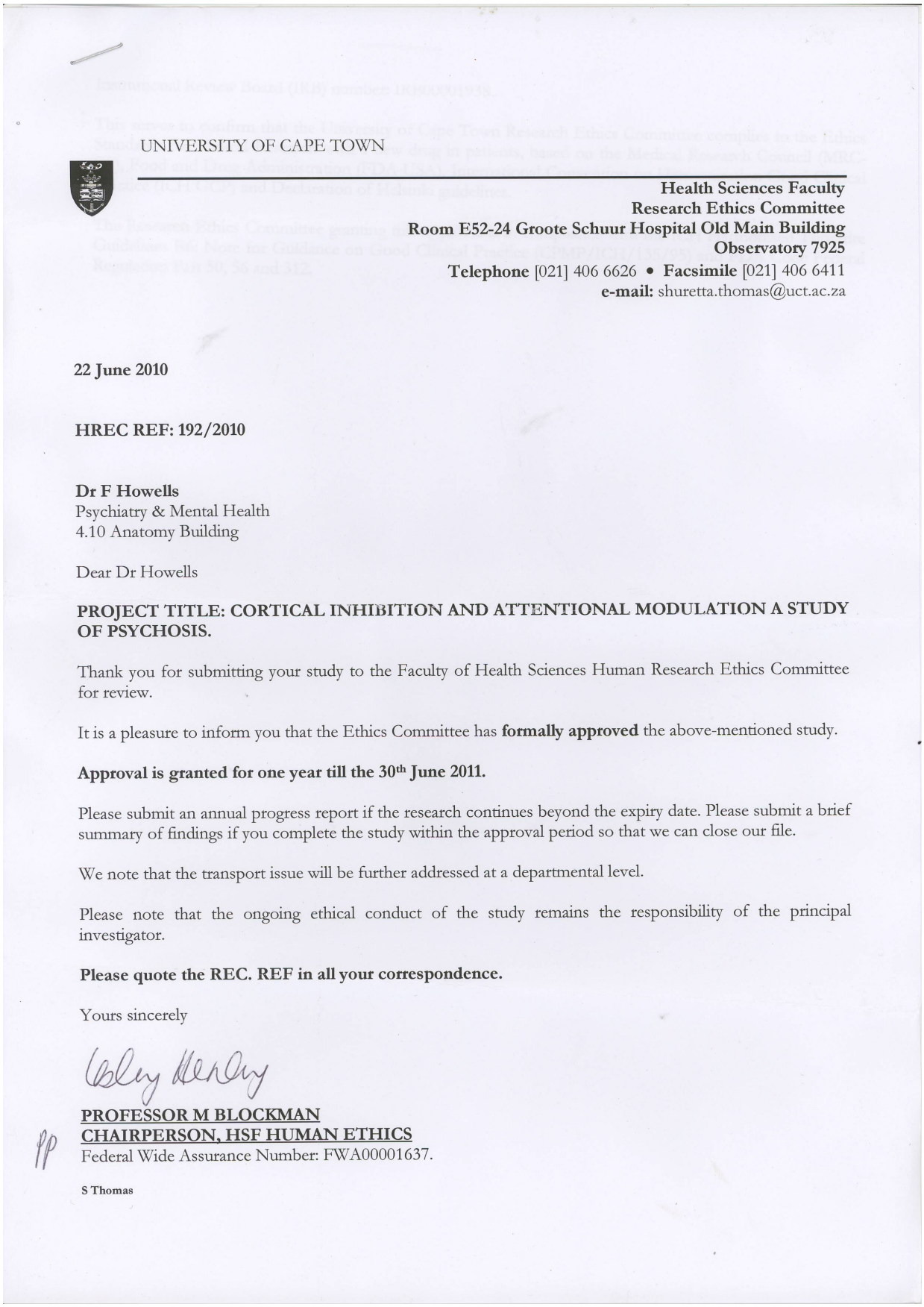
Appendices

A Appendix – Methods

A.1 Human Ethics Approvals

Human ethics approval was obtained in 2010 for this research and renewed until 2019. Approval documents below:

Figure A.1 – Human Ethics Approval, HREC number 192/2010



UNIVERSITY OF CAPE TOWN

Health Sciences Faculty
Research Ethics Committee
Room E52-24 Groote Schuur Hospital Old Main Building
Observatory 7925
Telephone [021] 406 6626 • **Facsimile** [021] 406 6411
e-mail: shuretta.thomas@uct.ac.za

22 June 2010

HREC REF: 192/2010

Dr F Howells
Psychiatry & Mental Health
4.10 Anatomy Building

Dear Dr Howells

PROJECT TITLE: CORTICAL INHIBITION AND ATTENTIONAL MODULATION A STUDY OF PSYCHOSIS.

Thank you for submitting your study to the Faculty of Health Sciences Human Research Ethics Committee for review.

It is a pleasure to inform you that the Ethics Committee has **formally approved** the above-mentioned study.

Approval is granted for one year till the 30th June 2011.

Please submit an annual progress report if the research continues beyond the expiry date. Please submit a brief summary of findings if you complete the study within the approval period so that we can close our file.

We note that the transport issue will be further addressed at a departmental level.

Please note that the ongoing ethical conduct of the study remains the responsibility of the principal investigator.

Please quote the REC. REF in all your correspondence.

Yours sincerely

PROFESSOR M BLOCKMAN
CHAIRPERSON, HSF HUMAN ETHICS
Federal Wide Assurance Number: FWA00001637.

pp

S Thomas

Figure A.2 – Human Ethics Renewal to 2013, HREC number 192/2010

UNIVERSITY OF CAPE TOWN

FACULTY OF HEALTH SCIENCES
Human Research Ethics Committee

Annual Progress Report

Date	30th May 2011
HREC REF Number	192/2010
Protocol number (if applicable) & Protocol title	Cortical Inhibition and Attentional Modulation a study of psychosis
Principal Investigator	Dr Fleur M Howells
Department / Office Internal Mail Address	Psychiatry & Mental Health 109, J-2 Block Old GSH

List of documentation

No changes to the project have been made. We ask only for renewal of the approved standing application 192/2010.

RESEARCH ETHICS COMMITTEE
2011 -06- 01
HEALTH SCIENCES FACULTY
UNIVERSITY OF CAPE TOWN

HREC office use only (FWA00001637; IRB00001938)			
☐ Approved ✓	This serves as notification of annual approval, including all documentation described above.		
☐ Not approved	See attached comments.		
Type of review	☐ Expedited ✓	☐ Full committee	
Expiry date	28 JUNE 2012		
Signature Chairperson of the HREC	Wesley Henley	Date	1.6.11

PP

7 October 2010 Page 5 of 5 FHS016

Figure A.3 – Human Ethics Renewal to 2019, HREC number 192/2010

UNIVERSITY OF CAPE TOWN

FACULTY OF HEALTH SCIENCES
Human Research Ethics Committee

FHS016: Annual Progress Report / Renewal

HREC office use only (FWA00001637; IRB00001938)			
This serves as notification of annual approval, including any documentation described below.			
☐ Approved	Annual progress report	Approved until/next renewal date	30/07/19
☒ Not approved	See attached comments		
Signature Chairperson of the HREC		Date Signed	8/8/18

Comments to PI from the HREC

Principal Investigator to complete the following:

1. Protocol Information

Date (when submitting this form)	06 August 2018		
HREC REF Number	192/2010	Current Ethics Approval was granted until	30 July 2018
Protocol title	Cortical Inhibition and Attentional Modulation: a study of psychosis (CIAM)		
Protocol number (if applicable)			
Are there any sub-studies linked to this study?	☐ Yes ☑ No		
If yes, could you please provide the HREC Ref's for all sub-studies? **Note:** A separate FHS016 must be submitted for each sub-study.			
Principal Investigator	Fleur M Howells		
Department / Office Internal Mail Address	Department of Psychiatry and Mental Health Office H37, H-Floor Old Main Building Groote Schuur Hospital		
1.1 Does this protocol receive US Federal funding?	☐ Yes	☒ No	

(Note: Please complete the Closure form (FHS010) if the study is completed within the approval period)

HUMAN RESEARCH ETHICS COMMITTEE
07 AUG 2018
HEALTH SCIENCES FACULTY
UNIVERSITY OF CAPE TOWN

Figure A.4 – Approval for accessing patient details from medical files at Groote Schuur Hospital





GROOTE SCHUUR HOSPITAL
Enquiries: Dr Bhavna Patel
E-mail : Bhavna.Patel@westerncape.gov.za

Dr Fleur Howells
Psychiatry & Mental Health
Room 4.10 - Anatomy Building
MEDICAL SCHOOL

E-mail: howellsfleur@gmail.com

Dear Dr Howells

RESEARCH STUDY: Cortical Inhibition and Attentional Modulation a Study of Psychosis

Your recent letter to the hospital refers.

You are hereby granted permission to proceed with your research.

Please note the following:

a) Your research may not interfere with normal patient care
b) Hospital staff may not be asked to assist with the research.
c) No hospital consumables and stationary may be used.
d) No patient folders may be removed from the premises or be inaccessible. Please liaise with Mr Noel Weeder in this regard on ext. 4058 or 4066.
e) Please introduce yourself to the person in charge of an area before commencing.

I would like to wish you every success with the project.

Yours sincerely

Patel

DR BHAVNA PATEL
SENIOR MANAGER: MEDICAL SERVICES
Date: 30th July 2012

C.C. Ms C. Small

G46 Management Suite, Old Main Building,
Observatory 7925

Private Bag X,
Observatory, 7935

DEPARTMENT of HEALTH
Provincial Government of the Western Cape

Sean.Kaliski@uct.ac.za
PMilligan@pgwc.gov.za
tel: +27 21 4403195
Research & Ethics Committee
Valkenberg Hospital, P/B X1, Observatory, 7935

REFERENCE:
ENQUIRIES: SZ Kaliski / P Milligan

For attention: Dr B Eick, SMS

Re: Cortical Inhibition and attentional modulation a study of psychosis
(Investigator: Ms F Howells)

1. The protocol for the above study has been reviewed.
2. The study is generally acceptable, as all the queries have been satisfactorily answered.

A/PROF S KALISKI
Principal Specialist

DR P MILLIGAN
Principal Specialist

DATE: 31 August 2010

Figure A.5 – Approval for accessing patient details from medical files at Valkenberg Hospital

A.2 Informed Consent

Informed consent was obtained from each participant with the following documents:

-

Cortical inhibition and attentional modulation a study of psychosis

Research ethics approval obtained from:
University of Cape Town Human Ethics (021 406 6338) reference number: 192/2010
University of Stellenbosch Health Research Ethics Committee (021 938 9677) reference number: UCT8

Participant information sheet

Attention is when you are able to focus on information. Like when you think of what you are going to wear, needs a level of attention. A person may find this difficult if they have other thoughts that don't allow them to pay attention. This is only one example, but applies to feelings as well. Like if you are worried about something, you cannot pay attention to something that may really need your attention. The ability to pay attention is different for everyone and may be more difficult for some.

The present study is not clinical. This study would like to understand how interfering or too many thoughts lower a person's ability to pay attention. This will be done through brain imaging techniques that allow us to record electrical activity (electroencephalography), the level of brain chemicals (magnetic resonance spectroscopy, MRS), and changes in electrical activity (electroencephalography with transcranial magnetic stimulation).

Recruitment into the present study will occur through referral from a medical practitioner who is informed as to your psychiatric illness. Participants without a history of psychosis will also be recruited as controls to compare findings. The control participants will be interviewed by a psychiatrist to determine inclusion (can participate). The controls will not undergo the brief repetitive transcranial magnetic stimulation (brTMS) but will have a 'fake' treatment referred to as sham TMS treatment.

Basic exclusion (cannot participate) criteria for the present study are as follows. Individuals who: are under the age of 18, or older than 40; have a history of, or have first-degree relatives (father, mother, brothers and/or sisters) with a history of, epilepsy or seizures; have a history of stroke or brain aneurism; have a chronic medical condition, including Parkinson's disease, Huntington's chorea, multiple sclerosis, and dementia; have cardiac devices, implanted medication pumps, intracardial lines, or cardiac disease; have apparent mental retardation; have a history of treatment with TMS therapy; have extensive tattoos on their face; or have orthodontic braces, will not be included in the study. Woman who are known or suspected to be pregnant or who are breast feeding will also be excluded from the study. Each participant will be checked off against a set of criterion from the TMS adult safety screen (Keel et al., 2000) by the researcher involved, and a magnetic resonance imaging (MRI) safety screen by a radiographer at the Cross-University Brain Imaging Centre (CUBIC).

Individuals who are suitable and willing to participate in the present study will need to be available for one working day from 08h30 to 17h30. Each participant will receive shopping vouchers for food to the value of R200, and will receive R50 toward travel expenses. Lunch will be provided on the day of participation.

Each participant is free to withdraw from the present study at anytime. This study is for research purposes only and is not funded by a pharmaceutical (drug) company. Participant's details will be anonymous, as each participant will be assigned a participant number on the day of the recording session.

If you have any questions with respect to the present study do not hesitate to contact the principal investigator, Dr Fleur Howells at fleur.howells@uct.ac.za

If you would like to participate in the present study please contact us through any of the following:

Email: participant.CIAM@gmail.com, Cell number: 082 749 5223, Landline number: 021 404 5488

Please see the next page for further information of the brain imaging modalities that will be used in the present study.

-

Additional information for participant:





Fig 1 **Fig 2**

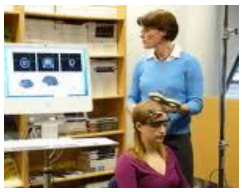
Magnetic Resonance Imaging (MRI) is a form of medical imaging that needs you lie on a scanner bed and be placed into a short tunnel (open at both ends) in line with a strong magnetic field (Fig 1). A device is placed over your head with a mirror system attached (Fig 2). You can relax during the scanning session by watching a movie or taking a nap, but you do need to keep as still as possible.

The magnetic field attracts (pulls) metal objects. Therefore an MRI safety checklist is required to prevent cancellation of the scan once scheduled. These precautions are for your safety and to ensure optimal image data. Prior to entering the scan room the Radiographer will go through a checklist to ensure your safety. There are no known side effects of undergoing an MRI if you are seen as suitable by a Radiographer.

In addition, should you pass the first checkpoint, we will ask that you remove all metal objects for the period of scanning: no jewelry, watches, metal piercing (this includes all forms of piercing), pens, coins, cell phones etc. lockable change rooms and hospital gowns will be available, but we suggest you wear more suitable clothing such as a t-shirt & track pants that are preferably not nylon (with no zips, buckles etc). Any clothing that contains metal wire, buttons, and zips will need to be removed.

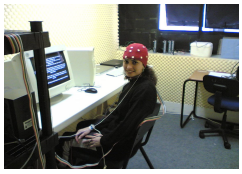
Once the scan commences you will hear a continuous loud noise for the duration of the sequence and each sequence lasts about 6-9 minutes each. Each of the sequences will make a different set of noises. You will be provided with earplugs and headphones to protect your ears from this noise. You will be under constant supervision verbally and visually for the duration of the entire scan (± 1hour in total).

The MRI scanning will be done at the Cross-University Brain Imaging Centre (CUBIC), Tygerberg hospital. You (the participant) will be transported to Tygerberg and back by a research assistant.



Transmagnetic cranial stimulation (TMS), works by placing a magnet next to the brain (over the scalp). When the magnetic coil is charged it changes the electrical activity of the surface area of the brain that is targeted. After one pulse from the magnetic coil the brain area is briefly inactive and this is a measure of the brain's ability to inhibit activity (cortical inhibition). This inhibition of activity is decreased in individuals with a history of psychosis. All participants with and without a history of psychosis will undergo the cortical inhibition protocol.

Brief repetitive transmagnetic cranial stimulation (brTMS) is used to increase communication between neurons. In doing this, we aim to improve attentional information processing. brTMS has been associated with brief headaches, which is as a result of nerves and muscles on the scalp. In addition the participant may show symptoms of temporary mania or depression, but this is very very rare. Only the participants with a history of psychosis will have brTMS as we would like to see whether we can improve their attention. The TMS machine makes a clicking noise, but not as loud at the MRI scanner. Earplugs will be provided to reduce the noise. The results from this study are for research purposes only and not a form of therapy.



During the cortical inhibition protocol and the brTMS continuous electroencephalographic (EEG) data will be collected. EEG records brain wave activity by placement of an electrode cap (similar to a swimming cap) that records electrical activity from the scalp. The participants' will complete computerized tasks of attention with breaks between the different protocols.

The EEG, cortical inhibition and brTMS will take place in the EEG suite of the educational center at Valkenberg Hospital, Observatory.

-

Participant Name _____ Participant Number _____

Cortical inhibition and attentional modulation a study of psychosis

Research ethics approval obtained from:
University of Cape Town Human Ethics (021 406 6338) reference number: 192/2010
University of Stellenbosch Health Research Ethics Committee (021 938 9677) reference number: UCT8

CONSENT FORM

I voluntarily agree to participate in the present study: Cortical inhibition and attentional modulation a study of psychosis, which includes magnetic resonance imaging (MRI), cortical inhibition protocol through transmagnetic cranial stimulation (TMS) pulses, and electroencephalography (EEG).

YES NO

In addition I voluntarily agree to undergo brief repetitive transmagnetic cranial stimulation (bRTMS) for research purposes only. (Only participants with a history of psychosis.)

YES NO

I am aware that brief repetitive transmagnetic cranial stimulation (brTMS) may lead to a brief headache as a result of stimulating nerves and muscles on the scalp and/or short-term symptoms of mania or depression.

YES NO

I have been informed of the procedures and have a copy of the study's information sheet (attached).

YES NO

I have been allowed the opportunity to ask questions that relate to the present study and they have been answered (else please ask these questions of the researcher before you sign this consent form).

YES NO

I …… (participant's full name) am voluntarily participating in the present study and am aware that at any point I may stop participating in the present study. If I stop participating there will be no impact (effect) on my current or future medical treatment.

Participant's signature: …… date: DAY / MONTH / YEAR

Participant's email and/or contact number: ……

I ……(researcher's full name) have gone through the consent form and answered any questions that the participant has asked

Researcher's signature …… date: DAY / MONTH / YEAR

A.3 Clinical scales

The following clinical scales were performed on Test Day for the MAP and SCZ participants:

PANSS (Kay et al., 1987) A 30 item, 40 to 50 minute evaluation for the presence and/or severity of various positive and negative symptoms, such as social impairment, impulse control, hostility, motor, cognitive, affective, perceptual and interactive functions. It is a 7 point rating scale where 1 is the absent of symptoms, and 7 being extreme presentation of symptoms. Ratings are based on clinical judgment and from as many sources of information available to the clinician as possible. This scale was included to characterize the core type of clinical presentation of psychosis and to determine severity of participant illness for sufficient clinical stability to participate in the present study. Results were also used to determine potential statistical effects (or confounding effects) of psychopathalogical characterization and severity on MEP and EEG data.

BPRS (Overall and Gorham, 1988; Leucht et al., 2005) An 18 item, 20 to 30 minute assessment on constructs such as hostility, suspiciousness, hallucination, and grandiosity over the previous 2 days, based on clinical judgement of patient behaviour during the interview, as well as any other source of information available to the clinician. It is particularly useful in gauging the efficacy of treatment in patients who have moderate to severe psychoses. It is a 7 point rating scale where 1 is the absence of symptoms, and 7 being extreme presentation of symptoms. This scale was included to characterize the core type of clinical presentation of psychosis and and to support the results of the PANSS scale to determine severity of participant illness for sufficient clinical stability to participate in the present study. Results were also used to determine potential statistical effects (or confounding effects) of psychopathalogical severity on MEP and EEG data.

CGI-S (Busner and Targum, 2007) A short, 10 minute evaluation that aims to determine the average severity of psychopathology over the previous 7 days. It is a 7 point scale from 1 being normal, not at all ill, to 7 being extremely ill. Clinicians are provided with guidelines for rating, based upon as much information as is available to the clinician, including the patient's self report, as well as family, primary care givers, and clinical judgment. This scale was included to determine severity of participant illness for sufficient clinical stability to participate in the present study, and to support the PANSS and BPRS scales. Results were also used to determine potential statistical effects (or confounding effects) of psychopathalogical severity on MEP and EEG data.

HAMD (Hamilton, 1960) A 17 item, 20-30 minute assessment for the presence and/or severity of depressive symptoms such as depressed mood, feelings of guilt, various forms of insomnia, suicide, anxiety, weight loss etc. Rating is based on clinical impression during the interview. This scale was included to determine severity of participant illness for sufficient clinical stability to participate in the present study, especially pertinent for the bipolar I (BP) participants that were part of the larger Cortical Inhibition and Attentional Modulation: A study of Psychosis (CIAM) study. Results were also used to determine potential statistical effects (or confounding effects) of depressive symptoms and severity on MEP and EEG data.

YMRS (Young et al., 1978) And 11 item, 15 to 30 minute assessment for the presence and/or severity of symptoms such as irritability, rate and amount of speech, thought content, aggressive behaviour, sleep, elevated mood, increased motor activity, sexual interest, appearance and insight. Ratings are based on patient's own subjective report of his/her own manic symptoms over the previous 2 days, as well as the clinicians judgment during the interview. This scale was included to determine severity of participant illness for sufficient clinical stability to participate in the present study, especially pertinent for the BP participants that were part of the larger CIAM study. Results were also used to determine potential statistical effects (or confounding effects) of manic symtoms and severity on MEP and EEG data.

GAF (Aas, 2011) Assessment of day-to-day functioning on a scale of 0-100 where a score of 1-10

would indicate severe dysfunction with persistent danger of hurting oneself or others, and a score of 91-100 would indicate no symptoms, where the patient's day-to-day challenges do not overwhelm the participant. Scoring values between 40 to 80 were considered able to participate in the present study as a participant with psychosis. This scale was included to determine severity of participant illness for sufficient clinical stability to participate in the present study. Results were also used to determine potential statistical effects (or confounding effects) of day-to-day functional capacity on MEP and EEG data.

ASRS-v1.1 (Van de Glind et al., 2013) An 18 item, 5 to 10 minute patient subjective self-report used to detect ADHD in treatment seeking substance use disordered patients. This scale was included to determine severity of inattention in all participants. Scoring values were "never", "rarely", "sometimes", "often", and "very often". Scoring cut-off value for questions 1, 2, 3, 9, 12, 16 and 18 was "sometimes", and the scoring cut-off value for the remaining questions was "often". Results were also used to determine potential statistical effects (or confounding effects) of ADHD symptomology on MEP and EEG data.

ASSIST (Humeniuk et al., 2008) Assessment for the presence and frequency of use of various drugs, including alcohol, MA, cocaine, opiates, nicotine, methaqualone, marijuana. This scale was included to determine drug use background and current frequency in all participants. Results were also used to determine potential statistical effects (or confounding effects) of illicit drug use on MEP and EEG data.

B Appendix: Transcranial Magnetic Stimulation: Cortical Inhibition and Excitability

B.1 120% Resting motor threshold cortical silent period

B.1.1 Raw Data for 120RMT

Raw data for the "120RMT" dataset presented in parts below:

Participant	Hemisphere	Group	Sex	B10_Edinburgh_Handedness_Questionnaire	Age_on_Day_of_Testing	Years_at_School	Years_of_Tertiary_Education	Total_Years_of_Education	Height	Weight	BMI	Right_Hand_Maximum_Force_in_kg	_Hand_40_percent_of_Maximum_Force_in_kg	Left_Hand_Maximum_Force_in_kg	Hand_40_percent_of_Maximum_Force_in_kg	Rel	Abs	Lat	Amp	Base	SI
C01	L	CON	Male	Left	29	12	8	20	1.71	81.4	27.83763	13	5.2	12	4.8	120	77	19.5	0.10876	0.01381	67
C02	L	CON	Male	Right	23	12	7	19	1.86	133	38.44375	12	4.8	10	4	125	85	23	0.08127	0.01337	90
C03	L	CON	Male	Right	26	12	5	17	1.85	76	22.20599	9.5	3.8	9.5	3.8	162	119	20	0.09546	0.00897	80
C05	L	CON	Female	Right	32	12	0	12	1.81	71	21.67211	6.5	2.6	5.5	2.2	182	132	21	0.08191	0.01749	83
C06	L	CON	Female	Right	27	12	3	15	1.75	63.4	20.70204	7	2.8	6.5	2.6	117	77	19	0.1292	0.0088	79
C07	L	CON	Female	Right	30	12	3	15	1.74	79	26.09328	5.2	2	5.8	2.3	54.5	19	18	0.17727	0.01861	94
C08	L	CON	Female	Right	20	12	0	12	1.59	59	23.33768	7.5	3	7.5	3	159	116	16.5	0.014056	0.01663	88
C09	L	CON	Male	Right	22	12	0	12	1.74	55	18.1662	11.5	4.6	11	4.4	141	89	20	0.11806	0.01382	90
C10	L	CON	Male	Right	19	12	0	12	1.88	67	18.95654	9.5	3.8	7.5	3	221	167	21.5	0.07547	0.01009	79
C11	L	CON	Male	Right	22	10	0	10	1.88	70	19.80534	11	4.4	9.5	3.8	154	96.5	20.5	0.08817	0.01158	79
C13	L	CON	Female	Right	24	12	7	19	1.68	55.3	19.59325	5.5	2.2	5.5	2.2	17	93.5	21	0.11009	0.01433	90
C14	L	CON	Female	Right	27	12	10	22	1.75	76	24.81633	5.5	2.2	5	2	143.5	92.5	19.5	0.11928	0.0092	88
C16	L	CON	Male	Right	25	12	8	20	1.79	76	23.71961	7	2.8	7.5	3	170	110	21	0.05287	0.0168	71
C17	L	CON	Female	Right	25	12	6	18	1.65	65	23.87511	6.5	2.6	6	2.4	107	63	19	0.16453	0.01166	77
C18	L	CON	Female	Right	28	12	1	13	1.57	70.1	28.43929	5	2.4	6.5	2.6	151	109	21	0.1701	0.02153	82
C19	L	CON	Female	Right	27	12	0	12	1.72	67	22.64738	6	2.4	5	2	116	76	21	0.14741	0.01754	85
C20	L	CON	Female	Right	24	11	0	11	1.61	58	22.37568	7	2.8	6	2.4	179	136	21	0.12967	0.01021	89
C22	L	CON	Male	Right	28	12	0	12	1.8	61	18.82716	10	4	10	4	153.5	104.5	21.5	0.1565	0.01821	67
C23	L	CON	Male	Ambidextr	19	12	1	13	1.71	65	22.22906	8.5	3.4	8.5	3.4	124	82.5	20	0.11686	0.01219	83
C25	L	CON	Male	Right	24	8	0	8	1.78	74.9	23.63969	9.5	3.8	9.5	3.8	123	71	20	0.13411	0.01091	74
C26	L	CON	Female	Right	22	8	0	8	1.65	84	30.85399	5.5	2.2	5.5	2.2	109	67	20	0.0373	0.00847	76
C27	L	CON	Female	Right	33	12	0	12	1.65	68	24.97704	8.5	3.4	8	3.2	100	56	20	0.07677	0.00796	86
C29	L	CON	Male	Right	27	12	0	12	1.64	64.7	24.05562	7.5	3	6	2.4	123	78	21.5	0.12221	0.01772	68
C30	L	CON	Male	Right	26	11	1	12	1.75	71	23.18367	9.5	3.8	9	3.6	178	132.2	22.5	0.14059	0.01013	72
C31	L	CON	Male	Right	40	11	0	11	1.75	53.5	17.46939	9.5	3.8	9	3.6	154.5	103	20	0.1018	0.00977	83
C33	L	CON	Male	Right	22	12	1	13	1.79	69	21.53491	11	4.4	10.5	4.2	138	82	18.5	0.17833	0.01428	88
C34	L	CON	Female	Right	23	10	0	10	1.6	65	25.39063	7.5	3	6.5	2.6	NA	NA	NA	NA	NA	NA
C36	L	CON	Female	Right	23	14	5	19	1.71	67	22.91303	6	2.4	6	2.4	178	133	21	0.09087	0.01298	80
S01	L	SCZ	Male	Left	34	9	0	9	1.76	88	28.40909	9	3.6	11.5	4.6	NA	NA	NA	NA	NA	NA
S03	L	SCZ	Male	Right	38	12	3	15	1.85	100	29.21841	12	4.8	9	3.6	157	118.5	21	0.09971	0.02349	103
S04	L	SCZ	Male	Right	29	12	3	15	1.87	81.3	23.24916	8.5	3.4	7.5	3	162	102	21	0.1768	0.02176	82
S05	L	SCZ	Female	Right	29	12	0	12	1.68	133	47.12302	6	2.4	5.5	2.2	NA	NA	NA	NA	NA	NA
S07	L	SCZ	Male	Left	24	9	0	9	1.68	76	26.92744	8.7	3.48	6.5	2.6	67	28	20	0.0848	0.0119	104
S08	L	SCZ	Male	Right	29	12	6	18	1.78	96.5	30.45701	7	2.8	9	3.6	209	149	22	0.06245	0.00931	89
S10	L	SCZ	Male	Right	32	7	0	7	1.64	80	29.7442	7.5	3	9.5	3.8	NA	NA	NA	NA	NA	NA
S11	L	SCZ	Male	Right	25	8	2	10	1.79	104	32.45841	11.5	4.6	10	4	268.5	222	21.5	0.05457	0.00926	110
S12	L	SCZ	Male	Right	33	11	0	11	1.81	92	28.08217	10.5	4.2	9.5	3.8	146	99.5	19	0.07603	0.01753	78
S14	L	SCZ	Male	Right	40	6	3	9	1.85	88	25.7122	4.5	1.8	5	2	162	110	24	0.09283	0.01002	107
S15	L	SCZ	Male	Right	29	12	4	16	1.82	136	41.05784	10.5	4.2	10	4	170	125	21	0.07075	0.01492	70
S17	L	SCZ	Male	Right	23	12	0	12	1.67	59	21.15529	7	2.8	8	3.2	235	175	15	0.06341	0.01146	95
S18	L	SCZ	Male	Right	28	10	0	10	1.83	89	26.57589	7.5	3	9	3.6	123	75	19	0.06398	0.00845	80
S19	L	SCZ	Female	Left	20	12	4	16	1.57	69.2	28.07416	6	2.4	6	2.4	176	129	18	0.18621	0.0164	83
S23	L	SCZ	Female	Right	27	10	0	10	1.57	117	47.46643	5.5	2.2	4	1.6	84.5	41.5	16.5	0.07405	0.00621	76
S24	L	SCZ	Female	Right	36	12	3	15	1.67	71	25.45807	4	1.6	3.5	1.4	191.5	131	19	0.05075	0.01162	72
S26	L	SCZ	Male	Right	39	9	0	9	1.81	73	22.28259	8	3.2	6.5	2.6	210.5	160.5	20.5	0.06047	0.00779	102
S27	L	SCZ	Female	Right	31	10	0	10	1.51	57	24.9989	6.5	2.6	6	2.4	147	103	20	0.07818	0.00759	85
S29	L	SCZ	Female	Right	23	14	0	14	1.57	50	20.2848	4.5	1.8	4	1.6	158.5	117	15.5	0.10075	0.01821	109
S31	L	SCZ	Female	Right	20	12	3	15	1.68	76.8	27.21088	8.5	3.4	8.3	3.4	131	86.5	22	0.12045	0.01707	66
M01	L	MAP	Male	Right	21	9	0	9	1.75	68	22.20408	7	2.8	8	3.2	160	108	20	0.10596	0.00977	74
M02	L	MAP	Female	Right	22	10	0	10	1.6	53.8	21.01563	4	1.6	4	1.6	18	0	18.5	0.09531	0.02424	102
M03	L	MAP	Male	Right	20	8	0	8	1.82	86.3	26.05362	7	2.8	7.5	3	168	121.5	21	0.1377	0.01228	96
M04	L	MAP	Male	Right	20	12	0	12	1.71	66	22.57105	9	3.6	9.5	3.8	181	134	16	0.11983	0.01717	96
M05	L	MAP	Male	Right	29	9	0	9	1.73	68	22.72044	7.5	3	7.7	3	124	86	18.5	0.09567	0.00946	90
M06	L	MAP	Male	Right	30	9	0	9	1.8	98	30.24691	9.5	3.8	8.5	3.4	150	105	19	0.09412	0.00972	91
M08	L	MAP	Male	Right	22	12	0	12	1.89	93	26.03511	7.5	3	8.5	3.4	92	46	21	0.10486	0.00935	91
M09	L	MAP	Female	Left	28	12	0	12	1.67	85.5	30.65725	8	3.2	7	2.8	145	99	17	0.05148	0.00923	90
M10	L	MAP	Male	Right	32	10	0	10	1.71	67.1	22.94723	8	3.2	8.5	3.4	222	172	21.5	0.05495	0.01138	72
M11	L	MAP	Male	Right	23	12	1	13	1.84	83.5	24.66328	9	3.6	9	5.6	234.5	187	21	0.13916	0.01418	103
M14	L	MAP	Female	Right	35	10	4.5	14.5	1.68	77	27.28175	8	3.2	6	2.4	156	111	19.5	0.04874	0.01161	79
M15	L	MAP	Male	Right	20	12	0	12	1.66	54.3	19.70533	6.5	2.6	6	2.4	212	167	18	0.07324	0.00938	72
M16	L	MAP	Female	Left	19	9	0	9	1.56	49.7	20.42242	5.5	2.2	5.5	2.2	110	67	16.5	0.10773	0.01771	72
M18	L	MAP	Male	Right	31	7	0	7	1.79	64	19.97441	11	4	11	4	175	125	23.5	0.09498	0.02879	80
M20	L	MAP	Male	Right	21	9	0	9	1.79	72	22.47121	8.5	3.4	10.5	4.2	153.5	93.5	17	0.09626	0.01781	67
M21	L	MAP	Female	Right	34	12	0.75	12.75	1.58	48	19.22769	6.5	2.6	6.5	2.6	164	108	20	0.13459	0.02386	82
M22	L	MAP	Male	Right	22	11	0	11	1.74	72.8	24.04545	8.5	3.4	7	2.8	209	166	17.5	0.07051	0.01529	90
M23	L	MAP	Male	Right	28	12	1	13	1.79	59.3	18.50754	7.5	3	6	2.4	116.5	65.5	21.5	0.14371	0.01725	90
M24	L	MAP	Female	Right	20	9	0	9	1.65	58	21.30395	5	2	4.5	1.8	165	119	17	0.0587	0.0101	82
M25	L	MAP	Female	Right	25	11	0	11	1.6	47.9	18.71094	6	2.4	5	2	143	96	17	0.06653	0.01233	91
M27	L	MAP	Female	Right	32	12	4.5	16.5	1.52	50	21.64127	4.5	1.8	4	1.6	88.5	47.5	16.5	0.07614	0.01194	72
M28	L	MAP	Female	Right	26	10	0	10	1.67	62.7	22.48198	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Participant	Hemisphere	Group	Sex	B10_Edinburgh_Handedness_Questionnaire	Age_on_Day_of_Testing	Years_at_School	Years_of_Tertiary_Education	Total_Years_of_Education	Height	Weight	BMI	Right_Hand_Maximum_Force_in_kg	_Hand_40_percent_of_Maximum_Force_in_kg	Left_Hand_Maximum_Force_in_kg	Hand_40_percent_of_Maximum_Force_in_kg	Rel	Abs	Lat	Amp	Base	SI	
C01	R	CON	Male	Left	29	12	8	20	1.71	81.4	27.83763	13	5.2	12	4.8	194	146	19	0.14517	0.01016	64	
C02	R	CON	Male	Right	23	12	7	19	1.86	133	38.44375	12	4.8	10	4	211	171	25	0.07092	0.01118	92	
C03	R	CON	Male	Right	26	12	5	17	1.85	76	22.20599	9.5	3.8	9.5	3.8	182	137	18	0.06493	0.0086	102	
C05	R	CON	Female	Right	32	12	0	12	1.81	71	21.67211	6.5	2.6	5.5	2.2	121	68	18	0.10724	0.02273	55	
C06	R	CON	Female	Right	27	12	3	15	1.75	63.4	20.70204	7	2.8	6.5	2.6	121	78	18	0.09393	0.01039	71	
C07	R	CON	Female	Right	30	12	3	15	1.74	79	26.09328	5.2	2	5.8	2.3	105	72	18.5	0.19928	0.00986	88	
C08	R	CON	Female	Right	20	12	0	12	1.59	59	23.33768	7.5	3	7.5	3	148	95.5	16.5	0.15868	0.01904	88	
C09	R	CON	Male	Right	22	12	0	12	1.74	55	18.1662	11.5	4.6	11	4.4	138	87	21	0.3425	0.01782	90	
C10	R	CON	Male	Right	19	12	0	12	1.88	67	18.95654	9.5	3.8	7.5	3	211.1	158	21.5	0.12133	0.01424	76	
C11	R	CON	Male	Right	22	10	0	10	1.88	70	19.80534	11	4.4	9.5	3.8	198	140.5	21	0.05289	0.01444	104	
C13	R	CON	Female	Right	24	12	7	19	1.68	55.3	19.59325	5.5	2.2	5.5	2.2	156	128	19.5	0.15162	0.01096	91	
C14	R	CON	Female	Right	27	12	10	22	1.75	76	24.81633	5.5	2.2	5	2	139	87	20	0.16566	0.01437	89	
C16	R	CON	Male	Right	25	12	8	20	1.79	76	23.71961	7	2.8	7.5	3	167	128	18	0.07728	0.01799	77	
C17	R	CON	Female	Right	25	12	6	18	1.65	65	23.87511	6.5	2.6	6	2.4	83	40.5	16	0.12705	0.01419	86	
C18	R	CON	Female	Right	28	12	1	13	1.57	70.1	28.43929	5	2.4	6.5	2.6	180	134	17	0.08496	0.0161	80	
C19	R	CON	Female	Right	27	12	0	12	1.72	67	22.64738	6	2.4	5	2	103	67	20	0.28985	0.0139	78	
C20	R	CON	Female	Right	24	11	0	11	1.61	58	22.37568	7	2.8	6	2.4	160	114.5	22	0.17675	0.01135	90	
C22	R	CON	Male	Right	28	12	0	12	1.8	61	18.82716	10	4	10	4	124	79	22	0.15496	0.01224	70	
C23	R	CON	Male	Ambidextr	19	12	1	13	1.71	65	22.22906	8.5	3.4	8.5	3.4	138	97	22	0.16374	0.01788	80	
C25	R	CON	Male	Right	24	8	0	8	1.78	74.9	23.63969	9.5	3.8	9.5	3.8	158	120	21	0.20633	0.01346	79	
C26	R	CON	Female	Right	22	8	0	8	1.65	84	30.85399	5.5	2.2	5.5	2.2	108	75	20	0.05231	0.00679	72	
C27	R	CON	Female	Right	33	12	0	12	1.65	68	24.97704	8.5	3.4	8	3.2	122	77	19	0.012154	0.01171	91	
C29	R	CON	Male	Right	27	12	0	12	1.64	64.7	24.05562	7.5	3	6	2.4	174	126	18.5	0.10866	0.01063	83	
C30	R	CON	Male	Right	26	11	1	12	1.75	71	23.18367	9.5	3.8	9	3.6	199	143	21	0.12551	0.00917	76	
C31	R	CON	Male	Right	40	11	0	11	1.75	53.5	17.46939	9.5	3.8	9	3.6	149	101	21	0.12321	0.00732	74	
C33	R	CON	Male	Right	22	12	1	13	1.79	69	21.53491	11	4.4	10.5	4.2	170	124.5	19	0.12239	0.01185	79	
C34	R	CON	Female	Right	23	10	0	10	1.6	65	25.39063	7.5	3	6.5	2.6	165	122	19.5	0.10086	0.02174	98	
C36	R	CON	Female	Right	23	14	5	19	1.71	67	22.91303	6	2.4	6	2.4	162	117	21	0.147	0.01742	72	
S01	R	SCZ	Male	Left	34	9	0	9	1.76	88	28.40909	9	3.6	11.5	4.6	146	102	19	0.105	0.01381	104	
S03	R	SCZ	Male	Right	38	12	3	15	1.85	100	29.21841	12	4.8	9	3.6	195.5	139	20	0.014573	0.01681	91	
S04	R	SCZ	Male	Right	29	12	3	15	1.87	81.3	23.24916	8.5	3.4	7.5	3	174	132	21	0.08426	0.01719	77	
S05	R	SCZ	Female	Right	29	12	0	12	1.68	133	47.12302	6	2.4	5.5	2.2	NA	NA	NA	NA	NA	NA	
S07	R	SCZ	Male	Left	24	9	0	9	1.68	76	26.92744	8.7	3.48	6.5	2.6	144	114	18	0.09659	0.01148	109	
S08	R	SCZ	Male	Right	29	12	6	18	1.78	96.5	30.45701	7	2.8	9	3.6	214	141	24	0.14021	0.01358	96	
S10	R	SCZ	Male	Right	32	7	0	7	1.64	80	29.7442	7.5	3	9.5	3.8	NA	NA	NA	NA	NA	NA	
S11	R	SCZ	Male	Right	25	8	2	10	1.79	104	32.45841	11.5	4.6	10	4	NA	NA	NA	NA	NA	NA	
S12	R	SCZ	Male	Right	33	11	0	11	1.81	92	28.08217	10.5	4.2	9.5	3.8	129	81	18.5	0.1125	0.01357	78	
S14	R	SCZ	Male	Right	40	6	3	9	1.85	88	25.7122	4.5	1.8	5	2	209	152	24	0.03038	0.00704	110	
S15	R	SCZ	Male	Right	29	12	4	16	1.82	136	41.05784	10.5	4.2	10	4	203	162	21.5	0.0518	0.01425	72	
S17	R	SCZ	Male	Right	23	12	0	12	1.67	59	21.15529	7	2.8	8	3.2	236.5	182	19	0.10439	0.00918	90	
S18	R	SCZ	Male	Right	28	10	0	10	1.83	89	26.57589	7.5	3	9	3.6	167	122	19.5	0.07991	0.01013	83	
S19	R	SCZ	Female	Left	20	12	4	16	1.57	69.2	28.07416	6	2.4	6	2.4	151	105	18	0.07285	0.00912	82	
S23	R	SCZ	Female	Right	27	10	0	10	1.57	117	47.46643	5.5	2.2	4	1.6	113	67	16.5	0.08568	0.0092	80	
S24	R	SCZ	Female	Right	36	12	3	15	1.67	71	25.45807	4	1.6	3.5	1.4	177	129	19	0.145	0.0205	74	
S26	R	SCZ	Male	Right	39	9	0	9	1.81	73	22.28259	8	3.2	6.5	2.6	169	117	19	0.08331	0.01047	103	
S27	R	SCZ	Female	Right	31	10	0	10	1.51	57	24.9989	6.5	2.6	6	2.4	155	111	19	0.05014	0.01588	82	
S29	R	SCZ	Female	Right	23	14	0	14	1.57	50	20.2848	4.5	1.8	4	1.6	129	85	15.5	0.06219	0.00827	104	
S31	R	SCZ	Female	Right	20	12	3	15	1.68	76.8	27.21088	8.5	3.4	8.3	3.4	113	71	21.5	0.11669	0.01525	54	
M01	R	MAP	Male	Right	21	9	0	9	1.75	68	22.20408	7	2.8	8	3.2	170	127	21	0.17223	0.0137	71	
M02	R	MAP	Female	Right	22	10	0	10	1.6	53.8	21.01563	4	1.6	4	1.6	NA	NA	NA	NA	NA	NA	
M03	R	MAP	Male	Right	20	8	0	8	1.82	86.3	26.05362	7	2.8	7.5	3	161	116	18.5	0.07783	0.00958	89	
M04	R	MAP	Male	Right	20	12	0	12	1.71	66	22.57105	9	3.6	9.5	3.8	168	125	19	0.11096	0.01219	97	
M05	R	MAP	Male	Right	29	9	0	9	1.73	68	22.72044	7.5	3	7.7	3	162	120.5	17	0.05691	0.01573	82	
M06	R	MAP	Male	Right	30	9	0	9	1.8	98	30.24691	9.5	3.8	8.5	3.4	131.5	88	21	0.07617	0.00676	96	
M08	R	MAP	Male	Right	22	12	0	12	1.89	93	26.03511	7.5	3	8.5	3.4	131	79	19	0.08064	0.01024	110	
M09	R	MAP	Female	Left	28	12	0	12	1.67	85.5	30.65725	8	3.2	7	2.8	170	128	18	0.06282	0.01197	110	
M10	R	MAP	Male	Right	32	10	0	10	1.71	67.1	22.94723	8	3.2	8.5	3.4	185	140	18	0.03526	0.01255	77	
M11	R	MAP	Male	Right	23	12	1	13	1.84	83.5	24.66328	9	3.6	9	5.6	247	203	25	0.10256	0.01058	103	
M14	R	MAP	Female	Right	35	10	4.5	14.5	1.68	77	27.28175	8	3.2	6	2.4	180	123	21	0.06122	0.00828	83	
M15	R	MAP	Male	Right	20	12	0	12	1.66	54.3	19.70533	6.5	2.6	6	2.4	199	154	19	0.05255	0.00906	72	
M16	R	MAP	Female	Left	19	9	0	9	1.56	49.7	20.42242	5.5	2.2	5.5	2.2	193	143	18	0.13375	0.02545	80	
M18	R	MAP	Male	Right	31	7	0	7	1.79	64	19.97441	11	4	11	4	107	50	22.5	0.08455	0.02928	79	
M20	R	MAP	Male	Right	21	9	0	9	1.79	72	22.47121	8.5	3.4	10.5	4.2	177	121	19.5	0.11636	0.02033	72	
M21	R	MAP	Female	Right	34	12	0.75	12.75	1.58	48	19.22769	6.5	2.6	6.5	2.6	180.5	116.5	19.5	0.11816	0.01491	86	
M22	R	MAP	Male	Right	22	11	0	11	1.74	72.8	24.04545	8.5	3.4	7	2.8	213	169.5	18.5	0.10274	0.0151	83	
M23	R	MAP	Male	Right	28	12	1	13	1.79	59.3	18.50754	7.5	3	6	2.4	230	177	20.5	0.07391	0.01345	90	
M24	R	MAP	Female	Right	20	9	0	9	1.65	58	21.30395	5	2	4.5	1.8	223	166	16.5	0.05019	0.01894	82	
M25	R	MAP	Female	Right	25	11	0	11	1.6	47.9	18.71094	6	2.4	5	2	160	113	15.5	0.05146	0.01618	92	
M27	R	MAP	Female	Right	32	12	4.5	16.5	1.52	50	21.64127	4.5	1.8	4	1.6	97.5	68.5	15	0.09972	0.02048	70	
M28	R	MAP	Female	Right	26	10	0	10	1.67	62.7	22.48198	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	

Participant	B7_ASRS_PartA_above_cut_off	B7_ASRS_PartB_above_cut_off	B9_ASSIST_Subscore_Tobacco	B9_ASSIST_Subscore_Alcohol	B9_ASSIST_Subscore_Cannabis	B9_ASSIST_Subscore_Cocaine	B9_ASSIST_Subscore_Methamphetamine	B9_ASSIST_Subscore_Inhalants	B9_ASSIST_Subscore_Sedatives	B9_ASSIST_Subscore_Hallucinogens	B9_ASSIST_Subscore_Opiods	B9_ASSIST_Subscore_Methaqualone	B9_ASSIST_Total_Score	B8_Mental_Effort_Prior_to_MRI	B8_Mental_Effort_Prior_to_EEG	B8_Mental_Effort_During_Resting_Eyes_Open_Phase	B8_Mental_Effort_During_Resting_Eyes_Closed_Phase	B8_Mental_Effort_During_Event_Related_Potential_Phase
C01	3	5	0	0	0	0	0	0	0	0	0	0	24	0.9	1.7	24.3	0.9	11.3
C02	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C03	0	1	0	3	2	0	0	0	0	0	0	0	14	0	0	6.1	6.1	6.1
C05	2	3	0	9	0	0	0	0	0	0	0	0	15	4.3	6.1	4.3	5.2	11.3
C06	5	4	9	11	0	3	0	0	0	0	2	0	28	6.1	13	10.4	5.2	68.7
C07	1	2	9	3	0	0	0	0	0	0	0	0	15	0	0	12.2	17.4	27
C08	2	3	4	2	2	0	0	0	0	0	0	0	10	13.9	0.9	0	47.8	78.3
C09	2	1	0	0	0	0	0	0	0	0	0	0	0	72.2	82.6	67.8	57.4	64.3
C10	1	2	0	0	0	0	0	0	0	0	0	0	3	15.7	0.9	0	0	0.9
C11	0	0	0	2	5	0	0	0	0	0	0	0	13	40.9	40	31.3	33	33.9
C13	3	2	6	3	0	0	0	0	0	0	0	0	12	3.5	2.6	17.4	2.6	47.8
C14	1	2	0	2	0	0	0	0	0	0	0	0	5	0	0	0	0	0
C16	1	3	2	9	2	0	0	0	0	0	0	0	20	0	0	40	0	73
C17	2	3	0	2	6	0	0	0	0	0	0	0	14	0	50.4	0	0	5.2
C18	1	2	0	0	0	0	0	0	0	0	0	0	3	0	0	20.9	0	70.4
C19	4	2	0	0	0	0	0	0	0	0	0	0	6	21.7	93.9	33	20.9	21.7
C20	0	1	0	6	0	0	0	0	0	0	0	0	9	47.8	32.2	58.3	75.7	42.6
C22	2	2	18	25	0	0	0	0	0	0	0	0	34	0	0	0	0	0
C23	0	4	9	21	0	0	0	0	0	0	0	0	30	78.3	57.4	34.8	17.4	38.3
C25	2	1	0	0	0	0	0	0	0	0	0	0	3	49.6	47	7	1.7	5.2
C26	1	2	21	2	0	0	0	0	0	0	0	0	5	27	5.2	10.4	4.3	40.9
C27	0	0	0	0	0	0	0	0	0	0	0	0	0	4.3	2.6	1.7	1.7	0.9
C29	1	1	15	3	0	0	0	0	0	0	0	0	9	13.9	18.3	5.2	7.8	8.7
C30	1	1	12	3	0	0	0	0	0	0	0	0	9	0	0	0	0	0
C31	1	4	26	3	0	0	0	0	0	0	0	0	6	0.9	9.6	2.6	0.9	61.7
C33	1	2	0	0	0	0	0	0	0	0	0	0	0	15.7	9.6	6.1	0	0
C34	2	1	4	3	0	0	0	0	0	0	0	0	12	0	0	19.1	0	0
C36	1	2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	9.6	5.2	77.4	42.6	97.4
S01	0	3	0	3	0	0	0	0	0	0	0	3	15	29.6	7.8	39.1	57.4	11.3
S03	2	5	0	0	0	0	0	0	0	0	0	0	0	NA	NA	NA	NA	NA
S04	2	2	21	12	3	0	0	0	0	0	0	0	21	0	28.7	4.3	4.3	3.5
S05	4	5	24	0	0	0	0	0	0	0	0	0	3	8.7	13.9	90.4	70.4	98.3
S07	2	5	18	0	0	0	0	0	0	0	0	0	6	17.4	31.3	91.3	73.9	93
S08	1	0	15	5	0	0	0	0	0	0	0	0	8	52.2	49.6	75.7	82.6	67
S10	2	1	25	11	18	3	26	3	3	0	3	3	94	0	0	17.4	7.8	15.7
S11	3	6	24	7	0	0	0	0	0	0	0	0	13	NA	NA	NA	NA	NA
S12	1	3	17	0	0	0	3	0	0	0	0	0	12	2.6	3.5	3.5	36.5	47.8
S14	NA	NA	18	5	0	0	0	0	0	0	0	0	8	97.39	5.22	3.48	4.35	5.22
S15	3	3	6	9	9	0	0	0	3	0	0	0	36	NA	NA	NA	NA	NA
S17	4	2	3	0	0	0	0	0	0	0	0	0	6	0	7.8	3.5	3.5	15.7
S18	1	4	3	11	9	0	0	0	0	0	0	0	32	85.2	2.6	93.9	93.9	93
S19	2	3	0	0	0	0	0	0	0	0	0	0	3	33	26.1	63.5	36.5	36.5
S23	1	0	0	2	0	0	0	0	0	0	0	0	5	0	20	0	8.7	0
S24	1	3	30	3	0	0	0	0	0	0	0	0	21	1.7	1.7	52.2	0.9	32.2
S26	2	4	21	3	0	0	0	0	0	0	0	0	12	6.1	24.3	11.3	1.7	42.6
S27	4	6	0	9	0	0	0	0	0	0	0	0	12	54.8	70.4	74.8	63.5	73
S29	2	2	0	0	0	0	0	0	0	0	0	0	3	94.8	80.9	0	93.9	101.7
S31	1	3	0	3	0	0	0	0	0	0	0	0	9	0	0	0	0	0
M01	2	4	11	0	0	0	0	0	0	0	0	0	6	67	71.3	22.6	80.9	55.7
M02	1	2	15	0	0	0	8	0	0	0	0	0	20	47.8	47.8	75.7	75.7	75.7
M03	0	1	9	0	0	0	3	0	0	0	0	0	12	13.9	13	12.2	12.2	11.3
M04	2	2	24	12	15	0	30	0	0	0	0	0	66	6.1	4.3	3.5	41.7	2.6
M05	3	3	18	0	9	0	5	0	0	0	0	3	32	0	0	0	0	0
M06	1	2	18	9	6	0	6	0	0	0	0	3	36	5.2	5.2	26.1	1.7	26.1
M08	4	7	24	5	6	0	3	0	0	0	3	0	35	13	23.5	18.3	10.4	24.3
M09	2	1	18	5	13	6	14	0	16	0	0	14	86	5.2	6.1	2.6	89.6	0.9
M10	1	2	21	4	0	0	6	0	0	0	0	0	25	47.8	33.9	60.9	86.1	50.4
M11	3	3	15	11	6	0	5	3	0	0	0	0	34	78.3	87	82.6	80	80.9
M14	2	8	9	3	0	3	18	0	0	0	0	0	46	12.2	28.7	7.8	26.1	24.3
M15	0	2	21	0	6	0	0	0	0	0	0	0	24	20	3.5	2.6	2.6	36.5
M16	3	2	13	19	16	0	0	0	0	0	0	0	44	6.1	0.9	0	0	0
M18	1	1	31	6	10	0	10	0	0	0	0	3	41	0	100	0	0	100
M20	1	7	24	3	0	0	33	0	3	0	0	0	54	40	23.5	79.1	79.1	51.3
M21	1	6	15	0	0	0	3	0	3	0	0	0	30	96.5	96.5	98.3	97.4	97.4
M22	0	0	22	21	31	0	38	0	4	0	3	12	127	55.7	54.8	0	0	0
M23	2	6	14	0	3	0	6	0	0	0	0	0	27	0	0.9	10.4	0	48.7
M24	2	2	30	0	0	0	9	0	0	0	0	6	27	85.2	93.9	10.4	94.8	15.7
M25	4	3	21	10	31	0	9	0	0	0	0	0	59	0	0	0	22.6	24.3
M27	2	1	21	9	5	0	13	0	0	0	0	5	47	0	0	0	0	0
M28	1	0	15	3	0	0	11	0	0	0	0	3	29	84.3	100	87	73.9	97.4

Participant	Years_with_Diagnosis	B11_Extrapyramidal_side_effects_Score	B1_PANSS_Total_Score	B1_PANSS_Positive_Subscale_Score	B1_PANSS_Negative_Subscale_Score	B1_PANSS_General_Psychopathology_Score	B2_CDSS_Total_Score	B3_YMRS_Total_Score	B4_HAMD_Total_Score	B5_Clinical_Global_Impression_Severity_Score	B6_Global_Assessment_of_Functioning_Score
C01	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C02	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C03	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C05	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C06	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C07	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C08	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C09	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C10	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C11	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C13	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C14	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C16	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C17	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C18	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C19	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C20	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C22	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C23	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C25	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C26	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C27	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C29	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C30	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C31	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C33	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C34	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C36	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
S01	11	2	70	17	16	37	0	6	15	4	45
S03	13	0	71	16	23	32	1	5	6	4	50
S04	3	3	36	8	11	17	2	0	4	2	60
S05	7	4	47	12	14	21	2	2	1	4	61
S07	3	0	39	8	10	21	4	4	3	2	71
S08	13	4	66	11	28	27	0	8	2	4	55.5
S10	19	1	50	12	15	23	7	0	2	2	60
S11	9	0	30	7	7	16	3	1	0	2	71
S12	12	1	40	7	13	20	4	10	1	3	65.5
S14	4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
S15	7	3	48	13	13	22	6	2	3	4	55.5
S17	1	0	39	7	11	21	3	2	4	3	30
S18	6	3	64	17	12	35	4	3	5	4	51
S19	1	0	40	7	11	22	6	0	4	1	80
S23	3	1	46	8	19	19	0	0	2	2	61
S24	15	0	74	24	21	29	5	0	13	4	60
S26	20	2	46	15	8	23	1	0	4	2	60
S27	9	0	100	22	28	50	2	0	12	4	51
S29	1	0	45	9	13	23	3	0	4	2	75.5
S31	2	3	33	8	8	17	0	0	3	2	75.5
M01	0.75	0	46	7	12	27	6	3	2	1	70
M02	1	1	32	7	9	16	0	1	0	1	90
M03	1	3	47	8	12	27	1	4	5	4	55.5
M04	0.25	0	45	8	15	22	0	0	0	1	90
M05	0.25	0	77	13	27	37	1	2	6	2	60
M06	4	2	51	7	25	19	0	0	0	3	49
M08	1.5	6	69	10	21	38	4	5	8	4	31
M09	0.25	1	30	7	7	16	0	2	4	3	65.5
M10	12	0	36	7	11	18	4	1	5	3	70
M11	6	0	33	7	9	17	0	2	0	2	81
M14	7	0	59	19	15	25	8	3	2	4	45.5
M15	0.25	0	38	10	10	18	0	0	0	3	60
M16	0.33	0	43	12	11	20	0	3	1	2	65.5
M18	4	0	49	7	21	21	0	2	3	2	65
M20	4	3	77	30	16	31	1	3	5	3	58
M21	2	2	42	7	12	23	5	0	12	3	69
M22	0.25	0	55	13	14	28	1	0	5	2	60
M23	13	9	53	10	16	27	9	2	7	2	68
M24	7	5	52	7	22	23	1	0	2	2	60
M25	1	0	37	8	11	18	2	1	3	2	75.5
M27	1	0	44	8	14	22	0	0	2	2	65
M28	3	0	44	7	11	26	8	2	6	2	75

Participant	Cumulative_antipsychotic_dose_expressed_as_chlorpromazine_equivalents	Prescribed_First_Generation_Antipsychotics	Prescribed_Second_Generation_Antipsychotics	Prescribed_Mood_Stabalizers	Prescribed_Anticholinergics	Prescribed_Any_Antiphsychotic	Prescribed_Antipsychotic_Categories	Prescribed_Moodstabalizer_Categories	Prescribed_clozapine	Prescribed_olanzapine	Prescribed_risperidone_oral	Prescribed_quetiapine	Prescribed_haloperidol
C01	0	No	No	No	No	No	None	None	No	No	No	No	No
C02	0	No	No	No	No	No	None	None	No	No	No	No	No
C03	0	No	No	No	No	No	None	None	No	No	No	No	No
C05	0	No	No	No	No	No	None	None	No	No	No	No	No
C06	0	No	No	No	No	No	None	None	No	No	No	No	No
C07	0	No	No	No	No	No	None	None	No	No	No	No	No
C08	0	No	No	No	No	No	None	None	No	No	No	No	No
C09	0	No	No	No	No	No	None	None	No	No	No	No	No
C10	0	No	No	No	No	No	None	None	No	No	No	No	No
C11	0	No	No	No	No	No	None	None	No	No	No	No	No
C13	0	No	No	No	No	No	None	None	No	No	No	No	No
C14	0	No	No	No	No	No	None	None	No	No	No	No	No
C16	0	No	No	No	No	No	None	None	No	No	No	No	No
C17	0	No	No	No	No	No	None	None	No	No	No	No	No
C18	0	No	No	No	No	No	None	None	No	No	No	No	No
C19	0	No	No	No	No	No	None	None	No	No	No	No	No
C20	0	No	No	No	No	No	None	None	No	No	No	No	No
C22	0	No	No	No	No	No	None	None	No	No	No	No	No
C23	0	No	No	No	No	No	None	None	No	No	No	No	No
C25	0	No	No	No	No	No	None	None	No	No	No	No	No
C26	0	No	No	No	No	No	None	None	No	No	No	No	No
C27	0	No	No	No	No	No	None	None	No	No	No	No	No
C29	0	No	No	No	No	No	None	None	No	No	No	No	No
C30	0	No	No	No	No	No	None	None	No	No	No	No	No
C31	0	No	No	No	No	No	None	None	No	No	No	No	No
C33	0	No	No	No	No	No	None	None	No	No	No	No	No
C34	0	No	No	No	No	No	None	None	No	No	No	No	No
C36	0	No	No	No	No	No	None	None	No	No	No	No	No
S01	100	Yes	No	No	No	Yes	First_gene	None	No	No	No	No	No
S03	200	No	Yes	No	No	Yes	Second_ge	None	No	No	Yes	No	No
S04	1000	Yes	No	No	No	Yes	First_gene	None	No	No	No	No	No
S05	0	No	No	No	No	No	None	None	No	No	No	No	No
S07	1500	Yes	Yes	Yes	Yes	Yes	Both_gene	Sodium_va	Yes	No	No	No	Yes
S08	800	No	Yes	No	No	Yes	Second_ge	None	Yes	No	No	No	No
S10	0	No	Yes	No	No	Yes	Second_ge	None	Yes	No	No	No	No
S11	0	No	No	No	No	No	None	None	No	No	No	No	No
S12	0	No	Yes	No	Yes	Yes	Second_ge	None	No	No	Yes	No	No
S14	NA	Yes	No	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
S15	400	No	Yes	No	No	Yes	Second_ge	None	Yes	No	No	No	No
S17	200	No	Yes	No	Yes	Yes	Second_ge	None	No	No	Yes	No	No
S18	250	No	Yes	No	No	Yes	Second_ge	None	No	No	Yes	No	No
S19	0	No	Yes	No	No	Yes	Second_ge	None	No	No	No	Yes	No
S23	300	No	Yes	No	No	Yes	Second_ge	None	No	Yes	No	No	No
S24	1150	Yes	Yes	Yes	No	Yes	Both_gene	Sodium_va	Yes	No	No	No	No
S26	100	Yes	No	Yes	Yes	Yes	First_gene	Sodium_va	No	No	No	No	No
S27	500	No	Yes	No	No	Yes	Second_ge	None	Yes	No	No	No	No
S29	0	No	No	No	No	No	None	None	No	No	No	No	No
S31	300	No	Yes	Yes	No	Yes	Second_ge	Lithium	No	Yes	No	No	No
M01	200	Yes	No	No	No	Yes	First_gene	None	No	No	No	No	No
M02	100	Yes	No	No	Yes	Yes	First_gene	None	No	No	No	No	Yes
M03	200	Yes	No	No	No	Yes	First_gene	None	No	No	No	No	Yes
M04	0	Yes	No	No	No	Yes	First_gene	None	No	No	No	No	Yes
M05	0	Yes	No	No	No	Yes	First_gene	None	No	No	No	No	Yes
M06	100	No	Yes	No	No	Yes	Second_ge	None	No	No	Yes	No	No
M08	450	Yes	No	No	Yes	Yes	First_gene	None	No	No	No	No	No
M09	0	Yes	No	Yes	Yes	Yes	First_gene	Sodium_va	No	No	No	No	Yes
M10	200	Yes	No	No	No	Yes	First_gene	None	No	No	No	No	Yes
M11	0	No	No	No	No	No	None	None	No	No	No	No	No
M14	100	No	Yes	No	No	Yes	Second_ge	None	No	No	Yes	No	No
M15	250	Yes	No	No	Yes	Yes	First_gene	None	No	No	No	No	Yes
M16	50	Yes	No	No	Yes	Yes	First_gene	None	No	No	No	No	Yes
M18	125	Yes	No	No	No	Yes	First_gene	None	No	No	No	No	Yes
M20	100	No	Yes	No	Yes	Yes	Second_ge	None	No	No	Yes	No	No
M21	225	Yes	Yes	No	No	Yes	Both_gene	None	No	No	Yes	No	No
M22	150	Yes	No	No	No	Yes	First_gene	None	No	No	No	No	Yes
M23	250	Yes	No	Yes	Yes	Yes	First_gene	Sodium_va	No	No	No	No	Yes
M24	0	No	No	Yes	No	No	None	Sodium_va	No	No	No	No	No
M25	125	Yes	No	No	Yes	Yes	First_gene	None	No	No	No	No	Yes
M27	75	Yes	No	No	No	Yes	First_gene	None	No	No	No	No	Yes
M28	250	Yes	No	No	No	Yes	First_gene	None	No	No	No	No	Yes

Participant	Prescribed_chlorpromazine	Prescribed_trifluoperazine	Prescribed_sulpride	Prescribed_flupentixol_long_acting_injectable	Prescribed_zuclopenthixol_decanoate_long_acting_injectable	Prescribed_fluphenazine_long_acting_injectable	Prescribed_lithium	Prescribed_sodium_valproate	Prescribed_fluoxetine	Prescribed_citalopram	Prescribed_amitriptiline	Prescribed_orphenadrine
C01	No	No	No	No	No	No	No	No	No	No	No	No
C02	No	No	No	No	No	No	No	No	No	No	No	No
C03	No	No	No	No	No	No	No	No	No	No	No	No
C05	No	No	No	No	No	No	No	No	No	No	No	No
C06	No	No	No	No	No	No	No	No	No	No	No	No
C07	No	No	No	No	No	No	No	No	No	No	No	No
C08	No	No	No	No	No	No	No	No	No	No	No	No
C09	No	No	No	No	No	No	No	No	No	No	No	No
C10	No	No	No	No	No	No	No	No	No	No	No	No
C11	No	No	No	No	No	No	No	No	No	No	No	No
C13	No	No	No	No	No	No	No	No	No	No	No	No
C14	No	No	No	No	No	No	No	No	No	No	No	No
C16	No	No	No	No	No	No	No	No	No	No	No	No
C17	No	No	No	No	No	No	No	No	No	No	No	No
C18	No	No	No	No	No	No	No	No	No	No	No	No
C19	No	No	No	No	No	No	No	No	No	No	No	No
C20	No	No	No	No	No	No	No	No	No	No	No	No
C22	No	No	No	No	No	No	No	No	No	No	No	No
C23	No	No	No	No	No	No	No	No	No	No	No	No
C25	No	No	No	No	No	No	No	No	No	No	No	No
C26	No	No	No	No	No	No	No	No	No	No	No	No
C27	No	No	No	No	No	No	No	No	No	No	No	No
C29	No	No	No	No	No	No	No	No	No	No	No	No
C30	No	No	No	No	No	No	No	No	No	No	No	No
C31	No	No	No	No	No	No	No	No	No	No	No	No
C33	No	No	No	No	No	No	No	No	No	No	No	No
C34	No	No	No	No	No	No	No	No	No	No	No	No
C36	No	No	No	No	No	No	No	No	No	No	No	No
S01	No	No	No	No	Yes	No	No	No	No	No	Yes	No
S03	No	No	No	No	No	No	NA	No	No	No	No	No
S04	No	Yes	No	No	No	No	No	No	Yes	No	No	No
S05	No	No	No	No	No	No	NA	No	No	No	No	No
S07	No	No	Yes	No	No	No	No	Yes	No	No	No	Yes
S08	No	No	No	No	No	No	No	No	No	No	No	No
S10	No	No	No	No	No	No	No	No	No	No	No	No
S11	No	No	No	No	No	No	NA	No	No	No	No	No
S12	No	No	No	No	No	No	No	No	No	No	No	Yes
S14	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
S15	No	No	No	No	No	No	NA	No	No	No	No	No
S17	No	No	No	No	No	No	No	No	No	Yes	No	Yes
S18	No	No	No	No	No	No	No	No	No	No	No	No
S19	No	No	No	No	No	No	No	No	No	No	No	No
S23	No	No	No	No	No	No	NA	No	No	No	No	No
S24	No	No	No	No	No	Yes	No	Yes	No	No	No	No
S26	No	No	No	No	Yes	No	No	Yes	No	No	No	Yes
S27	No	No	No	No	No	No	NA	No	No	No	No	No
S29	No	No	No	No	No	No	No	No	Yes	No	No	No
S31	No	No	No	No	No	No	Yes	No	No	No	No	No
M01	Yes	No	No	No	No	No	No	No	No	No	No	No
M02	No	No	No	No	No	No	No	No	No	No	No	Yes
M03	No	No	No	No	Yes	No	No	No	No	No	No	No
M04	No	No	No	No	No	No	No	No	No	No	No	No
M05	No	No	No	No	No	No	No	No	No	No	No	No
M06	No	No	No	No	No	No	No	No	No	No	No	No
M08	Yes	No	No	Yes	No	No	No	No	No	No	No	Yes
M09	No	No	No	No	No	No	No	Yes	No	No	No	Yes
M10	No	No	No	No	No	No	No	No	No	No	No	No
M11	No	No	No	No	No	No	No	No	No	No	No	No
M14	No	No	No	No	No	No	No	No	Yes	No	Yes	No
M15	No	No	No	No	No	No	No	No	No	No	No	Yes
M16	No	No	No	No	No	No	No	No	No	No	No	Yes
M18	No	No	No	No	No	No	No	No	No	No	No	No
M20	No	No	No	No	No	No	No	No	No	No	No	Yes
M21	No	No	No	Yes	No	No	NA	No	No	No	No	No
M22	No	No	No	No	No	No	No	No	No	No	No	No
M23	No	No	No	No	No	No	No	Yes	No	No	No	Yes
M24	No	No	No	No	No	No	No	Yes	No	No	No	No
M25	No	No	No	No	No	No	No	No	No	No	No	Yes
M27	No	No	No	No	No	No	No	No	No	No	No	No
M28	No	No	No	No	No	No	No	No	No	No	No	No

B.1.2 Group Differences for CSP measures: F-Statistics

```
F-test with Kenward-Roger approximation; computing time: 0.12 sec.
large : Rel ~ Group + (1 | Participant)
small : Rel ~ (1 | Participant)
         stat     ndf     ddf F.scaling p.value
Ftest  1.9943  2.0000 63.9687         1  0.1445
F-test with Kenward-Roger approximation; computing time: 0.16 sec.
large : Abs ~ Group + (1 | Participant)
small : Abs ~ (1 | Participant)
         stat     ndf     ddf F.scaling p.value
Ftest  1.5641  2.0000 63.9554         1  0.2172
F-test with Kenward-Roger approximation; computing time: 0.14 sec.
large : Lat ~ Group + (1 | Participant)
small : Lat ~ (1 | Participant)
         stat     ndf     ddf F.scaling p.value
Ftest  1.7433  2.0000 64.0304         1  0.1831
F-test with Kenward-Roger approximation; computing time: 0.12 sec.
large : Amp ~ Group + (1 | Participant)
small : Amp ~ (1 | Participant)
         stat     ndf     ddf F.scaling  p.value
Ftest  7.3639  2.0000 63.6504         1 0.001328 **
F-test with Kenward-Roger approximation; computing time: 0.16 sec.
large : SI ~ Group + (1 | Participant)
small : SI ~ (1 | Participant)
         stat     ndf     ddf F.scaling p.value
Ftest  2.4276  2.0000 64.0514         1 0.09632 .
F-test with Kenward-Roger approximation; computing time: 0.30 sec.
large : Base ~ Group + (1 | Participant)
small : Base ~ (1 | Participant)
         stat     ndf     ddf F.scaling p.value
Ftest  1.0417  2.0000 63.9575         1  0.3588
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

B.1.2.1 Group Differences for CSP measures: Multiple Comparisons

```
 Simultaneous Tests for General Linear Hypotheses

Multiple Comparisons of Means: Tukey Contrasts


Fit: lme4::lmer(formula = Rel ~ Group + (1 | Participant), data = CLb120,
    REML = TRUE)

Linear Hypotheses:
               Estimate Std. Error z value Pr(>|z|)
MAP - CON == 0   15.504     10.884   1.424    0.231
SCZ - CON == 0   21.273     11.444   1.859    0.189
SCZ - MAP == 0    5.769     12.168   0.474    0.635
(Adjusted p values reported -- fdr method)
```

```
 Simultaneous Tests for General Linear Hypotheses

Multiple Comparisons of Means: Tukey Contrasts


Fit: lme4::lmer(formula = Abs ~ Group + (1 | Participant), data = CLb120,
    REML = TRUE)

Linear Hypotheses:
               Estimate Std. Error z value Pr(>|z|)
MAP - CON == 0   12.468      9.632   1.294    0.293
SCZ - CON == 0   16.491     10.130   1.628    0.293
SCZ - MAP == 0    4.023     10.770   0.374    0.709
(Adjusted p values reported -- fdr method)


 Simultaneous Tests for General Linear Hypotheses

Multiple Comparisons of Means: Tukey Contrasts


Fit: lme4::lmer(formula = Lat ~ Group + (1 | Participant), data = CLb120,
    REML = TRUE)

Linear Hypotheses:
               Estimate Std. Error z value Pr(>|z|)
MAP - CON == 0  -0.9990     0.5375  -1.858    0.189
SCZ - CON == 0  -0.3336     0.5645  -0.591    0.554
SCZ - MAP == 0   0.6653     0.6002   1.109    0.401
(Adjusted p values reported -- fdr method)


 Simultaneous Tests for General Linear Hypotheses

Multiple Comparisons of Means: Tukey Contrasts


Fit: lme4::lmer(formula = Amp ~ Group + (1 | Participant), data = CLb120,
    REML = TRUE)

Linear Hypotheses:
                Estimate Std. Error z value Pr(>|z|)
MAP - CON == 0 -0.032897   0.010451  -3.148  0.00247 **
SCZ - CON == 0 -0.036208   0.011024  -3.285  0.00247 **
SCZ - MAP == 0 -0.003311   0.011721  -0.282  0.77756
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
(Adjusted p values reported -- fdr method)


 Simultaneous Tests for General Linear Hypotheses
```

```
Multiple Comparisons of Means: Tukey Contrasts


Fit: lme4::lmer(formula = SI ~ Group + (1 | Participant), data = CLb120,
    REML = TRUE)

Linear Hypotheses:
               Estimate Std. Error z value Pr(>|z|)
MAP - CON == 0    4.078      3.217   1.268   0.3074
SCZ - CON == 0    7.300      3.375   2.163   0.0916 .
SCZ - MAP == 0    3.222      3.588   0.898   0.3692
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
(Adjusted p values reported -- fdr method)


 Simultaneous Tests for General Linear Hypotheses

Multiple Comparisons of Means: Tukey Contrasts


Fit: lme4::lmer(formula = Base ~ Group + (1 | Participant), data = CLb120,
    REML = TRUE)

Linear Hypotheses:
                  Estimate Std. Error z value Pr(>|z|)
MAP - CON == 0  0.0012617  0.0011852   1.065    0.431
SCZ - CON == 0 -0.0005704  0.0012464  -0.458    0.647
SCZ - MAP == 0 -0.0018321  0.0013252  -1.383    0.431
(Adjusted p values reported -- fdr method)
```

B.2 Potential Confounding Factors at 120RMT

B.2.1 Spearman Correlations of Demographic and Clinical variables against CSP measures at 120RMT

Table B.1 – Full Table of Spearman's Correlations of Demographic variables against CSP Measures at 120RMT

	Relelative CSP (ms)		Absolute CSP (ms)		Latency to MEP (ms)		MEP Amplitude (mV)		Baseline Muscle Activity (mV)		Stimulation Intensity (%)	
All Groups	Spearman's rho	p-value	Spearman's rho	p-value	Spearman's rho	p-value	Spearman's rho	p-value	Spearman's rho	p-value	Spearman's rho	p-value
Age_on_Day_of_Testing	-0.006	0.959	-0.008	0.946	0.214	0.087	-0.133	0.289	-0.073	0.562	0.008	0.951
Years_at_School	0.004	0.975	0.031	0.805	-0.007	0.958	0.257	0.039 *	0.295	0.017 *	-0.042	0.737
Total_Years_of_Education	-0.028	0.825	0.008	0.948	0.085	0.499	0.209	0.095	0.211	0.092	-0.123	0.328
Weight	0.056	0.659	0.028	0.823	0.284	0.022 *	-0.169	0.179	-0.222	0.076	0.071	0.574
BMI	-0.063	0.616	-0.049	0.696	0.108	0.393	-0.209	0.095	-0.199	0.111	0.04	0.752
B9_ASSIST_Subscore_Tobacco	0.202	0.112	0.166	0.194	-0.052	0.686	-0.317	0.011 *	-0.012	0.926	0.069	0.589
B9_ASSIST_Subscore_Cannabis	0.02	0.877	0.001	0.994	-0.239	0.059	-0.141	0.269	0.027	0.835	0.031	0.812
B9_ASSIST_Subscore_Methamphetamine	0.053	0.682	0.054	0.672	-0.25	0.048 *	-0.174	0.172	0.169	0.184	0.152	0.235
B9_ASSIST_Total_Score	0.055	0.67	0.04	0.754	-0.205	0.107	-0.189	0.137	0.122	0.34	-0.126	0.325
CON Only												
Age_on_Day_of_Testing	-0.178	0.373	-0.207	0.299	-0.01	0.959	0.278	0.161	0.137	0.495	-0.119	0.554
Years_at_School	-0.036	0.86	0.068	0.735	-0.026	0.898	0.012	0.953	0.396	0.041 *	0.191	0.34
Total_Years_of_Education	-0.149	0.46	-0.02	0.923	-0.13	0.517	0.051	0.799	0.172	0.392	0.113	0.574
Weight	-0.07	0.73	-0.205	0.305	-0.012	0.953	-0.139	0.488	-0.071	0.726	-0.173	0.388
BMI	-0.354	0.07	-0.411	0.033 *	-0.085	0.674	-0.038	0.851	0.06	0.766	-0.066	0.742
B9_ASSIST_Subscore_Tobacco	-0.126	0.548	-0.057	0.787	0.119	0.57	-0.054	0.797	0.043	0.837	-0.235	0.257
B9_ASSIST_Subscore_Cannabis	0.182	0.384	0.136	0.516	-0.218	0.295	-0.288	0.163	-0.02	0.923	-0.163	0.436
B9_ASSIST_Subscore_Methamphetamine												
B9_ASSIST_Total_Score	0.019	0.927	0.074	0.726	-0.021	0.921	-0.032	0.879	0.239	0.249	-0.328	0.11
MAP Only												
Age_on_Day_of_Testing	-0.097	0.677	-0.06	0.795	0.383	0.086	-0.301	0.185	-0.003	0.989	-0.097	0.674
Years_at_School	-0.027	0.907	-0.03	0.898	-0.142	0.538	0.063	0.786	-0.145	0.531	0.177	0.443
Total_Years_of_Education	-0.079	0.733	-0.052	0.821	-0.083	0.721	-0.028	0.903	-0.086	0.71	0.065	0.780
Weight	0.194	0.401	0.193	0.401	0.321	0.155	-0.003	0.989	-0.46	0.036	0.309	0.173
BMI	0.143	0.535	0.189	0.412	0.059	0.798	-0.227	0.32	-0.513	0.019 *	0.266	0.244
B9_ASSIST_Subscore_Tobacco	0.186	0.42	0.14	0.545	-0.232	0.312	-0.308	0.174	-0.001	0.998	-0.119	0.608
B9_ASSIST_Subscore_Cannabis	-0.023	0.92	0.036	0.878	-0.369	0.1	-0.08	0.731	-0.04	0.865	0.219	0.340
B9_ASSIST_Subscore_Methamphetamine	0.038	0.871	0.052	0.822	-0.363	0.106	-0.453	0.039 *	0.232	0.311	0.012	0.959
B9_ASSIST_Total_Score	-0.09	0.697	-0.053	0.821	-0.55	0.01 *	-0.31	0.172	0.098	0.672	-0.018	0.937
SCZ Only												
Age_on_Day_of_Testing	0.114	0.662	0.114	0.662	0.362	0.153	-0.304	0.236	-0.138	0.598	0.064	0.807
Years_at_School	0.119	0.650	0.158	0.544	-0.275	0.285	0.304	0.236	0.635	0.006 *	-0.321	0.209
Total_Years_of_Education	0.262	0.309	0.278	0.281	0.061	0.815	0.193	0.458	0.520	0.032	-0.431	0.084
Weight	-0.097	0.711	-0.100	0.701	0.449	0.071	-0.223	0.388	-0.071	0.787	-0.199	0.443
BMI	-0.153	0.557	-0.103	0.694	0.306	0.233	-0.110	0.673	-0.086	0.744	-0.272	0.290
B9_ASSIST_Subscore_Tobacco	0.441	0.077	0.310	0.226	0.318	0.214	-0.530	0.029 *	-0.108	0.680	0.158	0.544
B9_ASSIST_Subscore_Cannabis	-0.119	0.649	-0.216	0.405	0.084	0.750	0.028	0.916	0.094	0.719	-0.387	0.124
B9_ASSIST_Subscore_Methamphetamine	-0.204	0.432	-0.204	0.432	-0.154	0.555	0.000	1.000	0.255	0.323	-0.204	0.432
B9_ASSIST_Total_Score	0.153	0.558	0.041	0.877	0.273	0.290	-0.448	0.071	-0.216	0.406	-0.424	0.090

Table B.2 – Full Table of Spearman's Correlations of Duration of Diagnosis against CSP Measures at 120RMT

	Relelative CSP (ms)		**Absolute CSP (ms)**		**Latency to MEP (ms)**		**MEP Amplitude (mV)**		**Baseline Muscle Activity (mV)**		**Stimulation Intensity (%)**	
Both Clinical Groups	**Spearman's rho**	**p-value**	**Spearman's rho**	**p-value**	**Spearman's rho**	**p-value**	**Spearman's rho**	**p-value**	**Spearman's rho**	**p-value**	**Spearman's rho**	**p-value**
Duration of Diagnosis (yrs)	0.186	0.263	0.19	0.254	**0.551**	**<0.0001***	-0.307	0.061	-0.115	0.491	-0.021	0.9
MAP Only												
Duration of Diagnosis (yrs)	0.083	0.721	0.055	0.812	**0.549**	**0.01***	0.021	0.928	0.212	0.356	-0.084	0.718
SCZ Only												
Duration of Diagnosis (yrs)	0.237	0.36	0.296	0.249	0.376	0.137	**-0.608**	**0.01***	-0.247	0.34	-0.023	0.929

B.2.2 ANCOVA of Group Differences for CSP measures, accounting for potential confounders as a result of Spearman Correlations of Demographic variables against CSP measures: F-Statistics and Relevant Multiple Comparisons

B.2.2.1 Absolute CSP

```
F-test with Kenward-Roger approximation; computing time: 0.15 sec.
large : Abs ~ BMI + Group + (1 | Participant)
small : Abs ~ BMI + (1 | Participant)
       stat    ndf    ddf F.scaling p.value
Ftest  1.755  2.000 62.556         1  0.1813
```

B.2.2.2 Latency to CSP

```
F-test with Kenward-Roger approximation; computing time: 0.15 sec.
large : Lat ~ B9_ASSIST_Subscore_Methamphetamine + Group + (1 | Participant)
small : Lat ~ B9_ASSIST_Subscore_Methamphetamine + (1 | Participant)
         stat     ndf     ddf F.scaling p.value
Ftest  0.1008  2.0000 60.8598         1  0.9043
F-test with Kenward-Roger approximation; computing time: 0.22 sec.
large : Lat ~ B9_ASSIST_Subscore_Methaqualone + Group + (1 | Participant)
small : Lat ~ B9_ASSIST_Subscore_Methaqualone + (1 | Participant)
         stat     ndf     ddf F.scaling p.value
```

```
Ftest  0.3233  2.0000 61.1846         1   0.725
F-test with Kenward-Roger approximation; computing time: 0.18 sec.
large : Lat ~ B9_ASSIST_Total_Score + Group + (1 | Participant)
small : Lat ~ B9_ASSIST_Total_Score + (1 | Participant)
         stat     ndf     ddf F.scaling p.value
Ftest  0.1199  2.0000 61.1647         1  0.8872
```

B.2.2.3 MEP Amplitude

```
F-test with Kenward-Roger approximation; computing time: 0.14 sec.
large : Amp ~ B9_ASSIST_Subscore_Tobacco + Group + (1 | Participant)
small : Amp ~ B9_ASSIST_Subscore_Tobacco + (1 | Participant)
         stat     ndf     ddf F.scaling p.value
Ftest  5.0814  2.0000 60.9081         1  0.0091 **
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

 Simultaneous Tests for General Linear Hypotheses

Multiple Comparisons of Means: User-defined Contrasts


Fit: lme4::lmer(formula = Amp ~ B9_ASSIST_Subscore_Tobacco + Group +
    (1 | Participant), data = CLb120, REML = TRUE)

Linear Hypotheses:
                 Estimate Std. Error z value Pr(>|z|)
CON vs MAP == 0 -0.027568   0.013248  -2.081  0.05616 .
CON vs SCZ == 0 -0.035794   0.011520  -3.107  0.00567 **
MAP vs SCZ == 0 -0.008226   0.012895  -0.638  0.52354
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
(Adjusted p values reported -- fdr method)

F-test with Kenward-Roger approximation; computing time: 0.20 sec.
large : Amp ~ B9_ASSIST_Subscore_Methamphetamine + Group + (1 | Participant)
small : Amp ~ B9_ASSIST_Subscore_Methamphetamine + (1 | Participant)
         stat     ndf     ddf F.scaling  p.value
Ftest  6.6705  2.0000 60.3907         1 0.002413 **
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

 Simultaneous Tests for General Linear Hypotheses

Multiple Comparisons of Means: User-defined Contrasts


Fit: lme4::lmer(formula = Amp ~ B9_ASSIST_Subscore_Methamphetamine +
    Group + (1 | Participant), data = CLb120, REML = TRUE)

Linear Hypotheses:
                 Estimate Std. Error z value Pr(>|z|)
CON vs MAP == 0 -0.032948   0.013273  -2.482  0.01958 *
CON vs SCZ == 0 -0.038160   0.011294  -3.379  0.00218 **
```

```
MAP vs SCZ == 0 -0.005211   0.014111  -0.369  0.71190
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
(Adjusted p values reported -- fdr method)

F-test with Kenward-Roger approximation; computing time: 0.22 sec.
large : Amp ~ B9_ASSIST_Subscore_Methaqualone + Group + (1 | Participant)
small : Amp ~ B9_ASSIST_Subscore_Methaqualone + (1 | Participant)
         stat     ndf     ddf F.scaling  p.value
Ftest  6.6828  2.0000 60.9051         1 0.002377 **
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

 Simultaneous Tests for General Linear Hypotheses

Multiple Comparisons of Means: User-defined Contrasts


Fit: lme4::lmer(formula = Amp ~ B9_ASSIST_Subscore_Methaqualone +
    Group + (1 | Participant), data = CLb120, REML = TRUE)

Linear Hypotheses:
                 Estimate Std. Error z value Pr(>|z|)
CON vs MAP == 0 -0.029832   0.011486  -2.597  0.01410 *
CON vs SCZ == 0 -0.037953   0.011175  -3.396  0.00205 **
MAP vs SCZ == 0 -0.008121   0.012434  -0.653  0.51368
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
(Adjusted p values reported -- fdr method)
```

B.2.2.4 Baseline Muscle Contraction

```
F-test with Kenward-Roger approximation; computing time: 0.17 sec.
large : Base ~ Years_at_School + Group + (1 | Participant)
small : Base ~ Years_at_School + (1 | Participant)
         stat     ndf     ddf F.scaling p.value
Ftest  1.2572  2.0000 62.9708         1  0.2915
F-test with Kenward-Roger approximation; computing time: 0.19 sec.
large : Base ~ Weight + Group + (1 | Participant)
small : Base ~ Weight + (1 | Participant)
         stat     ndf     ddf F.scaling p.value
Ftest  0.4879  2.0000 62.4383         1  0.6162
F-test with Kenward-Roger approximation; computing time: 0.19 sec.
large : Base ~ BMI + Group + (1 | Participant)
small : Base ~ BMI + (1 | Participant)
         stat     ndf     ddf F.scaling p.value
Ftest  0.5096  2.0000 62.5387         1  0.6032
F-test with Kenward-Roger approximation; computing time: 0.21 sec.
large : Base ~ Total_Years_of_Education + Group + (1 | Participant)
small : Base ~ Total_Years_of_Education + (1 | Participant)
         stat     ndf     ddf F.scaling p.value
Ftest  1.0927  2.0000 63.0578         1  0.3416
```

B.2.3 ANCOVA of Group Differences for CSP measures, accounting for potential confounders as a result of Spearman Correlations of Duration of diagnosis against CSP measures: F-Statistics

```
F-test with Kenward-Roger approximation; computing time: 0.18 sec.
large : Lat ~ Years_with_Diagnosis + Group + (1 | Participant)
small : Lat ~ Years_with_Diagnosis + (1 | Participant)
         stat     ndf     ddf F.scaling p.value
Ftest  0.0099  1.0000 35.5716         1  0.9212

F-test with Kenward-Roger approximation; computing time: 0.21 sec.
large : Amp ~ Years_with_Diagnosis + Group + (1 | Participant)
small : Amp ~ Years_with_Diagnosis + (1 | Participant)
         stat     ndf     ddf F.scaling p.value
Ftest  0.0546  1.0000 34.7153         1  0.8165
```

B.2.4 ANCOVA of Group Differences for CSP measures, accounting for potential medication confounders: F-Statistics and Relevant Multiple Comparisons

B.2.4.1 Relative CSP

```
F-test with Kenward-Roger approximation; computing time: 0.18 sec.
large : Rel ~ Prescribed_First_Generation_Antipsychotics + Group + (1 |
    Participant)
small : Rel ~ Prescribed_First_Generation_Antipsychotics + (1 | Participant)
         stat     ndf     ddf F.scaling p.value
Ftest  0.0015  1.0000 36.0212         1  0.9697
F-test with Kenward-Roger approximation; computing time: 0.24 sec.
large : Rel ~ Prescribed_Second_Generation_Antipsychotics + Group + (1 |
    Participant)
small : Rel ~ Prescribed_Second_Generation_Antipsychotics + (1 | Participant)
         stat     ndf     ddf F.scaling p.value
Ftest  0.5808  1.0000 36.8429         1  0.4509
F-test with Kenward-Roger approximation; computing time: 0.18 sec.
large : Rel ~ Prescribed_Antipsychotic_Categories + Group + (1 | Participant)
small : Rel ~ Prescribed_Antipsychotic_Categories + (1 | Participant)
         stat     ndf     ddf F.scaling p.value
Ftest  0.0231  1.0000 33.7158         1  0.8802
F-test with Kenward-Roger approximation; computing time: 0.19 sec.
large : Rel ~ Prescribed_clozapine + Group + (1 | Participant)
small : Rel ~ Prescribed_clozapine + (1 | Participant)
         stat     ndf     ddf F.scaling p.value
Ftest  0.0835  1.0000 35.3764         1  0.7744
F-test with Kenward-Roger approximation; computing time: 0.20 sec.
large : Rel ~ Prescribed_haloperidol + Group + (1 | Participant)
small : Rel ~ Prescribed_haloperidol + (1 | Participant)
         stat     ndf     ddf F.scaling p.value
Ftest  0.1883  1.0000 34.4549         1   0.667
```

B.2.4.2 Absolute CSP

```
F-test with Kenward-Roger approximation; computing time: 0.17 sec.
large : Abs ~ Prescribed_First_Generation_Antipsychotics + Group + (1 |
    Participant)
small : Abs ~ Prescribed_First_Generation_Antipsychotics + (1 | Participant)
         stat     ndf     ddf F.scaling p.value
Ftest  0.0127  1.0000 36.0012         1   0.911
F-test with Kenward-Roger approximation; computing time: 0.18 sec.
large : Abs ~ Prescribed_Second_Generation_Antipsychotics + Group + (1 |
    Participant)
small : Abs ~ Prescribed_Second_Generation_Antipsychotics + (1 | Participant)
         stat     ndf     ddf F.scaling p.value
Ftest  0.6918  1.0000 36.9523         1  0.4109
F-test with Kenward-Roger approximation; computing time: 0.19 sec.
large : Abs ~ Prescribed_Antipsychotic_Categories + Group + (1 | Participant)
small : Abs ~ Prescribed_Antipsychotic_Categories + (1 | Participant)
         stat     ndf     ddf F.scaling p.value
Ftest  0.0634  1.0000 33.8137         1  0.8028
F-test with Kenward-Roger approximation; computing time: 0.16 sec.
large : Abs ~ Prescribed_clozapine + Group + (1 | Participant)
small : Abs ~ Prescribed_clozapine + (1 | Participant)
         stat     ndf     ddf F.scaling p.value
Ftest  0.0492  1.0000 35.4110         1  0.8257
F-test with Kenward-Roger approximation; computing time: 0.20 sec.
large : Abs ~ Prescribed_haloperidol + Group + (1 | Participant)
small : Abs ~ Prescribed_haloperidol + (1 | Participant)
         stat     ndf     ddf F.scaling p.value
Ftest  0.0737  1.0000 34.3712         1  0.7876
```

B.2.4.3 Latency to MEP

```
F-test with Kenward-Roger approximation; computing time: 0.16 sec.
large : Lat ~ Prescribed_First_Generation_Antipsychotics + Group + (1 |
    Participant)
small : Lat ~ Prescribed_First_Generation_Antipsychotics + (1 | Participant)
         stat     ndf     ddf F.scaling p.value
Ftest  0.8568  1.0000 36.0373         1  0.3608
F-test with Kenward-Roger approximation; computing time: 0.16 sec.
large : Lat ~ Prescribed_Second_Generation_Antipsychotics + Group + (1 |
    Participant)
small : Lat ~ Prescribed_Second_Generation_Antipsychotics + (1 | Participant)
         stat     ndf     ddf F.scaling p.value
Ftest  0.7757  1.0000 36.6928         1  0.3842
F-test with Kenward-Roger approximation; computing time: 0.18 sec.
large : Lat ~ Prescribed_Antipsychotic_Categories + Group + (1 | Participant)
small : Lat ~ Prescribed_Antipsychotic_Categories + (1 | Participant)
         stat     ndf     ddf F.scaling p.value
Ftest  0.0374  1.0000 33.6225         1  0.8478
F-test with Kenward-Roger approximation; computing time: 0.17 sec.
large : Lat ~ Prescribed_clozapine + Group + (1 | Participant)
small : Lat ~ Prescribed_clozapine + (1 | Participant)
        stat    ndf    ddf F.scaling p.value
```

```
Ftest  0.000  1.000 35.366         1  0.9954
F-test with Kenward-Roger approximation; computing time: 0.18 sec.
large : Lat ~ Prescribed_haloperidol + Group + (1 | Participant)
small : Lat ~ Prescribed_haloperidol + (1 | Participant)
         stat     ndf     ddf F.scaling p.value
Ftest  0.0989  1.0000 34.4955         1   0.755
```

B.2.4.4 MEP Amplitude

```
F-test with Kenward-Roger approximation; computing time: 0.16 sec.
large : Amp ~ Prescribed_First_Generation_Antipsychotics + Group + (1 |
    Participant)
small : Amp ~ Prescribed_First_Generation_Antipsychotics + (1 | Participant)
        stat    ndf    ddf F.scaling p.value
Ftest  0.000  1.000 35.635         1  0.9974
F-test with Kenward-Roger approximation; computing time: 0.16 sec.
large : Amp ~ Prescribed_Second_Generation_Antipsychotics + Group + (1 |
    Participant)
small : Amp ~ Prescribed_Second_Generation_Antipsychotics + (1 | Participant)
         stat     ndf     ddf F.scaling p.value
Ftest  0.2462  1.0000 37.1935         1  0.6227
F-test with Kenward-Roger approximation; computing time: 0.18 sec.
large : Amp ~ Prescribed_Antipsychotic_Categories + Group + (1 | Participant)
small : Amp ~ Prescribed_Antipsychotic_Categories + (1 | Participant)
         stat     ndf     ddf F.scaling p.value
Ftest  0.0005  1.0000 33.9965         1   0.983
F-test with Kenward-Roger approximation; computing time: 0.16 sec.
large : Amp ~ Prescribed_clozapine + Group + (1 | Participant)
small : Amp ~ Prescribed_clozapine + (1 | Participant)
         stat     ndf     ddf F.scaling p.value
Ftest  0.0044  1.0000 35.3144         1  0.9473
F-test with Kenward-Roger approximation; computing time: 0.15 sec.
large : Amp ~ Prescribed_haloperidol + Group + (1 | Participant)
small : Amp ~ Prescribed_haloperidol + (1 | Participant)
         stat     ndf     ddf F.scaling p.value
Ftest  0.4723  1.0000 33.6751         1  0.4966
```

B.2.4.5 Baseline Muscle Contraction

```
F-test with Kenward-Roger approximation; computing time: 0.18 sec.
large : Base ~ Prescribed_First_Generation_Antipsychotics + Group + (1 |
    Participant)
small : Base ~ Prescribed_First_Generation_Antipsychotics + (1 | Participant)
         stat     ndf     ddf F.scaling p.value
Ftest  0.5743  1.0000 35.9838         1  0.4535
F-test with Kenward-Roger approximation; computing time: 0.17 sec.
large : Base ~ Prescribed_Second_Generation_Antipsychotics + Group +
    (1 | Participant)
small : Base ~ Prescribed_Second_Generation_Antipsychotics + (1 | Participant)
         stat     ndf     ddf F.scaling p.value
Ftest  1.2341  1.0000 36.9971         1  0.2738
F-test with Kenward-Roger approximation; computing time: 0.16 sec.
large : Base ~ Prescribed_Antipsychotic_Categories + Group + (1 | Participant)
```

```
small : Base ~ Prescribed_Antipsychotic_Categories + (1 | Participant)
         stat     ndf     ddf F.scaling p.value
Ftest  0.2873  1.0000 33.8399         1  0.5954
F-test with Kenward-Roger approximation; computing time: 0.19 sec.
large : Base ~ Prescribed_clozapine + Group + (1 | Participant)
small : Base ~ Prescribed_clozapine + (1 | Participant)
         stat     ndf     ddf F.scaling p.value
Ftest  0.8626  1.0000 35.4343         1  0.3593
F-test with Kenward-Roger approximation; computing time: 0.18 sec.
large : Base ~ Prescribed_haloperidol + Group + (1 | Participant)
small : Base ~ Prescribed_haloperidol + (1 | Participant)
         stat     ndf     ddf F.scaling p.value
Ftest  0.0833  1.0000 34.2748         1  0.7747
```

B.2.4.6 Stimulation Intensity

```
F-test with Kenward-Roger approximation; computing time: 0.16 sec.
large : SI ~ Prescribed_First_Generation_Antipsychotics + Group + (1 |
    Participant)
small : SI ~ Prescribed_First_Generation_Antipsychotics + (1 | Participant)
         stat     ndf     ddf F.scaling p.value
Ftest  1.3959  1.0000 36.0343         1  0.2452
F-test with Kenward-Roger approximation; computing time: 0.18 sec.
large : SI ~ Prescribed_Second_Generation_Antipsychotics + Group + (1 |
    Participant)
small : SI ~ Prescribed_Second_Generation_Antipsychotics + (1 | Participant)
         stat     ndf     ddf F.scaling p.value
Ftest  4.4922  1.0000 36.3961         1 0.04094 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
F-test with Kenward-Roger approximation; computing time: 0.16 sec.
large : SI ~ Prescribed_Antipsychotic_Categories + Group + (1 | Participant)
small : SI ~ Prescribed_Antipsychotic_Categories + (1 | Participant)
        stat    ndf    ddf F.scaling p.value
Ftest  2.072  1.000 33.355         1  0.1593
F-test with Kenward-Roger approximation; computing time: 0.16 sec.
large : SI ~ Prescribed_clozapine + Group + (1 | Participant)
small : SI ~ Prescribed_clozapine + (1 | Participant)
         stat     ndf     ddf F.scaling p.value
Ftest  0.5034  1.0000 35.1806         1  0.4827
F-test with Kenward-Roger approximation; computing time: 0.24 sec.
large : SI ~ Prescribed_haloperidol + Group + (1 | Participant)
small : SI ~ Prescribed_haloperidol + (1 | Participant)
         stat     ndf     ddf F.scaling p.value
Ftest  0.6121  1.0000 34.7968         1  0.4393
```

B.3 140% Resting motor threshold cortical silent period

B.3.1 Raw Data for 140RMT

Raw data for the "140RMT" dataset presented in parts below:

Participant	StimLevel	Hemisphere	Group	Sex	B10_Edinburgh_Handedness_Questionnaire	Age_on_Day_of_Testing	Years_at_School	Years_of_Tertiary_Education	Total_Years_of_Education	Height	Weight	BMI	Right_Hand_Maximum_Force_in_kg	Right_Hand_40_percent_of_Maximum_Force_in_kg	Left_Hand_Maximum_Force_in_kg	Left_Hand_40_percent_of_Maximum_Force_in_kg	Rel	Abs	Lat	Amp	Base	SI
C01	140RMT	L	CON	Male	Left	29	12	8	20	1.71	81.4	27.83763	13	5.2	12	4.8	258	210	19	0.101	0.013	78
C02	140RMT	L	CON	Male	Right	23	12	7	19	1.86	133	38.44375	12	4.8	10	4	132	88	22	0.084	0.007	105
C03	140RMT	L	CON	Male	Right	26	12	5	17	1.85	76	22.20599	9.5	3.8	9.5	3.8	170	125	20	0.089	0.009	94
C05	140RMT	L	CON	Female	Right	32	12	0	12	1.81	71	21.67211	6.5	2.6	5.5	2.2	200	149	18.5	0.087	0.026	97
C06	140RMT	L	CON	Female	Right	27	12	3	15	1.75	63.4	20.70204	7	2.8	6.5	2.6	147	102	18	0.109	0.018	92
C07	140RMT	L	CON	Female	Right	30	12	3	15	1.74	79	26.09328	5.2	2	5.8	2.3	76.5	25.5	16.5	0.116	0.021	109
C08	140RMT	L	CON	Female	Right	20	12	0	12	1.59	59	23.33768	7.5	3	7.5	3	160	120	17	0.13	0.017	102
C09	140RMT	L	CON	Male	Right	22	12	0	12	1.74	55	18.1662	11.5	4.6	11	4.4	159	112.5	17	0.075	0.022	105
C10	140RMT	L	CON	Male	Right	19	12	0	12	1.88	67	18.95654	9.5	3.8	7.5	3	229	175	21.5	0.062	0.009	92
C11	140RMT	L	CON	Male	Right	22	10	0	10	1.88	70	19.80534	11	4.4	9.5	3.8	209	149	19.5	0.086	0.014	92
C13	140RMT	L	CON	Female	Right	24	12	7	19	1.68	55.3	19.59325	5.5	2.2	5.5	2.2	147	98	18.5	0.068	0.016	105
C14	140RMT	L	CON	Female	Right	27	12	10	22	1.75	76	24.81633	5.5	2.2	5	2	151	99	20	0.114	0.012	102
C16	140RMT	L	CON	Male	Right	25	12	8	20	1.79	76	23.71961	7	2.8	7.5	3	174	115	21	0.086	0.011	83
C17	140RMT	L	CON	Female	Right	25	12	6	18	1.65	65	23.87511	6.5	2.6	6	2.4	124	73	15	0.134	0.014	90
C18	140RMT	L	CON	Female	Right	28	12	1	13	1.57	70.1	28.43929	5	2.4	6.5	2.6	222	174.5	18	0.12	0.027	95
C19	140RMT	L	CON	Female	Right	27	12	0	12	1.72	67	22.64738	6	2.4	5	2	170	129	19	0.152	0.018	99
C20	140RMT	L	CON	Female	Right	24	11	0	11	1.61	58	22.37568	7	2.8	6	2.4	187	137	21	0.146	0.009	104
C22	140RMT	L	CON	Male	Right	28	12	0	12	1.8	61	18.82716	10	4	10	4	223	180	23	0.062	0.021	78
C23	140RMT	L	CON	Male	Ambidextr	19	12	1	13	1.71	65	22.22906	8.5	3.4	8.5	3.4	147	104.5	20	0.108	0.016	97
C25	140RMT	L	CON	Male	Right	24	8	0	8	1.78	74.9	23.63969	9.5	3.8	9.5	3.8	158	117	20	0.214	0.009	87
C26	140RMT	L	CON	Female	Right	22	8	0	8	1.65	84	30.85399	5.5	2.2	5.5	2.2	164	131	21	0.062	0.012	88
C27	140RMT	L	CON	Female	Right	33	12	0	12	1.65	68	24.97704	8.5	3.4	8	3.2	117	71	19	0.134	0.01	101
C29	140RMT	L	CON	Male	Right	27	12	0	12	1.64	64.7	24.05562	7.5	3	6	2.4	163	109	22	0.13	0.018	80
C30	140RMT	L	CON	Male	Right	26	11	1	12	1.75	71	23.18367	9.5	3.8	9	3.6	209	159.5	22	0.125	0.012	84
C31	140RMT	L	CON	Male	Right	40	11	0	11	1.75	53.5	17.46939	9.5	3.8	9	3.6	162	112	19	0.128	0.01	97
C33	140RMT	L	CON	Male	Right	22	12	1	13	1.79	69	21.53491	11	4.4	10.5	4.2	194	136	17	0.127	0.016	102
C34	140RMT	L	CON	Female	Right	23	10	0	10	1.6	65	25.39063	7.5	3	6.5	2.6	NA	NA	NA	NA	NA	NA
C36	140RMT	L	CON	Female	Right	23	14	5	19	1.71	67	22.91303	6	2.4	6	2.4	214.5	168	19	0.049	0.011	94
S01	140RMT	L	SCZ	Male	Left	34	9	0	9	1.76	88	28.40909	9	3.6	11.5	4.6	NA	NA	NA	NA	NA	NA
S03	140RMT	L	SCZ	Male	Right	38	12	3	15	1.85	100	29.21841	12	4.8	9	3.6	NA	NA	NA	NA	NA	NA
S04	140RMT	L	SCZ	Male	Right	29	12	3	15	1.87	81.3	23.24916	8.5	3.4	7.5	3	182.5	134	22	0.156	0.029	95
S05	140RMT	L	SCZ	Female	Right	29	12	0	12	1.68	133	47.12302	6	2.4	5.5	2.2	NA	NA	NA	NA	NA	NA
S07	140RMT	L	SCZ	Male	Left	24	9	0	9	1.68	76	26.92744	8.7	3.48	6.5	2.6	NA	NA	NA	NA	NA	NA
S08	140RMT	L	SCZ	Male	Right	29	12	6	18	1.78	96.5	30.45701	7	2.8	9	3.6	NA	NA	NA	NA	NA	NA
S10	140RMT	L	SCZ	Male	Right	32	7	0	7	1.64	80	29.7442	7.5	3	9.5	3.8	NA	NA	NA	NA	NA	NA
S11	140RMT	L	SCZ	Male	Right	25	8	2	10	1.79	104	32.45841	11.5	4.6	10	4	NA	NA	NA	NA	NA	NA
S12	140RMT	L	SCZ	Male	Right	33	11	0	11	1.81	92	28.08217	10.5	4.2	9.5	3.8	199	150	19	0.092	0.022	91
S14	140RMT	L	SCZ	Male	Right	40	6	3	9	1.85	88	25.7122	4.5	1.8	5	2	NA	NA	NA	NA	NA	NA
S15	140RMT	L	SCZ	Male	Right	29	12	4	16	1.82	136	41.05784	10.5	4.2	10	4	235	188	18	0.061	0.011	81
S17	140RMT	L	SCZ	Male	Right	23	12	0	12	1.67	59	21.15529	7	2.8	8	3.2	259	213	17	0.06	0.01	110
S18	140RMT	L	SCZ	Male	Right	28	10	0	10	1.83	89	26.57589	7.5	3	9	3.6	165	116.5	20	0.076	0.007	94
S19	140RMT	L	SCZ	Female	Left	20	12	4	16	1.57	69.2	28.07416	6	2.4	6	2.4	174	130	17.5	0.131	0.016	97
S23	140RMT	L	SCZ	Female	Right	27	10	0	10	1.57	117	47.46643	5.5	2.2	4	1.6	143	90	16	0.075	0.007	88
S24	140RMT	L	SCZ	Female	Right	36	12	3	15	1.67	71	25.45807	4	1.6	3.5	1.4	234	185.5	18.5	0.146	0.02	84
S26	140RMT	L	SCZ	Male	Right	39	9	0	9	1.81	73	22.28259	8	3.2	6.5	2.6	NA	NA	NA	NA	NA	NA
S27	140RMT	L	SCZ	Female	Right	31	10	0	10	1.51	57	24.9989	6.5	2.6	6	2.4	152	98.5	19	0.055	0.012	99
S29	140RMT	L	SCZ	Female	Right	23	14	0	14	1.57	50	20.2848	4.5	1.8	4	1.6	NA	NA	NA	NA	NA	NA
S31	140RMT	L	SCZ	Female	Right	20	12	3	15	1.68	76.8	27.21088	8.5	3.4	8.3	3.4	195	147.5	22	0.109	0.015	77
M01	140RMT	L	MAP	Male	Right	21	9	0	9	1.75	68	22.20408	7	2.8	8	3.2	178	132	20	0.096	0.015	87
M02	140RMT	L	MAP	Female	Right	22	10	0	10	1.6	53.8	21.01563	4	1.6	4	1.6	NA	NA	NA	NA	NA	NA
M03	140RMT	L	MAP	Male	Right	20	8	0	8	1.82	86.3	26.05362	7	2.8	7.5	3	NA	NA	NA	NA	NA	NA
M04	140RMT	L	MAP	Male	Right	20	12	0	12	1.71	66	22.57105	9	3.6	9.5	3.8	NA	NA	NA	NA	NA	NA
M05	140RMT	L	MAP	Male	Right	29	9	0	9	1.73	68	22.72044	7.5	3	7.7	3	171	116	18.5	0.068	0.011	105
M06	140RMT	L	MAP	Male	Right	30	9	0	9	1.8	98	30.24691	9.5	3.8	8.5	3.4	165	117	19.5	0.088	0.01	106
M08	140RMT	L	MAP	Male	Right	22	12	0	12	1.89	93	26.03511	7.5	3	8.5	3.4	149	103	21	0.086	0.007	106
M09	140RMT	L	MAP	Female	Left	28	12	0	12	1.67	85.5	30.65725	8	3.2	7	2.8	223	178.5	18	0.05	0.014	105
M10	140RMT	L	MAP	Male	Right	32	10	0	10	1.71	67.1	22.94723	8	3.2	8.5	3.4	254	208	21.5	0.074	0.016	84
M11	140RMT	L	MAP	Male	Right	23	12	1	13	1.84	83.5	24.66328	9	3.6	9	5.6	NA	NA	NA	NA	NA	NA
M14	140RMT	L	MAP	Female	Right	35	10	4.5	14.5	1.68	77	27.28175	8	3.2	6	2.4	171	116	20	0.055	0.013	92
M15	140RMT	L	MAP	Male	Right	20	12	0	12	1.66	54.3	19.70533	6.5	2.6	6	2.4	262	207	18	0.083	0.011	84
M16	140RMT	L	MAP	Female	Left	19	9	0	9	1.56	49.7	20.42242	5.5	2.2	5.5	2.2	142	99	16	0.129	0.018	84
M18	140RMT	L	MAP	Male	Right	31	7	0	7	1.79	64	19.97441	11	4	11	4	168	126	25	0.068	0.031	94
M20	140RMT	L	MAP	Male	Right	21	9	0	9	1.79	72	22.47121	8.5	3.4	10.5	4.2	183.5	135.5	20	0.15	0.028	78
M21	140RMT	L	MAP	Female	Right	34	12	0.75	12.8	1.58	48	19.22769	6.5	2.6	6.5	2.6	211	162	18.5	0.097	0.007	95
M22	140RMT	L	MAP	Male	Right	22	11	0	11	1.74	72.8	24.04545	8.5	3.4	7	2.8	213	171	17.5	0.079	0.02	105
M23	140RMT	L	MAP	Male	Right	28	12	1	13	1.79	59.3	18.50754	7.5	3	6	2.4	244	199	21	0.151	0.013	105
M24	140RMT	L	MAP	Female	Right	20	9	0	9	1.65	58	21.30395	5	2	4.5	1.8	191	137	17	0.067	0.009	95
M25	140RMT	L	MAP	Female	Right	25	11	0	11	1.6	47.9	18.71094	6	2.4	5	2	217	169	17.5	0.066	0.012	106
M27	140RMT	L	MAP	Female	Right	32	12	4.5	16.5	1.52	50	21.64127	4.5	1.8	4	1.6	158	113.5	15	0.158	0.018	84
M28	140RMT	L	MAP	Female	Right	26	10	0	10	1.67	62.7	22.48198	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Participant	StimLevel	Hemisphere	Group	Sex	B10_Edinburgh_Handedness_Questionnaire	Age_on_Day_of_Testing	Years_at_School	Years_of_Tertiary_Education	Total_Years_of_Education	Height	Weight	BMI	Right_Hand_Maximum_Force_in_kg	Right_Hand_40_percent_of_Maximum_Force_in_kg	Left_Hand_Maximum_Force_in_kg	Left_Hand_40_percent_of_Maximum_Force_in_kg	Rel	Abs	Lat	Amp	Base	SI
C01	140RMT	R	CON	Male	Left	29	12	8	20	1.71	81.4	27.83763	13	5.2	12	4.8	241	187	16.5	0.102	0.013	74
C02	140RMT	R	CON	Male	Right	23	12	7	19	1.86	133	38.44375	12	4.8	10	4	284	238	21	0.072	0.009	108
C03	140RMT	R	CON	Male	Right	26	12	5	17	1.85	76	22.20599	9.5	3.8	9.5	3.8	194	148	19	0.066	0.008	110
C05	140RMT	R	CON	Female	Right	32	12	0	12	1.81	71	21.67211	6.5	2.6	5.5	2.2	129	78	19	0.1	0.014	64
C06	140RMT	R	CON	Female	Right	27	12	3	15	1.75	63.4	20.70204	7	2.8	6.5	2.6	197	153	19	0.127	0.021	83
C07	140RMT	R	CON	Female	Right	30	12	3	15	1.74	79	26.09328	5.2	2	5.8	2.3	127.5	99	18.5	0.257	0.012	102
C08	140RMT	R	CON	Female	Right	20	12	0	12	1.59	59	23.33768	7.5	3	7.5	3	193	140	15	0.121	0.023	102
C09	140RMT	R	CON	Male	Right	22	12	0	12	1.74	55	18.1662	11.5	4.6	11	4.4	182	126	15	0.181	0.02	105
C10	140RMT	R	CON	Male	Right	19	12	0	12	1.88	67	18.95654	9.5	3.8	7.5	3	236	183	22	0.116	0.02	88
C11	140RMT	R	CON	Male	Right	22	10	0	10	1.88	70	19.80534	11	4.4	9.5	3.8	NA	NA	NA	NA	NA	NA
C13	140RMT	R	CON	Female	Right	24	12	7	19	1.68	55.3	19.59325	5.5	2.2	5.5	2.2	198	150	17.5	0.092	0.009	106
C14	140RMT	R	CON	Female	Right	27	12	10	22	1.75	76	24.81633	5.5	2.2	5	2	159	104.5	20	0.177	0.016	104
C16	140RMT	R	CON	Male	Right	25	12	8	20	1.79	76	23.71961	7	2.8	7.5	3	184	133	25	0.076	0.008	90
C17	140RMT	R	CON	Female	Right	25	12	6	18	1.65	65	23.87511	6.5	2.6	6	2.4	141	96	19	0.174	0.013	101
C18	140RMT	R	CON	Female	Right	28	12	1	13	1.57	70.1	28.43929	5	2.4	6.5	2.6	251	206	18	0.068	0.023	94
C19	140RMT	R	CON	Female	Right	27	12	0	12	1.72	67	22.64738	6	2.4	5	2	152	107	20	0.248	0.014	91
C20	140RMT	R	CON	Female	Right	24	11	0	11	1.61	58	22.37568	7	2.8	6	2.4	228.5	179.5	21.5	0.107	0.014	105
C22	140RMT	R	CON	Male	Right	28	12	0	12	1.8	61	18.82716	10	4	10	4	239	185.5	22	0.19	0.009	81
C23	140RMT	R	CON	Male	Ambidextr	19	12	1	13	1.71	65	22.22906	8.5	3.4	8.5	3.4	213	174	21	0.149	0.015	94
C25	140RMT	R	CON	Male	Right	24	8	0	8	1.78	74.9	23.63969	9.5	3.8	9.5	3.8	193	154.5	20	0.224	0.011	92
C26	140RMT	R	CON	Female	Right	22	8	0	8	1.65	84	30.85399	5.5	2.2	5.5	2.2	175	147	20	0.111	0.006	84
C27	140RMT	R	CON	Female	Right	33	12	0	12	1.65	68	24.97704	8.5	3.4	8	3.2	163	115	18	0.126	0.012	106
C29	140RMT	R	CON	Male	Right	27	12	0	12	1.64	64.7	24.05562	7.5	3	6	2.4	243	197	18.5	0.117	0.011	97
C30	140RMT	R	CON	Male	Right	26	11	1	12	1.75	71	23.18367	9.5	3.8	9	3.6	222	177	21	0.113	0.012	88
C31	140RMT	R	CON	Male	Right	40	11	0	11	1.75	53.5	17.46939	9.5	3.8	9	3.6	175	124	20	0.117	0.01	87
C33	140RMT	R	CON	Male	Right	22	12	1	13	1.79	69	21.53491	11	4.4	10.5	4.2	201	153	19.5	0.131	0.014	92
C34	140RMT	R	CON	Female	Right	23	10	0	10	1.6	65	25.39063	7.5	3	6.5	2.6	NA	NA	NA	NA	NA	NA
C36	140RMT	R	CON	Female	Right	23	14	5	19	1.71	67	22.91303	6	2.4	6	2.4	231.5	183	18.5	0.105	0.014	84
S01	140RMT	R	SCZ	Male	Left	34	9	0	9	1.76	88	28.40909	9	3.6	11.5	4.6	NA	NA	NA	NA	NA	NA
S03	140RMT	R	SCZ	Male	Right	38	12	3	15	1.85	100	29.21841	12	4.8	9	3.6	234	182	21	0.065	0.016	106
S04	140RMT	R	SCZ	Male	Right	29	12	3	15	1.87	81.3	23.24916	8.5	3.4	7.5	3	214.5	173.5	21	0.11	0.017	90
S05	140RMT	R	SCZ	Female	Right	29	12	0	12	1.68	133	47.12302	6	2.4	5.5	2.2	NA	NA	NA	NA	NA	NA
S07	140RMT	R	SCZ	Male	Left	24	9	0	9	1.68	76	26.92744	8.7	3.48	6.5	2.6	NA	NA	NA	NA	NA	NA
S08	140RMT	R	SCZ	Male	Right	29	12	6	18	1.78	96.5	30.45701	7	2.8	9	3.6	NA	NA	NA	NA	NA	NA
S10	140RMT	R	SCZ	Male	Right	32	7	0	7	1.64	80	29.7442	7.5	3	9.5	3.8	NA	NA	NA	NA	NA	NA
S11	140RMT	R	SCZ	Male	Right	25	8	2	10	1.79	104	32.45841	11.5	4.6	10	4	NA	NA	NA	NA	NA	NA
S12	140RMT	R	SCZ	Male	Right	33	11	0	11	1.81	92	28.08217	10.5	4.2	9.5	3.8	145	97	18.5	0.089	0.013	91
S14	140RMT	R	SCZ	Male	Right	40	6	3	9	1.85	88	25.7122	4.5	1.8	5	2	NA	NA	NA	NA	NA	NA
S15	140RMT	R	SCZ	Male	Right	29	12	4	16	1.82	136	41.05784	10.5	4.2	10	4	217	175	22.5	0.043	0.015	84
S17	140RMT	R	SCZ	Male	Right	23	12	0	12	1.67	59	21.15529	7	2.8	8	3.2	270	227	19	0.128	0.008	105
S18	140RMT	R	SCZ	Male	Right	28	10	0	10	1.83	89	26.57589	7.5	3	9	3.6	186	142	21	0.107	0.008	97
S19	140RMT	R	SCZ	Female	Left	20	12	4	16	1.57	69.2	28.07416	6	2.4	6	2.4	163	116	17	0.064	0.01	95
S23	140RMT	R	SCZ	Female	Right	27	10	0	10	1.57	117	47.46643	5.5	2.2	4	1.6	165	124	18.5	0.071	0.008	94
S24	140RMT	R	SCZ	Female	Right	36	12	3	15	1.67	71	25.45807	4	1.6	3.5	1.4	255	210	19	0.159	0.01	87
S26	140RMT	R	SCZ	Male	Right	39	9	0	9	1.81	73	22.28259	8	3.2	6.5	2.6	NA	NA	NA	NA	NA	NA
S27	140RMT	R	SCZ	Female	Right	31	10	0	10	1.51	57	24.9989	6.5	2.6	6	2.4	160	115	17	0.088	0.013	95
S29	140RMT	R	SCZ	Female	Right	23	14	0	14	1.57	50	20.2848	4.5	1.8	4	1.6	NA	NA	NA	NA	NA	NA
S31	140RMT	R	SCZ	Female	Right	20	12	3	15	1.68	76.8	27.21088	8.5	3.4	8.3	3.4	168	123	22	0.084	0.018	63
M01	140RMT	R	MAP	Male	Right	21	9	0	9	1.75	68	22.20408	7	2.8	8	3.2	178	134	21	0.168	0.018	83
M02	140RMT	R	MAP	Female	Right	22	10	0	10	1.6	53.8	21.01563	4	1.6	4	1.6	NA	NA	NA	NA	NA	NA
M03	140RMT	R	MAP	Male	Right	20	8	0	8	1.82	86.3	26.05362	7	2.8	7.5	3	NA	NA	NA	NA	NA	NA
M04	140RMT	R	MAP	Male	Right	20	12	0	12	1.71	66	22.57105	9	3.6	9.5	3.8	NA	NA	NA	NA	NA	NA
M05	140RMT	R	MAP	Male	Right	29	9	0	9	1.73	68	22.72044	7.5	3	7.7	3	176	134	18	0.061	0.011	95
M06	140RMT	R	MAP	Male	Right	30	9	0	9	1.8	98	30.24691	9.5	3.8	8.5	3.4	177	131	20.5	0.059	0.007	110
M08	140RMT	R	MAP	Male	Right	22	12	0	12	1.89	93	26.03511	7.5	3	8.5	3.4	NA	NA	NA	NA	NA	NA
M09	140RMT	R	MAP	Female	Left	28	12	0	12	1.67	85.5	30.65725	8	3.2	7	2.8	NA	NA	NA	NA	NA	NA
M10	140RMT	R	MAP	Male	Right	32	10	0	10	1.71	67.1	22.94723	8	3.2	8.5	3.4	225	179	16	0.051	0.013	90
M11	140RMT	R	MAP	Male	Right	23	12	1	13	1.84	83.5	24.66328	9	3.6	9	5.6	NA	NA	NA	NA	NA	NA
M14	140RMT	R	MAP	Female	Right	35	10	4.5	14.5	1.68	77	27.28175	8	3.2	6	2.4	240	187	20.5	0.048	0.007	97
M15	140RMT	R	MAP	Male	Right	20	12	0	12	1.66	54.3	19.70533	6.5	2.6	6	2.4	246	201	19.5	0.101	0.016	84
M16	140RMT	R	MAP	Female	Left	19	9	0	9	1.56	49.7	20.42242	5.5	2.2	5.5	2.2	220	174	18	0.142	0.027	94
M18	140RMT	R	MAP	Male	Right	31	7	0	7	1.79	64	19.97441	11	4	11	4	141	90	23	0.06	0.024	92
M20	140RMT	R	MAP	Male	Right	21	9	0	9	1.79	72	22.47121	8.5	3.4	10.5	4.2	188	143	19.5	0.106	0.026	84
M21	140RMT	R	MAP	Female	Right	34	12	0.75	12.8	1.58	48	19.22769	6.5	2.6	6.5	2.6	217	165.5	19	0.1	0.016	101
M22	140RMT	R	MAP	Male	Right	22	11	0	11	1.74	72.8	24.04545	8.5	3.4	7	2.8	259	216	18.5	0.108	0.015	97
M23	140RMT	R	MAP	Male	Right	28	12	1	13	1.79	59.3	18.50754	7.5	3	6	2.4	225	166	20	0.056	0.02	105
M24	140RMT	R	MAP	Female	Right	20	9	0	9	1.65	58	21.30395	5	2	4.5	1.8	299	246	16.5	0.048	0.017	95
M25	140RMT	R	MAP	Female	Right	25	11	0	11	1.6	47.9	18.71094	6	2.4	5	2	210	162	15.5	0.059	0.017	108
M27	140RMT	R	MAP	Female	Right	32	12	4.5	16.5	1.52	50	21.64127	4.5	1.8	4	1.6	137	94	19	0.103	0.014	81
M28	140RMT	R	MAP	Female	Right	26	10	0	10	1.67	62.7	22.48198	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Participant	B7_ASRS_PartA_above_cut_off	B7_ASRS_PartB_above_cut_off	B9_ASSIST_Subscore_Tobacco	B9_ASSIST_Subscore_Alcohol	B9_ASSIST_Subscore_Cannabis	B9_ASSIST_Subscore_Cocaine	B9_ASSIST_Subscore_Methamphetamine	B9_ASSIST_Subscore_Inhalants	B9_ASSIST_Subscore_Sedatives	B9_ASSIST_Subscore_Hallucinogens	B9_ASSIST_Subscore_Opiods	B9_ASSIST_Subscore_Methaqualone	B9_ASSIST_Total_Score	B8_Mental_Effort_Prior_to_MRI	B8_Mental_Effort_Prior_to_EEG	B8_Mental_Effort_During_Resting_Eyes_Open_Phase	B8_Mental_Effort_During_Resting_Eyes_Closed_Phase	B8_Mental_Effort_During_Event_Related_Potential_Phase
C01	3	5	0	0	0	0	0	0	0	0	0	0	24	0.9	1.7	24.3	0.9	11.3
C02	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C03	0	1	0	3	2	0	0	0	0	0	0	0	14	0	0	6.1	6.1	6.1
C05	2	3	0	9	0	0	0	0	0	0	0	0	15	4.3	6.1	4.3	5.2	11.3
C06	5	4	9	11	0	3	0	0	0	2	0	0	28	6.1	13	10.4	5.2	68.7
C07	1	2	9	3	0	0	0	0	0	0	0	0	15	0	0	12.2	17.4	27
C08	2	3	4	2	2	0	0	0	0	0	0	0	10	13.9	0.9	0	47.8	78.3
C09	2	1	0	0	0	0	0	0	0	0	0	0	0	72.2	82.6	67.8	57.4	64.3
C10	1	2	0	0	0	0	0	0	0	0	0	0	3	15.7	0.9	0	0	0.9
C11	0	0	0	2	5	0	0	0	0	0	0	0	13	40.9	40	31.3	33	33.9
C13	3	2	6	3	0	0	0	0	0	0	0	0	12	3.5	2.6	17.4	2.6	47.8
C14	1	2	0	2	0	0	0	0	0	0	0	0	5	0	0	0	0	0
C16	1	3	2	9	2	0	0	0	0	0	0	0	20	0	0	40	0	73
C17	2	3	0	2	6	0	0	0	0	0	0	0	14	0	50.4	0	0	5.2
C18	1	2	0	0	0	0	0	0	0	0	0	0	3	0	0	20.9	0	70.4
C19	4	2	0	0	0	0	0	0	0	0	0	0	6	21.7	93.9	33	20.9	21.7
C20	0	1	0	6	0	0	0	0	0	0	0	0	9	47.8	32.2	58.3	75.7	42.6
C22	2	2	18	25	0	0	0	0	0	0	0	0	34	0	0	0	0	0
C23	0	4	9	21	0	0	0	0	0	0	0	0	30	78.3	57.4	34.8	17.4	38.3
C25	2	1	0	0	0	0	0	0	0	0	0	0	3	49.6	47	7	1.7	5.2
C26	1	2	21	2	0	0	0	0	0	0	0	0	5	27	5.2	10.4	4.3	40.9
C27	0	0	0	0	0	0	0	0	0	0	0	0	0	4.3	2.6	1.7	1.7	0.9
C29	1	1	15	3	0	0	0	0	0	0	0	0	9	13.9	18.3	5.2	7.8	8.7
C30	1	1	12	3	0	0	0	0	0	0	0	0	9	0	0	0	0	0
C31	1	4	26	3	0	0	0	0	0	0	0	0	6	0.9	9.6	2.6	0.9	61.7
C33	1	2	0	0	0	0	0	0	0	0	0	0	0	15.7	9.6	6.1	0	0
C34	2	1	4	3	0	0	0	0	0	0	0	0	12	0	0	19.1	0	0
C36	1	2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	9.6	5.2	77.4	42.6	97.4
S01	0	3	0	3	0	0	0	0	0	0	0	3	15	29.6	7.8	39.1	57.4	11.3
S03	2	5	0	0	0	0	0	0	0	0	0	0	0	NA	NA	NA	NA	NA
S04	2	2	21	12	3	0	0	0	0	0	0	0	21	0	28.7	4.3	4.3	3.5
S05	4	5	24	0	0	0	0	0	0	0	0	0	3	8.7	13.9	90.4	70.4	98.3
S07	2	5	18	0	0	0	0	0	0	0	0	0	6	17.4	31.3	91.3	73.9	93
S08	1	0	15	5	0	0	0	0	0	0	0	0	8	52.2	49.6	75.7	82.6	67
S10	2	1	25	11	18	3	26	3	3	0	3	3	94	0	0	17.4	7.8	15.7
S11	3	6	24	7	0	0	0	0	0	0	0	0	13	NA	NA	NA	NA	NA
S12	1	3	17	0	0	0	3	0	0	0	0	0	12	2.6	3.5	3.5	36.5	47.8
S14	NA	NA	18	5	0	0	0	0	0	0	0	0	8	97.39	5.22	3.48	4.35	5.22
S15	3	3	6	9	9	0	0	0	3	0	0	0	36	NA	NA	NA	NA	NA
S17	4	2	3	0	0	0	0	0	0	0	0	0	6	0	7.8	3.5	3.5	15.7
S18	1	4	3	11	9	0	0	0	0	0	0	0	32	85.2	2.6	93.9	93.9	93
S19	2	3	0	0	0	0	0	0	0	0	0	0	3	33	26.1	63.5	36.5	36.5
S23	1	0	0	2	0	0	0	0	0	0	0	0	5	0	20	0	8.7	0
S24	1	3	30	3	0	0	0	0	0	0	0	0	21	1.7	1.7	52.2	0.9	32.2
S26	2	4	21	3	0	0	0	0	0	0	0	0	12	6.1	24.3	11.3	1.7	42.6
S27	4	6	0	9	0	0	0	0	0	0	0	0	12	54.8	70.4	74.8	63.5	73
S29	2	2	0	0	0	0	0	0	0	0	0	0	3	94.8	80.9	0	93.9	101.7
S31	1	3	0	3	0	0	0	0	0	0	0	0	9	0	0	0	0	0
M01	2	4	11	0	0	0	0	0	0	0	0	0	6	67	71.3	22.6	80.9	55.7
M02	1	2	15	0	0	0	8	0	0	0	0	0	20	47.8	47.8	75.7	75.7	75.7
M03	0	1	9	0	0	0	3	0	0	0	0	0	12	13.9	13	12.2	12.2	11.3
M04	2	2	24	12	15	0	30	0	0	0	0	0	66	6.1	4.3	3.5	41.7	2.6
M05	3	3	18	0	9	0	5	0	0	0	0	3	32	0	0	0	0	0
M06	1	2	18	9	6	0	6	0	0	0	0	3	36	5.2	5.2	26.1	1.7	26.1
M08	4	7	24	5	6	0	3	0	0	0	3	0	35	13	23.5	18.3	10.4	24.3
M09	2	1	18	5	13	6	14	0	16	0	0	14	86	5.2	6.1	2.6	89.6	0.9
M10	1	2	21	4	0	0	6	0	0	0	0	0	25	47.8	33.9	60.9	86.1	50.4
M11	3	3	15	11	6	0	5	3	0	0	0	0	34	78.3	87	82.6	80	80.9
M14	2	8	9	3	0	3	18	0	0	0	0	0	46	12.2	28.7	7.8	26.1	24.3
M15	0	2	21	0	6	0	0	0	0	0	0	0	24	20	3.5	2.6	2.6	36.5
M16	3	2	13	19	16	0	0	0	0	0	0	0	44	6.1	0.9	0	0	0
M18	1	1	31	6	10	0	10	0	0	0	0	3	41	0	100	0	0	100
M20	1	7	24	3	0	0	33	0	3	0	0	0	54	40	23.5	79.1	79.1	51.3
M21	1	6	15	0	0	0	3	0	3	0	0	0	30	96.5	96.5	98.3	97.4	97.4
M22	0	0	22	21	31	0	38	0	4	0	3	12	127	55.7	54.8	0	0	0
M23	2	6	14	0	3	0	6	0	0	0	0	0	27	0	0.9	10.4	0	48.7
M24	2	2	30	0	0	0	9	0	0	0	0	6	27	85.2	93.9	10.4	94.8	15.7
M25	4	3	21	10	31	0	9	0	0	0	0	0	59	0	0	0	22.6	24.3
M27	2	1	21	9	5	0	13	0	0	0	0	5	47	0	0	0	0	0
M28	1	0	15	3	0	0	11	0	0	0	0	3	29	84.3	100	87	73.9	97.4

Participant	Years_with_Diagnosis	B11_Extrapyramidal_side_effects_Score	B1_PANSS_Total_Score	B1_PANSS_Positive_Subscale_Score	B1_PANSS_Negative_Subscale_Score	B1_PANSS_General_Psychopathology_Score	B2_CDSS_Total_Score	B3_YMRS_Total_Score	B4_HAMD_Total_Score	B5_Clinical_Global_Impression_Severity_Score	B6_Global_Assessment_of_Functioning_Score
C01	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C02	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C03	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C05	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C06	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C07	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C08	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C09	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C10	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C11	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C13	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C14	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C16	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C17	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C18	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C19	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C20	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C22	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C23	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C25	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C26	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C27	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C29	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C30	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C31	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C33	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C34	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
C36	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
S01	11	2	70	17	16	37	0	6	15	4	45
S03	13	0	71	16	23	32	1	5	6	4	50
S04	3	3	36	8	11	17	2	0	4	2	60
S05	7	4	47	12	14	21	2	2	1	4	61
S07	3	0	39	8	10	21	4	4	3	2	71
S08	13	4	66	11	28	27	0	8	2	4	55.5
S10	19	1	50	12	15	23	7	0	2	2	60
S11	9	0	30	7	7	16	3	1	0	2	71
S12	12	1	40	7	13	20	4	10	1	3	65.5
S14	4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
S15	7	3	48	13	13	22	6	2	3	4	55.5
S17	1	0	39	7	11	21	3	2	4	3	30
S18	6	3	64	17	12	35	4	3	5	4	51
S19	1	0	40	7	11	22	6	0	4	1	80
S23	3	1	46	8	19	19	0	0	2	2	61
S24	15	0	74	24	21	29	5	0	13	4	60
S26	20	2	46	15	8	23	1	0	4	2	60
S27	9	0	100	22	28	50	2	0	12	4	51
S29	1	0	45	9	13	23	3	0	4	2	75.5
S31	2	3	33	8	8	17	0	0	3	2	75.5
M01	0.75	0	46	7	12	27	6	3	2	1	70
M02	1	1	32	7	9	16	0	1	0	1	90
M03	1	3	47	8	12	27	1	4	5	4	55.5
M04	0.25	0	45	8	15	22	0	0	0	1	90
M05	0.25	0	77	13	27	37	1	2	6	2	60
M06	4	2	51	7	25	19	0	0	0	3	49
M08	1.5	6	69	10	21	38	4	5	8	4	31
M09	0.25	1	30	7	7	16	0	2	4	3	65.5
M10	12	0	36	7	11	18	4	1	5	3	70
M11	6	0	33	7	9	17	0	2	0	2	81
M14	7	0	59	19	15	25	8	3	2	4	45.5
M15	0.25	0	38	10	10	18	0	0	0	3	60
M16	0.33	0	43	12	11	20	0	3	1	2	65.5
M18	4	0	49	7	21	21	0	2	3	2	65
M20	4	3	77	30	16	31	1	3	5	3	58
M21	2	2	42	7	12	23	5	0	12	3	69
M22	0.25	0	55	13	14	28	1	0	5	2	60
M23	13	9	53	10	16	27	9	2	7	2	68
M24	7	5	52	7	22	23	1	0	2	2	60
M25	1	0	37	8	11	18	2	1	3	2	75.5
M27	1	0	44	8	14	22	0	0	2	2	65
M28	3	0	44	7	11	26	8	2	6	2	75

Participant	Cumulative_antipsychotic_dose_expressed_as_chlorpromazine_equivalents	Prescribed_First_Generation_Antipsychotics	Prescribed_Second_Generation_Antipsychotics	Prescribed_Mood_Stabalizers	Prescribed_Anticholinergics	Prescribed_Any_Antiphsychotic	Prescribed_Antipsychotic_Categories	Prescribed_Moodstabalizer_Categories	Prescribed_clozapine	Prescribed_olanzapine	Prescribed_risperidone_oral	Prescribed_quetiapine	Prescribed_haloperidol
C01	0	No	No	No	No	No	None	None	No	No	No	No	No
C02	0	No	No	No	No	No	None	None	No	No	No	No	No
C03	0	No	No	No	No	No	None	None	No	No	No	No	No
C05	0	No	No	No	No	No	None	None	No	No	No	No	No
C06	0	No	No	No	No	No	None	None	No	No	No	No	No
C07	0	No	No	No	No	No	None	None	No	No	No	No	No
C08	0	No	No	No	No	No	None	None	No	No	No	No	No
C09	0	No	No	No	No	No	None	None	No	No	No	No	No
C10	0	No	No	No	No	No	None	None	No	No	No	No	No
C11	0	No	No	No	No	No	None	None	No	No	No	No	No
C13	0	No	No	No	No	No	None	None	No	No	No	No	No
C14	0	No	No	No	No	No	None	None	No	No	No	No	No
C16	0	No	No	No	No	No	None	None	No	No	No	No	No
C17	0	No	No	No	No	No	None	None	No	No	No	No	No
C18	0	No	No	No	No	No	None	None	No	No	No	No	No
C19	0	No	No	No	No	No	None	None	No	No	No	No	No
C20	0	No	No	No	No	No	None	None	No	No	No	No	No
C22	0	No	No	No	No	No	None	None	No	No	No	No	No
C23	0	No	No	No	No	No	None	None	No	No	No	No	No
C25	0	No	No	No	No	No	None	None	No	No	No	No	No
C26	0	No	No	No	No	No	None	None	No	No	No	No	No
C27	0	No	No	No	No	No	None	None	No	No	No	No	No
C29	0	No	No	No	No	No	None	None	No	No	No	No	No
C30	0	No	No	No	No	No	None	None	No	No	No	No	No
C31	0	No	No	No	No	No	None	None	No	No	No	No	No
C33	0	No	No	No	No	No	None	None	No	No	No	No	No
C34	0	No	No	No	No	No	None	None	No	No	No	No	No
C36	0	No	No	No	No	No	None	None	No	No	No	No	No
S01	100	Yes	No	No	No	Yes	First_gener	None	No	No	No	No	No
S03	200	No	Yes	No	No	Yes	Second_ge	None	No	No	Yes	No	No
S04	1000	Yes	No	No	No	Yes	First_gener	None	No	No	No	No	No
S05	0	No	No	No	No	No	None	None	No	No	No	No	No
S07	1500	Yes	Yes	Yes	Yes	Yes	Both_gene	Sodium_va	Yes	No	No	No	Yes
S08	800	No	Yes	No	No	Yes	Second_ge	None	Yes	No	No	No	No
S10	0	No	Yes	No	No	Yes	Second_ge	None	Yes	No	No	No	No
S11	0	No	No	No	No	No	None	None	No	No	No	No	No
S12	0	No	Yes	No	Yes	Yes	Second_ge	None	No	No	Yes	No	No
S14	NA	Yes	No	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
S15	400	No	Yes	No	No	Yes	Second_ge	None	Yes	No	No	No	No
S17	200	No	Yes	No	Yes	Yes	Second_ge	None	No	No	Yes	No	No
S18	250	No	Yes	No	No	Yes	Second_ge	None	No	No	Yes	No	No
S19	0	No	Yes	No	No	Yes	Second_ge	None	No	No	No	Yes	No
S23	300	No	Yes	No	No	Yes	Second_ge	None	No	Yes	No	No	No
S24	1150	Yes	Yes	Yes	No	Yes	Both_gene	Sodium_va	Yes	No	No	No	No
S26	100	Yes	No	Yes	Yes	Yes	First_gener	Sodium_va	No	No	No	No	No
S27	500	No	Yes	No	No	Yes	Second_ge	None	Yes	No	No	No	No
S29	0	No	No	No	No	No	None	None	No	No	No	No	No
S31	300	No	Yes	Yes	No	Yes	Second_ge	Lithium	No	Yes	No	No	No
M01	200	Yes	No	No	No	Yes	First_gener	None	No	No	No	No	No
M02	100	Yes	No	No	Yes	Yes	First_gener	None	No	No	No	No	Yes
M03	200	Yes	No	No	No	Yes	First_gener	None	No	No	No	No	Yes
M04	0	Yes	No	No	No	Yes	First_gener	None	No	No	No	No	Yes
M05	0	Yes	No	No	No	Yes	First_gener	None	No	No	No	No	Yes
M06	100	No	Yes	No	No	Yes	Second_ge	None	No	No	Yes	No	No
M08	450	Yes	No	No	Yes	Yes	First_gener	None	No	No	No	No	No
M09	0	Yes	No	Yes	Yes	Yes	First_gener	Sodium_va	No	No	No	No	Yes
M10	200	Yes	No	No	No	Yes	First_gener	None	No	No	No	No	Yes
M11	0	No	No	No	No	No	None	None	No	No	No	No	No
M14	100	No	Yes	No	No	Yes	Second_ge	None	No	No	Yes	No	No
M15	250	Yes	No	No	Yes	Yes	First_gener	None	No	No	No	No	Yes
M16	50	Yes	No	No	Yes	Yes	First_gener	None	No	No	No	No	Yes
M18	125	Yes	No	No	No	Yes	First_gener	None	No	No	No	No	Yes
M20	100	No	Yes	No	Yes	Yes	Second_ge	None	No	No	Yes	No	No
M21	225	Yes	Yes	No	No	Yes	Both_gene	None	No	No	Yes	No	No
M22	150	Yes	No	No	No	Yes	First_gener	None	No	No	No	No	Yes
M23	250	Yes	No	Yes	Yes	Yes	First_gener	Sodium_va	No	No	No	No	Yes
M24	0	No	No	Yes	No	No	None	Sodium_va	No	No	No	No	No
M25	125	Yes	No	No	Yes	Yes	First_gener	None	No	No	No	No	Yes
M27	75	Yes	No	No	No	Yes	First_gener	None	No	No	No	No	Yes
M28	250	Yes	No	No	No	Yes	First_gener	None	No	No	No	No	Yes

Participant	Prescribed_chlorpromazine	Prescribed_trifluoperazine	Prescribed_sulpride	Prescribed_flupentixol_long_acting_injectable	Prescribed_zuclopenthixol_decanoate_long_acting_injectable	Prescribed_fluphenazine_long_acting_injectable	Prescribed_lithium	Prescribed_sodium_valproate	Prescribed_fluoxetine	Prescribed_citalopram	Prescribed_amitriptiline	Prescribed_orphenadrine
C01	No	No	No	No	No	No	No	No	No	No	No	No
C02	No	No	No	No	No	No	No	No	No	No	No	No
C03	No	No	No	No	No	No	No	No	No	No	No	No
C05	No	No	No	No	No	No	No	No	No	No	No	No
C06	No	No	No	No	No	No	No	No	No	No	No	No
C07	No	No	No	No	No	No	No	No	No	No	No	No
C08	No	No	No	No	No	No	No	No	No	No	No	No
C09	No	No	No	No	No	No	No	No	No	No	No	No
C10	No	No	No	No	No	No	No	No	No	No	No	No
C11	No	No	No	No	No	No	No	No	No	No	No	No
C13	No	No	No	No	No	No	No	No	No	No	No	No
C14	No	No	No	No	No	No	No	No	No	No	No	No
C16	No	No	No	No	No	No	No	No	No	No	No	No
C17	No	No	No	No	No	No	No	No	No	No	No	No
C18	No	No	No	No	No	No	No	No	No	No	No	No
C19	No	No	No	No	No	No	No	No	No	No	No	No
C20	No	No	No	No	No	No	No	No	No	No	No	No
C22	No	No	No	No	No	No	No	No	No	No	No	No
C23	No	No	No	No	No	No	No	No	No	No	No	No
C25	No	No	No	No	No	No	No	No	No	No	No	No
C26	No	No	No	No	No	No	No	No	No	No	No	No
C27	No	No	No	No	No	No	No	No	No	No	No	No
C29	No	No	No	No	No	No	No	No	No	No	No	No
C30	No	No	No	No	No	No	No	No	No	No	No	No
C31	No	No	No	No	No	No	No	No	No	No	No	No
C33	No	No	No	No	No	No	No	No	No	No	No	No
C34	No	No	No	No	No	No	No	No	No	No	No	No
C36	No	No	No	No	No	No	No	No	No	No	No	No
S01	No	No	No	No	Yes	No	No	No	No	No	Yes	No
S03	No	No	No	No	No	No	NA	No	No	No	No	No
S04	No	Yes	No	No	No	No	No	No	Yes	No	No	No
S05	No	No	No	No	No	No	NA	No	No	No	No	No
S07	No	No	Yes	No	No	No	No	Yes	No	No	No	Yes
S08	No	No	No	No	No	No	No	No	No	No	No	No
S10	No	No	No	No	No	No	No	No	No	No	No	No
S11	No	No	No	No	No	No	NA	No	No	No	No	No
S12	No	No	No	No	No	No	No	No	No	No	No	Yes
S14	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
S15	No	No	No	No	No	No	NA	No	No	No	No	No
S17	No	No	No	No	No	No	No	No	No	Yes	No	Yes
S18	No	No	No	No	No	No	No	No	No	No	No	No
S19	No	No	No	No	No	No	No	No	No	No	No	No
S23	No	No	No	No	No	No	NA	No	No	No	No	No
S24	No	No	No	No	No	Yes	No	Yes	No	No	No	No
S26	No	No	No	No	Yes	No	No	Yes	No	No	No	Yes
S27	No	No	No	No	No	No	NA	No	No	No	No	No
S29	No	No	No	No	No	No	No	No	Yes	No	No	No
S31	No	No	No	No	No	No	Yes	No	No	No	No	No
M01	Yes	No	No	No	No	No	No	No	No	No	No	No
M02	No	No	No	No	No	No	No	No	No	No	No	Yes
M03	No	No	No	No	Yes	No	No	No	No	No	No	No
M04	No	No	No	No	No	No	No	No	No	No	No	No
M05	No	No	No	No	No	No	No	No	No	No	No	No
M06	No	No	No	No	No	No	No	No	No	No	No	No
M08	Yes	No	No	Yes	No	No	No	No	No	No	No	Yes
M09	No	No	No	No	No	No	No	Yes	No	No	No	Yes
M10	No	No	No	No	No	No	No	No	No	No	No	No
M11	No	No	No	No	No	No	No	No	No	No	No	No
M14	No	No	No	No	No	No	No	No	Yes	No	Yes	No
M15	No	No	No	No	No	No	No	No	No	No	No	Yes
M16	No	No	No	No	No	No	No	No	No	No	No	Yes
M18	No	No	No	No	No	No	No	No	No	No	No	No
M20	No	No	No	No	No	No	No	No	No	No	No	Yes
M21	No	No	No	Yes	No	No	NA	No	No	No	No	No
M22	No	No	No	No	No	No	No	No	No	No	No	No
M23	No	No	No	No	No	No	No	Yes	No	No	No	Yes
M24	No	No	No	No	No	No	No	Yes	No	No	No	No
M25	No	No	No	No	No	No	No	No	No	No	No	Yes
M27	No	No	No	No	No	No	No	No	No	No	No	No
M28	No	No	No	No	No	No	No	No	No	No	No	No

B.3.2 Group Differences for CSP measures: F-Statistics

```
F-test with Kenward-Roger approximation; computing time: 0.12 sec.
large : Rel ~ Group + (1 | Participant)
small : Rel ~ (1 | Participant)
         stat     ndf     ddf F.scaling p.value
Ftest  1.0729  2.0000 52.0188         1  0.3495
F-test with Kenward-Roger approximation; computing time: 0.13 sec.
large : Abs ~ Group + (1 | Participant)
small : Abs ~ (1 | Participant)
         stat     ndf     ddf F.scaling p.value
Ftest  1.1492  2.0000 51.9806         1  0.3248
F-test with Kenward-Roger approximation; computing time: 0.14 sec.
large : Lat ~ Group + (1 | Participant)
small : Lat ~ (1 | Participant)
         stat     ndf     ddf F.scaling p.value
Ftest  0.2141  2.0000 52.0785         1   0.808
F-test with Kenward-Roger approximation; computing time: 0.14 sec.
large : Amp ~ Group + (1 | Participant)
small : Amp ~ (1 | Participant)
        stat    ndf    ddf F.scaling  p.value
Ftest  5.326  2.000 51.901         1 0.007873 **
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
F-test with Kenward-Roger approximation; computing time: 0.11 sec.
large : SI ~ Group + (1 | Participant)
small : SI ~ (1 | Participant)
         stat     ndf     ddf F.scaling p.value
Ftest  0.3795  2.0000 52.1033         1  0.6861
F-test with Kenward-Roger approximation; computing time: 0.11 sec.
large : Base ~ Group + (1 | Participant)
small : Base ~ (1 | Participant)
         stat     ndf     ddf F.scaling p.value
Ftest  0.5607  2.0000 52.0298         1  0.5742
```

B.3.2.1 Group Differences for CSP measures: Multiple Comparisons

```
 Simultaneous Tests for General Linear Hypotheses

Multiple Comparisons of Means: User-defined Contrasts


Fit: lme4::lmer(formula = Rel ~ Group + (1 | Participant), data = CLb140,
    REML = TRUE)

Linear Hypotheses:
                Estimate Std. Error z value Pr(>|z|)
CON vs MAP == 0   15.288     10.992   1.391    0.493
CON vs SCZ == 0   11.349     12.680   0.895    0.556
MAP vs SCZ == 0   -3.939     13.765  -0.286    0.775
(Adjusted p values reported -- fdr method)
```

```
 Simultaneous Tests for General Linear Hypotheses

Multiple Comparisons of Means: User-defined Contrasts


Fit: lme4::lmer(formula = Abs ~ Group + (1 | Participant), data = CLb140,
    REML = TRUE)

Linear Hypotheses:
                Estimate Std. Error z value Pr(>|z|)
CON vs MAP == 0   15.210     10.728   1.418    0.469
CON vs SCZ == 0   12.078     12.373   0.976    0.493
MAP vs SCZ == 0   -3.132     13.437  -0.233    0.816
(Adjusted p values reported -- fdr method)


 Simultaneous Tests for General Linear Hypotheses

Multiple Comparisons of Means: User-defined Contrasts


Fit: lme4::lmer(formula = Lat ~ Group + (1 | Participant), data = CLb140,
    REML = TRUE)

Linear Hypotheses:
                Estimate Std. Error z value Pr(>|z|)
CON vs MAP == 0 -0.36475    0.57373  -0.636    0.949
CON vs SCZ == 0 -0.04231    0.66202  -0.064    0.949
MAP vs SCZ == 0  0.32244    0.71816   0.449    0.949
(Adjusted p values reported -- fdr method)


 Simultaneous Tests for General Linear Hypotheses

Multiple Comparisons of Means: User-defined Contrasts


Fit: lme4::lmer(formula = Amp ~ Group + (1 | Participant), data = CLb140,
    REML = TRUE)

Linear Hypotheses:
                 Estimate Std. Error z value Pr(>|z|)
CON vs MAP == 0 -0.031779   0.010562  -3.009  0.00787 **
CON vs SCZ == 0 -0.026655   0.012178  -2.189  0.04293 *
MAP vs SCZ == 0  0.005124   0.013233   0.387  0.69863
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
(Adjusted p values reported -- fdr method)


 Simultaneous Tests for General Linear Hypotheses

Multiple Comparisons of Means: User-defined Contrasts
```

```
Fit: lme4::lmer(formula = SI ~ Group + (1 | Participant), data = CLb140,
    REML = TRUE)

Linear Hypotheses:
                Estimate Std. Error z value Pr(>|z|)
CON vs MAP == 0    1.151      2.877   0.400    0.689
CON vs SCZ == 0   -1.983      3.320  -0.597    0.689
MAP vs SCZ == 0   -3.134      3.599  -0.871    0.689
(Adjusted p values reported -- fdr method)


 Simultaneous Tests for General Linear Hypotheses

Multiple Comparisons of Means: User-defined Contrasts


Fit: lme4::lmer(formula = Base ~ Group + (1 | Participant), data = CLb140,
    REML = TRUE)

Linear Hypotheses:
                  Estimate Std. Error z value Pr(>|z|)
CON vs MAP == 0  0.0013449  0.0015129   0.889    0.561
CON vs SCZ == 0 -0.0004364  0.0017453  -0.250    0.803
MAP vs SCZ == 0 -0.0017812  0.0018945  -0.940    0.561
(Adjusted p values reported -- fdr method)
```

B.4 Potential Confounding Factors at 140RMT

B.4.1 Spearman Correlations of Demographic and Clinical variables against CSP measures at 140RMT

B.4.2 ANCOVA of Group Differences for CSP measures, accounting for potential confounders as a result of Spearman Correlations of Demographic variables against CSP measures: F-Statistics

```
F-test with Kenward-Roger approximation; computing time: 0.22 sec.
large : Rel ~ Years_at_School + Group + (1 | Participant)
small : Rel ~ Years_at_School + (1 | Participant)
         stat     ndf     ddf F.scaling p.value
Ftest  2.5071  2.0000 51.7907         1 0.09135 .
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
F-test with Kenward-Roger approximation; computing time: 0.18 sec.
large : Abs ~ Years_at_School + Group + (1 | Participant)
small : Abs ~ Years_at_School + (1 | Participant)
         stat     ndf     ddf F.scaling p.value
Ftest  2.3923  2.0000 51.7968         1  0.1014
F-test with Kenward-Roger approximation; computing time: 0.16 sec.
large : Lat ~ Weight + Group + (1 | Participant)
```

Table B.3 – Full Table of Spearman's Correlations of Demographic Variables against CSP Measures at 140RMT

	Relative CSP (ms)			Absolute CSP (ms)			Latency to MEP (ms)			MEP Amplitude (mV)			Baseline Muscle Activity (mV)		Stimulation Intensity (%)	
All Groups	**Spearman's rho**	**p-value**		**Spearman's rho**	**p-value**		**Spearman's rho**	**p-value**		**Spearman's rho**	**p-value**		**Spearman's rho**	**p-value**	**Spearman's rho**	**p-value**
Age_on_Day_of_Testing	0.04278709	0.7586886		-0.002006311	0.9885122		0.05438469	0.69610602		0.02869707	0.83680063		0.07764788	0.576786	0.00325708	0.9813515
Years_at_School	0.1166913	0.4007324		0.087948625	0.5271304		-0.12869848	0.35368122		0.13495908	0.33055435		0.11181678	0.4208285	0.11432312	0.4104248
Total_Years_of_Education	9.618914E-05	0.9994492		-0.055417843	0.6906202		-0.07432531	0.59324672		0.15110069	0.27542499		0.05697158	0.6823998	-0.01442708	0.91753314
Weight	-0.02410374	0.8626466		-0.021622241	0.8766711		0.26864615	0.04950474	*	-0.08121867	0.55933231		-0.12072451	0.3845361	-0.09108143	0.5124603
BMI	-0.1541776	0.2656525		-0.145201564	0.2948197		0.04354536	0.75454459		-0.03457214	0.80354829		-0.10371839	0.4554537	-0.08283038	0.55153679
B9_ASSIST_Subscore_Tobacco	0.1672901	0.2358608		0.187986192	0.1820177		0.11335832	0.42362311		-0.12442306	0.37948874		0.1444648	0.3068761	-0.04543173	0.74910927
B9_ASSIST_Subscore_Cannabis	0.04973548	0.7262291		0.043664584	0.7585677		-0.15036447	0.28732905		-0.15696782	0.26643862		-0.07120878	0.6159145	0.15781468	0.2638348
B9_ASSIST_Subscore_Methamphetamine	0.2017713	0.1514511		0.194084579	0.1679897		-0.01169117	0.93444031		-0.21304054	0.12942335		0.04297201	0.7622842	0.18134012	0.19824366
B9_ASSIST_Total_Score	0.1615696	0.2524951		0.152488478	0.2804958		-0.01577771	0.91160382		-0.24639987	0.07825821	.	0.10269017	0.4688038	-0.04830457	0.73381111
CON Only																
Age_on_Day_of_Testing	-0.0365201	0.8564896		-0.101043556	0.6160331		-0.10418302	0.6050544		0.2885204	0.1444267		0.20450915	0.3061929	-0.11913929	0.5539262
Years_at_School	-0.03254822	0.8719634		-0.100544784	0.6177849		-0.30024058	0.1281022		-0.25816435	0.1935473		0.29742437	0.1318958	0.19107554	0.339723
Total_Years_of_Education	-0.14627082	0.466607		-0.247130454	0.2139598		-0.18759629	0.3487538		-0.26360713	0.1839897		-0.01371006	0.9458878	0.11326382	0.5737736
Weight	0.07053245	0.7266456		0.064669072	0.7486155		0.21791619	0.2748619		-0.1540815	0.442876		-0.25894252	0.1921603	-0.17290019	0.3884532
BMI	-0.21875964	0.2729623		-0.208517786	0.2966013		0.06976189	0.7295213		0.20512821	0.3032713		-0.12759463	0.524342	-0.06642205	0.7420262
B9_ASSIST_Subscore_Tobacco	-0.16485332	0.4310023		-0.171689426	0.4118641		0.29122612	0.157828		-0.21615992	0.2993629		0.11909988	0.5706893	-0.23544375	0.257228
B9_ASSIST_Subscore_Cannabis	-0.02924651	0.8896277		-0.075802356	0.7187525		-0.15886408	0.4481573		-0.01212604	0.9541245		-0.1807883	0.3871368	-0.16303877	0.4361618
B9_ASSIST_Subscore_Methamphetamine	NA	NA		NA	NA		NA	NA		NA	NA		NA	NA	NA	NA
B9_ASSIST_Total_Score	0.01892626	0.9284507		0.004437603	0.9832041		0.07549033	0.7198645		-0.29321127	0.1548846		0.19560278	0.3487388	-0.3276596	0.1098377
MAP Only																
Age_on_Day_of_Testing	-0.03690048	0.8881839		-0.02583034	0.921611		0.33786346	0.18472538		-0.131531	0.614821		-0.04056565	0.87715309	0.11798672	0.6519908
Years_at_School	0.39553548	0.1160667		0.34159882	0.1796099		-0.17282742	0.50712048		0.1437429	0.5820479		-0.33882261	0.18340274	0.18640662	0.47377604
Total_Years_of_Education	0.24331636	0.3466775		0.15780983	0.545235		-0.14460022	0.579775		0.1269245	0.6273693		-0.25007895	0.33301243	0.06126637	0.815307
Weight	-0.18588957	0.4750255		-0.14417178	0.5809105		0.42329414	0.09045113	.	-0.223176	0.3892246		-0.02207235	0.93298946	0.30451719	0.23467296
BMI	-0.24770084	0.3377818		-0.22562849	0.3838973		0.12192266	0.64110442		-0.3235294	0.2049731		0.0122549	0.9660694	0.17176939	0.50976398
B9_ASSIST_Subscore_Tobacco	0.0247534	0.9248704		0.11015265	0.6738561		0.03542607	0.89262687		-0.1496663	0.5664202		0.11998043	0.64646797	0.0307795	0.90664805
B9_ASSIST_Subscore_Cannabis	-0.09996719	0.7026553		-0.07859055	0.7643152		-0.36055338	0.15510813		-0.253849	0.3255318		0.18221833	0.48394374	0.4416284	0.07594089
B9_ASSIST_Subscore_Methamphetamine	0.08513395	0.7452796		0.11104428	0.6713546		-0.05514255	0.83351185		-0.2984027	0.2446766		0.45500248	0.06648482	0.03131008	0.9050456
B9_ASSIST_Total_Score	-0.20613497	0.4273357		-0.19877301	0.4443807		-0.35428549	0.16294335		-0.1986512	0.4446657		0.410791	0.1014275	0.19055677	0.46380583
SCZ Only																
Age_on_Day_of_Testing	0.14024651	0.69917414		0.14024651	0.69917414		0.17791411	0.6228998		0.04268372	0.9067993		0.3902512	0.2648874	-0.09146511	0.80158552
Years_at_School	0.728219081	0.01693251	*	0.728219081	0.01693251	*	0.02791135	0.9389915		0.47160855	0.1688103		0.478544	0.1617673	-0.16645008	0.64581175
Total_Years_of_Education	0.548502234	0.10063758		0.548502234	0.10063758		-0.0125422	0.9725682		0.47370647	0.1666609		0.4612405	0.1796749	-0.2804841	0.43247476
Weight	-0.006060606	1		-0.006060606	1		-0.01829302	0.9599974		0.07878788	0.8380041		-0.1636364	0.6567214	-0.63636364	0.05444507	.
BMI	-0.224242424	0.53668809		-0.224242424	0.53668809		-0.31707907	0.3720186		-0.04242424	0.9186333		-0.2363636	0.5138983	-0.6	0.07311988	.
B9_ASSIST_Subscore_Tobacco	0.570872417	0.08478577		0.570872417	0.08478577	.	0.22722093	0.5278312		0.43913263	0.2041889		0.5332325	0.1124657	-0.15683308	0.66524225	
B9_ASSIST_Subscore_Cannabis	0.052437767	0.88560728		0.052437767	0.88560728		0.32408787	0.3609448		0.02247333	0.9508644		-0.1423311	0.6948818	-0.1573133	0.66426762	
B9_ASSIST_Subscore_Methamphetamine	0.174077656	0.63053608		0.174077656	0.63053608		0.11676157	0.7480378		0.05802589	0.8734949		0.4061812	0.2441287	-0.05802589	0.87349489	
B9_ASSIST_Total_Score	0.262199996	0.46426935		0.262199996	0.46426935		0.47546012	0.1648768		0.04268372	0.9067993		0.1158558	0.7499398	-0.32317674	0.36237497	

Table B.4 – Full Table of Spearman's Correlations of Clinical Variables against CSP Measures at 140RMT

	Relative CSP (ms)		Absolute CSP (ms)		Latency to MEP (ms)		MEP Amplitude (mV)		Baseline Muscle Activity (mV)		Stimulation Intensity (%)	
Both Groups	**Spearman's rho**	**p-value**	**Spearman's rho**	**p-value**	**Spearman's rho**	**p-value**	**Spearman's rho**	**p-value**	**Spearman's rho**	**p-value**	**Spearman's rho**	**p-value**
Years with Diagnosis	0.076	0.708	0.086	0.67	**0.408**	**0.035***	0.025	0.9	0.054	0.789	-0.216	0.278
Cumulative antipsychotic dose expressed as chlorpromazine equivalents	0.106	0.6	0.103	0.609	**0.35**	**0.073.**	0.103	0.608	-0.168	0.402	-0.146	0.466
MAP Only												
Years with Diagnosis	0.035	0.895	0.09	0.73	**0.534**	**0.027***	0.094	0.72	-0.064	0.806	-0.07	0.788
Cumulative antipsychotic dose expressed as chlorpromazine equivalents	0.312	0.222	0.346	0.174	**0.508**	**0.037***	0.304	0.236	-0.184	0.48	0.072	0.783
SCZ Only												
Years with Diagnosis	0.043	0.907	0.043	0.907	0.212	0.557	-0.006	0.987	0.256	0.475	-0.317	0.372
Cumulative antipsychotic dose expressed as chlorpromazine equivalents	-0.018	0.96	-0.018	0.96	0.282	0.43	0.171	0.637	0.183	0.613	-0.274	0.443

```
small : Lat ~ Weight + (1 | Participant)
         stat     ndf     ddf F.scaling p.value
Ftest  0.3289  2.0000 51.1350         1  0.7213
```

B.4.3 ANCOVA of Group Differences for CSP measures, accounting for potential confounders as a result of Spearman Correlations of Clinical Variables against CSP measures: F-Statistics

```
F-test with Kenward-Roger approximation; computing time: 0.23 sec.
large : Lat ~ Years_with_Diagnosis + Group + (1 | Participant)
small : Lat ~ Years_with_Diagnosis + (1 | Participant)
         stat     ndf     ddf F.scaling p.value
Ftest  0.0258  1.0000 24.2307         1  0.8737

F-test with Kenward-Roger approximation; computing time: 0.22 sec.
large : Lat ~ Cumulative_antipsychotic_dose_expressed_as_chlorpromazine_equivalents +
    Group + (1 | Participant)
small : Lat ~ Cumulative_antipsychotic_dose_expressed_as_chlorpromazine_equivalents +
    (1 | Participant)
         stat     ndf     ddf F.scaling p.value
Ftest  0.0406  1.0000 25.1931         1  0.8418
```

B.4.4 ANCOVA of Group Differences for CSP measures, accounting for potential medication confounders: F-Statistics and Relevant Multiple Comparisons

B.4.4.1 Relative CSP

```
F-test with Kenward-Roger approximation; computing time: 0.16 sec.
large : Rel ~ Prescribed_First_Generation_Antipsychotics + Group + (1 |
    Participant)
small : Rel ~ Prescribed_First_Generation_Antipsychotics + (1 | Participant)
         stat     ndf     ddf F.scaling p.value
Ftest  0.0112  1.0000 24.1955         1  0.9165
F-test with Kenward-Roger approximation; computing time: 0.23 sec.
large : Rel ~ Prescribed_Second_Generation_Antipsychotics + Group + (1 |
    Participant)
small : Rel ~ Prescribed_Second_Generation_Antipsychotics + (1 | Participant)
         stat     ndf     ddf F.scaling p.value
Ftest  0.0033  1.0000 24.1603         1  0.9544
F-test with Kenward-Roger approximation; computing time: 0.22 sec.
large : Rel ~ Prescribed_olanzapine + Group + (1 | Participant)
small : Rel ~ Prescribed_olanzapine + (1 | Participant)
         stat     ndf     ddf F.scaling p.value
Ftest  0.0407  1.0000 24.8813         1  0.8417
F-test with Kenward-Roger approximation; computing time: 0.16 sec.
large : Rel ~ Prescribed_clozapine + Group + (1 | Participant)
small : Rel ~ Prescribed_clozapine + (1 | Participant)
         stat     ndf     ddf F.scaling p.value
Ftest  0.2669  1.0000 24.9746         1    0.61
F-test with Kenward-Roger approximation; computing time: 0.16 sec.
large : Rel ~ Prescribed_haloperidol + Group + (1 | Participant)
small : Rel ~ Prescribed_haloperidol + (1 | Participant)
         stat     ndf     ddf F.scaling p.value
Ftest  0.0306  1.0000 25.0040         1  0.8625
```

B.4.4.2 Absolute CSP

```
F-test with Kenward-Roger approximation; computing time: 0.20 sec.
large : Abs ~ Prescribed_First_Generation_Antipsychotics + Group + (1 |
    Participant)
small : Abs ~ Prescribed_First_Generation_Antipsychotics + (1 | Participant)
         stat     ndf     ddf F.scaling p.value
Ftest  0.0609  1.0000 24.1208         1  0.8072
F-test with Kenward-Roger approximation; computing time: 0.20 sec.
large : Abs ~ Prescribed_Second_Generation_Antipsychotics + Group + (1 |
    Participant)
small : Abs ~ Prescribed_Second_Generation_Antipsychotics + (1 | Participant)
        stat    ndf    ddf F.scaling p.value
Ftest  0.035  1.000 24.086         1  0.8531
F-test with Kenward-Roger approximation; computing time: 0.18 sec.
large : Abs ~ Prescribed_olanzapine + Group + (1 | Participant)
small : Abs ~ Prescribed_olanzapine + (1 | Participant)
         stat     ndf     ddf F.scaling p.value
Ftest  0.0662  1.0000 24.8564         1  0.7991
```

```
F-test with Kenward-Roger approximation; computing time: 0.15 sec.
large : Abs ~ Prescribed_clozapine + Group + (1 | Participant)
small : Abs ~ Prescribed_clozapine + (1 | Participant)
         stat     ndf     ddf F.scaling p.value
Ftest  0.2233  1.0000 24.9572         1  0.6406
F-test with Kenward-Roger approximation; computing time: 0.19 sec.
large : Abs ~ Prescribed_haloperidol + Group + (1 | Participant)
small : Abs ~ Prescribed_haloperidol + (1 | Participant)
         stat     ndf     ddf F.scaling p.value
Ftest  0.0871  1.0000 24.9878         1  0.7703
```

B.4.4.3 Latency to MEP

```
F-test with Kenward-Roger approximation; computing time: 0.19 sec.
large : Lat ~ Prescribed_First_Generation_Antipsychotics + Group + (1 |
    Participant)
small : Lat ~ Prescribed_First_Generation_Antipsychotics + (1 | Participant)
         stat     ndf     ddf F.scaling p.value
Ftest  0.2412  1.0000 24.1148         1  0.6278
F-test with Kenward-Roger approximation; computing time: 0.17 sec.
large : Lat ~ Prescribed_Second_Generation_Antipsychotics + Group + (1 |
    Participant)
small : Lat ~ Prescribed_Second_Generation_Antipsychotics + (1 | Participant)
         stat     ndf     ddf F.scaling p.value
Ftest  0.0622  1.0000 24.0720         1  0.8051
F-test with Kenward-Roger approximation; computing time: 0.18 sec.
large : Lat ~ Prescribed_olanzapine + Group + (1 | Participant)
small : Lat ~ Prescribed_olanzapine + (1 | Participant)
         stat     ndf     ddf F.scaling p.value
Ftest  0.1098  1.0000 24.8633         1  0.7432
F-test with Kenward-Roger approximation; computing time: 0.16 sec.
large : Lat ~ Prescribed_clozapine + Group + (1 | Participant)
small : Lat ~ Prescribed_clozapine + (1 | Participant)
         stat     ndf     ddf F.scaling p.value
Ftest  0.3166  1.0000 24.9544         1  0.5787
F-test with Kenward-Roger approximation; computing time: 0.18 sec.
large : Lat ~ Prescribed_haloperidol + Group + (1 | Participant)
small : Lat ~ Prescribed_haloperidol + (1 | Participant)
         stat     ndf     ddf F.scaling p.value
Ftest  0.0357  1.0000 24.9804         1  0.8517
```

B.4.4.4 MEP Amplitude

```
F-test with Kenward-Roger approximation; computing time: 0.19 sec.
large : Amp ~ Prescribed_First_Generation_Antipsychotics + Group + (1 |
    Participant)
small : Amp ~ Prescribed_First_Generation_Antipsychotics + (1 | Participant)
         stat     ndf     ddf F.scaling p.value
Ftest  3.1313  1.0000 23.7085         1 0.08967 .
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
F-test with Kenward-Roger approximation; computing time: 0.18 sec.
large : Amp ~ Prescribed_Second_Generation_Antipsychotics + Group + (1 |
```

```
    Participant)
small : Amp ~ Prescribed_Second_Generation_Antipsychotics + (1 | Participant)
         stat     ndf     ddf F.scaling p.value
Ftest  0.6139  1.0000 23.8189         1   0.441
F-test with Kenward-Roger approximation; computing time: 0.20 sec.
large : Amp ~ Prescribed_olanzapine + Group + (1 | Participant)
small : Amp ~ Prescribed_olanzapine + (1 | Participant)
         stat     ndf     ddf F.scaling p.value
Ftest  0.3177  1.0000 24.7641         1  0.5781
F-test with Kenward-Roger approximation; computing time: 0.21 sec.
large : Amp ~ Prescribed_clozapine + Group + (1 | Participant)
small : Amp ~ Prescribed_clozapine + (1 | Participant)
         stat     ndf     ddf F.scaling p.value
Ftest  0.1829  1.0000 24.8759         1  0.6726
F-test with Kenward-Roger approximation; computing time: 0.19 sec.
large : Amp ~ Prescribed_haloperidol + Group + (1 | Participant)
small : Amp ~ Prescribed_haloperidol + (1 | Participant)
         stat     ndf     ddf F.scaling p.value
Ftest  0.0582  1.0000 24.9093         1  0.8113
```

B.4.4.5 Baseline Muscle Contraction

```
F-test with Kenward-Roger approximation; computing time: 0.18 sec.
large : Base ~ Prescribed_First_Generation_Antipsychotics + Group + (1 |
    Participant)
small : Base ~ Prescribed_First_Generation_Antipsychotics + (1 | Participant)
        stat    ndf    ddf F.scaling p.value
Ftest  0.001  1.000 24.087         1  0.9753
F-test with Kenward-Roger approximation; computing time: 0.19 sec.
large : Base ~ Prescribed_Second_Generation_Antipsychotics + Group +
    (1 | Participant)
small : Base ~ Prescribed_Second_Generation_Antipsychotics + (1 | Participant)
         stat     ndf     ddf F.scaling p.value
Ftest  0.0442  1.0000 24.0329         1  0.8353
F-test with Kenward-Roger approximation; computing time: 0.15 sec.
large : Base ~ Prescribed_olanzapine + Group + (1 | Participant)
small : Base ~ Prescribed_olanzapine + (1 | Participant)
         stat     ndf     ddf F.scaling p.value
Ftest  0.3555  1.0000 24.8670         1  0.5564
F-test with Kenward-Roger approximation; computing time: 0.18 sec.
large : Base ~ Prescribed_clozapine + Group + (1 | Participant)
small : Base ~ Prescribed_clozapine + (1 | Participant)
         stat     ndf     ddf F.scaling p.value
Ftest  0.4998  1.0000 24.9591         1  0.4861
F-test with Kenward-Roger approximation; computing time: 0.17 sec.
large : Base ~ Prescribed_haloperidol + Group + (1 | Participant)
small : Base ~ Prescribed_haloperidol + (1 | Participant)
         stat     ndf     ddf F.scaling p.value
Ftest  0.0014  1.0000 24.9805         1  0.9706
```

B.4.4.6 Stimulation Intensity

```
F-test with Kenward-Roger approximation; computing time: 0.24 sec.
```

```
large : SI ~ Prescribed_First_Generation_Antipsychotics + Group + (1 |
    Participant)
small : SI ~ Prescribed_First_Generation_Antipsychotics + (1 | Participant)
         stat     ndf     ddf F.scaling p.value
Ftest  0.5912  1.0000 24.7035         1  0.4492
F-test with Kenward-Roger approximation; computing time: 0.16 sec.
large : SI ~ Prescribed_Second_Generation_Antipsychotics + Group + (1 |
    Participant)
small : SI ~ Prescribed_Second_Generation_Antipsychotics + (1 | Participant)
         stat     ndf     ddf F.scaling p.value
Ftest  0.3808  1.0000 24.6875         1  0.5428
F-test with Kenward-Roger approximation; computing time: 0.17 sec.
large : SI ~ Prescribed_olanzapine + Group + (1 | Participant)
small : SI ~ Prescribed_olanzapine + (1 | Participant)
         stat     ndf     ddf F.scaling p.value
Ftest  0.0189  1.0000 24.9881         1  0.8919
F-test with Kenward-Roger approximation; computing time: 0.17 sec.
large : SI ~ Prescribed_clozapine + Group + (1 | Participant)
small : SI ~ Prescribed_clozapine + (1 | Participant)
         stat     ndf     ddf F.scaling p.value
Ftest  0.1612  1.0000 25.0264         1  0.6915
F-test with Kenward-Roger approximation; computing time: 0.17 sec.
large : SI ~ Prescribed_haloperidol + Group + (1 | Participant)
small : SI ~ Prescribed_haloperidol + (1 | Participant)
         stat     ndf     ddf F.scaling p.value
Ftest  0.4183  1.0000 25.0385         1  0.5237
```

C Appendix: Electroencephalography: Relative Frequency Band Power

C.1 ANOVAs: Group Comparison of each Frequency Band power within each State

Analysis No.	Frequency Band	Electrode	State	ANOVA				Multiple Comparisons											
				Main Effects				CON vs MAP				CON vs SCZ				MAP vs SCZ			
				F-statistic	DF1	DF2	p-value	Estimate	Std_Error	t-value	p-value	Estimate	Std_Error	t-value	p-value	Estimate	Std_Error	t-value	p-value
81	A	FP1	REO	0.725	2	72	0.488												
82	A	FP2	REO	0.584	2	72	0.560												
83	A	F3	REO	1.731	2	72	0.185												
84	**A**	**F4**	**REO**	**3.135**	**2**	**72**	**0.049***	-3.175	1.364	-2.328	0.068	-2.593	1.397	-1.856	0.101	0.582	1.459	0.399	0.691
85	A	F7	REO	0.838	2	72	0.437												
86	A	F8	REO	0.738	2	72	0.482												
87	**A**	**C3**	**REO**	**4.120**	**2**	**72**	**0.020***	-4.584	1.647	-2.783	**0.020***	-3.141	1.688	-1.861	0.100	1.443	1.762	0.819	0.416
88	**A**	**C4**	**REO**	**5.909**	**2**	**72**	**0.004***	-5.046	1.559	-3.237	**0.005***	-3.944	1.597	-2.469	**0.023***	1.102	1.667	0.661	0.511
89	**A**	**P3**	**REO**	**4.004**	**2**	**72**	**0.022***	-4.850	1.879	-2.581	**0.035***	-4.202	1.926	-2.182	**0.048***	0.648	2.010	0.322	0.748
90	**A**	**P4**	**REO**	**5.351**	**2**	**72**	**0.006***	-5.345	1.772	-3.016	**0.010***	-4.483	1.816	-2.469	**0.023***	0.863	1.895	0.455	0.650
91	B	FP1	REO	1.998	2	72	0.143												
92	B	FP2	REO	2.449	2	72	0.094												
93	B	F3	REO	1.783	2	72	0.176												
94	B	F4	REO	2.190	2	72	0.119												
95	B	F7	REO	0.835	2	72	0.438												
96	B	F8	REO	0.205	2	72	0.815												
97	B	C3	REO	0.751	2	72	0.476												
98	B	C4	REO	0.367	2	72	0.694												
99	B	P3	REO	1.381	2	72	0.258												
100	B	P4	REO	0.920	2	72	0.403												
101	T	FP1	REO	0.110	2	72	0.896												
102	T	FP2	REO	0.153	2	72	0.859												
103	T	F3	REO	0.058	2	72	0.944												
104	T	F4	REO	0.001	2	72	0.999												
105	T	F7	REO	0.055	2	72	0.946												
106	T	F8	REO	0.206	2	72	0.815												
107	T	C3	REO	0.373	2	72	0.690												
108	T	C4	REO	0.361	2	72	0.698												
109	T	P3	REO	0.536	2	72	0.587												
110	T	P4	REO	0.371	2	72	0.691												
111	D	FP1	REO	1.612	2	72	0.207												
112	D	FP2	REO	1.748	2	72	0.181												
113	D	F3	REO	1.662	2	72	0.197												
114	D	F4	REO	2.544	2	72	0.086												
115	D	F7	REO	0.806	2	72	0.451												
116	D	F8	REO	0.469	2	72	0.627												
117	D	C3	REO	1.827	2	72	0.168												
118	D	C4	REO	1.998	2	72	0.143												
119	D	P3	REO	2.326	2	72	0.105												
120	D	P4	REO	2.611	2	72	0.080												
41	**A**	**FP1**	**REC**	**3.963**	**2**	**74**	**0.023***	-3.364	1.599	-2.104	0.058	-4.189	1.599	-2.620	**0.032***	-0.825	1.672	-0.493	0.623
42	**A**	**FP2**	**REC**	**4.673**	**2**	**74**	**0.012***	-2.932	1.665	-1.762	0.123	-5.036	1.665	-3.025	**0.010***	-2.104	1.741	-1.208	0.231
43	**A**	**F3**	**REC**	**3.750**	**2**	**74**	**0.028***	-4.642	1.873	-2.478	**0.046***	-4.051	1.873	-2.162	0.051	0.591	1.960	0.301	0.764
44	**A**	**F4**	**REC**	**4.871**	**2**	**74**	**0.010***	-5.515	1.922	-2.870	**0.016***	-4.599	1.922	-2.393	**0.028***	0.916	2.010	0.456	0.650
45	A	F7	REC	1.412	2	74	0.250												
46	A	F8	REC	2.090	2	74	0.131												
47	**A**	**C3**	**REC**	**4.859**	**2**	**74**	**0.010***	-6.505	2.146	-3.032	**0.010***	-4.333	2.146	-2.019	0.071	2.172	2.244	0.968	0.336
48	**A**	**C4**	**REC**	**8.165**	**2**	**74**	**0.0006***	-7.618	2.028	-3.756	**0.001***	-6.145	2.028	-3.030	**0.005***	1.473	2.122	0.694	0.490
49	**A**	**P3**	**REC**	**6.355**	**2**	**73**	**0.002***	-8.591	2.557	-3.359	**0.003***	-6.652	2.587	-2.571	**0.018***	1.939	2.704	0.717	0.476
50	**A**	**P4**	**REC**	**8.617**	**2**	**74**	**0.0004***	-9.509	2.367	-4.017	**0.0004***	-6.520	2.367	-2.754	**0.011***	2.989	2.476	1.207	0.231
51	**B**	**FP1**	**REC**	**4.289**	**2**	**74**	**0.017***	-3.618	2.070	-1.748	0.127	-5.977	2.070	-2.887	**0.015***	-2.359	2.166	-1.089	0.280
52	**B**	**FP2**	**REC**	**3.996**	**2**	**74**	**0.022***	-2.943	1.937	-1.519	0.200	-5.450	1.937	-2.813	**0.018***	-2.507	2.026	-1.237	0.220
53	B	F3	REC	2.455	2	74	0.093												
54	B	F4	REC	1.703	2	74	0.189												
55	B	F7	REC	0.660	2	74	0.520												
56	B	F8	REC	0.738	2	74	0.481												
57	B	C3	REC	1.895	2	74	0.158												
58	B	C4	REC	0.565	2	74	0.571												
59	B	P3	REC	1.725	2	73	0.185												
60	B	P4	REC	0.890	2	74	0.415												
61	T	FP1	REC	1.506	2	74	0.229												
62	T	FP2	REC	0.829	2	74	0.441												
63	T	F3	REC	1.313	2	74	0.275												

Analysis No.	Frequency Band	Electrode	State	ANOVA				Multiple Comparisons											
				Main Effects				CON vs MAP				CON vs SCZ				MAP vs SCZ			
				F-statistic	DF1	DF2	p-value	Estimate	Std_Error	t-value	p-value	Estimate	Std_Error	t-value	p-value	Estimate	Std_Error	t-value	p-value
64	T	F4	REC	1.198	2	74	0.308												
65	T	F7	REC	0.653	2	74	0.523												
66	T	F8	REC	1.116	2	74	0.333												
67	T	C3	REC	0.929	2	74	0.400												
68	T	C4	REC	0.768	2	74	0.468												
69	T	P3	REC	1.129	2	73	0.329												
70	T	P4	REC	1.675	2	74	0.194												
71	**D**	**FP1**	**REC**	**3.504**	**2**	**74**	**0.035***	6.303	3.482	1.810	0.111	8.850	3.482	2.542	**0.0393***	2.547	3.642	0.699	0.487
72	**D**	**FP2**	**REC**	**3.562**	**2**	**74**	**0.033***	5.131	3.593	1.428	0.236	9.547	3.593	2.657	**0.029***	4.415	3.758	1.175	0.244
73	D	F3	REC	3.088	2	74	0.052	8.646	3.744	2.310	0.071	6.977	3.744	1.864	0.100	-1.669	3.916	-0.426	0.671
74	**D**	**F4**	**REC**	**3.353**	**2**	**74**	**0.040***	9.461	3.759	2.517	**0.042***	6.322	3.759	1.682	0.145	-3.139	3.932	-0.798	0.427
75	D	F7	REC	0.963	2	74	0.386												
76	D	F8	REC	1.274	2	74	0.286												
77	**D**	**C3**	**REC**	**3.856**	**2**	**74**	**0.025***	10.539	3.839	2.745	**0.022***	6.205	3.839	1.616	0.165	-4.334	4.016	-1.079	0.284
78	**D**	**C4**	**REC**	**3.741**	**2**	**74**	**0.028***	10.580	3.969	2.665	**0.028***	6.963	3.969	1.754	0.125	-3.617	4.152	-0.871	0.387
79	**D**	**P3**	**REC**	**4.818**	**2**	**73**	**0.010***	11.836	3.867	3.061	**0.009***	7.169	3.913	1.832	0.106	-4.667	4.089	-1.141	0.257
80	**D**	**P4**	**REC**	**4.829**	**2**	**74**	**0.010***	11.704	3.797	3.082	**0.008***	6.643	3.797	1.749	0.127	-5.061	3.972	-1.274	0.207
1	A	FP1	ERP	0.615	2	76	0.543												
2	A	FP2	ERP	0.189	2	76	0.828												
3	A	F3	ERP	0.646	2	76	0.527												
4	A	F4	ERP	1.212	2	76	0.303												
5	A	F7	ERP	2.010	2	76	0.141												
6	A	F8	ERP	2.075	2	76	0.133												
7	A	C3	ERP	1.787	2	76	0.174												
8	A	C4	ERP	2.801	2	76	0.067												
9	A	P3	ERP	1.650	2	76	0.199												
10	A	P4	ERP	2.329	2	76	0.104												
11	B	FP1	ERP	0.671	2	76	0.514												
12	B	FP2	ERP	0.578	2	76	0.564												
13	B	F3	ERP	1.815	2	76	0.170												
14	**B**	**F4**	**ERP**	**3.738**	**2**	**76**	**0.028***	-5.496	2.092	-2.627	**0.031***	-3.864	2.047	-1.887	0.095	1.633	2.146	0.761	0.449
15	B	F7	ERP	0.995	2	76	0.375												
16	B	F8	ERP	1.667	2	76	0.196												
17	B	C3	ERP	1.423	2	76	0.247												
18	B	C4	ERP	0.942	2	76	0.395												
19	B	P3	ERP	2.040	2	76	0.137												
20	B	P4	ERP	1.035	2	76	0.360												
21	T	FP1	ERP	0.092	2	76	0.913												
22	T	FP2	ERP	0.541	2	76	0.585												
23	T	F3	ERP	0.550	2	76	0.579												
24	T	F4	ERP	0.630	2	76	0.535												
25	T	F7	ERP	1.174	2	76	0.315												
26	T	F8	ERP	0.691	2	76	0.504												
27	T	C3	ERP	0.671	2	76	0.514												
28	T	C4	ERP	0.332	2	76	0.718												
29	T	P3	ERP	0.574	2	76	0.566												
30	T	P4	ERP	0.839	2	76	0.436												
31	D	FP1	ERP	0.443	2	76	0.644												
32	D	FP2	ERP	0.112	2	76	0.894												
33	D	F3	ERP	0.826	2	76	0.442												
34	D	F4	ERP	2.265	2	76	0.111												
35	D	F7	ERP	1.431	2	76	0.245												
36	D	F8	ERP	1.945	2	76	0.150												
37	D	C3	ERP	1.723	2	76	0.185												
38	D	C4	ERP	1.787	2	76	0.175												
39	D	P3	ERP	2.089	2	76	0.131												
40	D	P4	ERP	2.075	2	76	0.133												

C.2 ANOVAs: State Comparison of each Frequency Band power within each Group

Frequency Band	Electrode	State	Group Means CON	Group Means MAP	Group Means SCZ	Comparisons	Estimate	Std.Error	t.value	p.value
						CON.ERPvsCON.REO	-0.411	2.89	-0.142	0.887
		Task	61.24	63.74	62.32	CON.RECvsCON.REO	-8.709	2.89	-3.016	0.020
D	FP1	REC	52.94	59.25	61.79	MAP.ERPvsMAP.REO	-0.895	3.17	-0.282	0.887
		REO	61.65	64.64	66.95	MAP.RECvsMAP.REO	-5.391	3.17	-1.698	0.273
						SCZ.ERPvsSCZ.REO	-4.623	3.19	-1.451	0.285
						SCZ.RECvsSCZ.REO	6.257	5.22	1.199	0.348
						CON.ERPvsCON.REO	-0.155	2.92	-0.053	0.958
		Task	61.51	62.72	62.24	CON.RECvsCON.REO	-8.766	2.92	-3.007	0.016
D	FP2	REC	52.90	58.03	62.44	MAP.ERPvsMAP.REO	-1.158	3.21	-0.361	0.923
		REO	61.66	63.88	67.25	MAP.RECvsMAP.REO	-5.851	3.21	-1.826	0.208
						SCZ.ERPvsSCZ.REO	-5.017	3.22	-1.560	0.260
						SCZ.RECvsSCZ.REO	6.680	5.27	1.268	0.309
						CON.ERPvsCON.REO	3.792	3.45	1.100	0.424
		Task	55.17	59.43	57.59	CON.RECvsCON.REO	-5.547	3.45	-1.609	0.424
D	F3	REC	45.83	54.48	52.81	MAP.ERPvsMAP.REO	4.079	3.79	1.077	0.424
		REO	51.38	55.35	58.35	MAP.RECvsMAP.REO	-0.870	3.79	-0.230	0.896
						SCZ.ERPvsSCZ.REO	-0.751	3.80	-0.197	0.896
						SCZ.RECvsSCZ.REO	0.812	6.23	0.130	0.896
						CON.ERPvsCON.REO	4.367	3.44	1.271	0.398
		Task	53.41	60.55	56.82	CON.RECvsCON.REO	-4.152	3.44	-1.209	0.398
D	F4	REC	44.89	54.36	51.22	MAP.ERPvsMAP.REO	4.216	3.78	1.116	0.398
		REO	49.05	56.33	56.15	MAP.RECvsMAP.REO	-1.974	3.78	-0.523	0.774
						SCZ.ERPvsSCZ.REO	0.667	3.79	0.176	0.931
						SCZ.RECvsSCZ.REO	0.540	6.21	0.087	0.931
						CON.ERPvsCON.REO	2.116	3.09	0.685	0.671
		Task	58.47	62.31	57.52	CON.RECvsCON.REO	-3.008	3.09	-0.973	0.671
D	F7	REC	53.35	57.87	56.28	MAP.ERPvsMAP.REO	2.261	3.40	0.665	0.671
		REO	56.36	60.05	60.27	MAP.RECvsMAP.REO	-2.178	3.40	-0.641	0.671
						SCZ.ERPvsSCZ.REO	-2.750	3.41	-0.807	0.671
						SCZ.RECvsSCZ.REO	-0.401	5.58	-0.072	0.943
						CON.ERPvsCON.REO	1.203	3.05	0.395	0.694
		Task	58.59	62.96	57.47	CON.RECvsCON.REO	-4.168	3.05	-1.367	0.528
D	F8	REC	53.22	58.41	55.02	MAP.ERPvsMAP.REO	2.424	3.35	0.723	0.677
		REO	57.39	60.54	59.88	MAP.RECvsMAP.REO	-2.126	3.35	-0.634	0.677
						SCZ.ERPvsSCZ.REO	-2.407	3.36	-0.715	0.677
						SCZ.RECvsSCZ.REO	-2.292	5.51	-0.416	0.694
						CON.ERPvsCON.REO	5.330	3.56	1.496	0.245
		Task	53.26	59.27	55.05	CON.RECvsCON.REO	-6.334	3.56	-1.778	0.173
D	C3	REC	41.59	52.13	47.80	MAP.ERPvsMAP.REO	4.356	3.92	1.112	0.401
		REO	47.93	54.91	54.29	MAP.RECvsMAP.REO	-2.777	3.92	-0.709	0.554
						SCZ.ERPvsSCZ.REO	0.758	3.93	0.193	0.847
						SCZ.RECvsSCZ.REO	-4.424	6.44	-0.687	0.554
						CON.ERPvsCON.REO	5.062	3.57	1.416	0.285
		Task	53.85	59.92	55.38	CON.RECvsCON.REO	-7.103	3.57	-1.988	0.157
D	C4	REC	41.69	52.26	48.65	MAP.ERPvsMAP.REO	3.906	3.93	0.994	0.438
		REO	48.79	56.02	55.10	MAP.RECvsMAP.REO	-3.752	3.93	-0.955	0.438
						SCZ.ERPvsSCZ.REO	0.283	3.94	0.072	0.943
						SCZ.RECvsSCZ.REO	-3.951	6.46	-0.612	0.609

Frequency Band	Electrode	State	Group Means CON	Group Means MAP	Group Means SCZ	Comparisons	Estimate	Std.Error	t.value	p.value
						CON.ERPvsCON.REO	4.799	3.39	1.415	0.285
		Task	53.47	59.31	54.29	CON.RECvsCON.REO	-9.676	3.39	-2.854	0.021
D	P3	REC	39.00	50.84	46.17	MAP.ERPvsMAP.REO	3.809	3.73	1.022	0.396
		REO	48.68	55.50	55.75	MAP.RECvsMAP.REO	-4.670	3.73	-1.253	0.317
						SCZ.ERPvsSCZ.REO	-1.461	3.74	-0.391	0.696
						SCZ.RECvsSCZ.REO	-5.026	6.15	-0.817	0.466
						CON.ERPvsCON.REO	3.705	3.34	1.108	0.404
		Task	53.24	59.44	55.22	CON.RECvsCON.REO	-8.722	3.34	-2.609	0.044
D	P4	REC	40.81	52.51	47.45	MAP.ERPvsMAP.REO	2.686	3.68	0.731	0.599
		REO	49.53	56.75	56.58	MAP.RECvsMAP.REO	-4.238	3.68	-1.153	0.404
						SCZ.ERPvsSCZ.REO	-1.365	3.69	-0.370	0.712
						SCZ.RECvsSCZ.REO	-2.440	6.04	-0.404	0.712
						CON.ERPvsCON.REO	0.413	0.77	0.536	0.667
		Task	12.00	11.85	11.70	CON.RECvsCON.REO	-2.169	0.77	-2.814	0.024
T	FP1	REC	9.42	10.10	10.74	MAP.ERPvsMAP.REO	0.603	0.85	0.711	0.614
		REO	11.59	11.25	11.69	MAP.RECvsMAP.REO	-1.147	0.85	-1.354	0.385
						SCZ.ERPvsSCZ.REO	0.013	0.85	0.016	0.988
						SCZ.RECvsSCZ.REO	-1.582	1.39	-1.137	0.385
						CON.ERPvsCON.REO	0.186	0.76	0.245	0.907
		Task	12.11	12.33	11.62	CON.RECvsCON.REO	-2.262	0.76	-2.990	0.014
T	FP2	REC	9.66	10.41	10.60	MAP.ERPvsMAP.REO	0.908	0.83	1.092	0.355
		REO	11.92	11.42	11.69	MAP.RECvsMAP.REO	-1.015	0.83	-1.220	0.336
						SCZ.ERPvsSCZ.REO	-0.062	0.83	-0.074	0.941
						SCZ.RECvsSCZ.REO	-1.932	1.37	-1.413	0.336
						CON.ERPvsCON.REO	-0.186	0.84	-0.221	0.936
		Task	11.09	11.19	11.85	CON.RECvsCON.REO	-0.007	0.84	-0.008	0.994
T	F3	REC	11.27	10.98	12.38	MAP.ERPvsMAP.REO	-0.417	0.93	-0.449	0.936
		REO	11.27	11.60	11.39	MAP.RECvsMAP.REO	-0.624	0.93	-0.672	0.936
						SCZ.ERPvsSCZ.REO	0.457	0.93	0.490	0.936
						SCZ.RECvsSCZ.REO	1.602	1.53	1.050	0.936
						CON.ERPvsCON.REO	-0.424	0.81	-0.522	0.848
		Task	11.21	11.43	12.02	CON.RECvsCON.REO	-0.250	0.81	-0.307	0.848
T	F4	REC	11.38	11.07	12.38	MAP.ERPvsMAP.REO	-0.171	0.89	-0.192	0.848
		REO	11.63	11.60	11.60	MAP.RECvsMAP.REO	-0.530	0.89	-0.594	0.848
						SCZ.ERPvsSCZ.REO	0.419	0.90	0.468	0.848
						SCZ.RECvsSCZ.REO	1.556	1.47	1.061	0.848
						CON.ERPvsCON.REO	-0.467	0.75	-0.619	0.775
		Task	10.45	10.71	11.45	CON.RECvsCON.REO	-0.765	0.75	-1.015	0.775
T	F7	REC	10.15	10.06	10.92	MAP.ERPvsMAP.REO	-0.001	0.83	-0.001	1.000
		REO	10.91	10.71	11.02	MAP.RECvsMAP.REO	-0.652	0.83	-0.787	0.775
						SCZ.ERPvsSCZ.REO	0.433	0.83	0.521	0.775
						SCZ.RECvsSCZ.REO	1.052	1.36	0.773	0.775
						CON.ERPvsCON.REO	-0.664	0.73	-0.903	0.730
		Task	10.42	10.61	11.19	CON.RECvsCON.REO	-1.179	0.73	-1.604	0.730
T	F8	REC	9.91	10.04	10.93	MAP.ERPvsMAP.REO	-0.052	0.81	-0.065	0.949
		REO	11.09	10.66	10.55	MAP.RECvsMAP.REO	-0.615	0.81	-0.762	0.730
						SCZ.ERPvsSCZ.REO	0.643	0.81	0.794	0.730
						SCZ.RECvsSCZ.REO	0.633	1.33	0.477	0.815

Frequency Band	Electrode	State	Group Means CON	Group Means MAP	Group Means SCZ	Comparisons	Estimate	Std.Error	t.value	p.value
						CON.ERPvsCON.REO	-0.418	0.80	-0.520	0.940
		Task	10.91	10.85	11.63	CON.RECvsCON.REO	0.061	0.80	0.075	0.940
T	C3	REC	11.38	11.12	12.27	MAP.ERPvsMAP.REO	0.135	0.88	0.153	0.940
		REO	11.32	10.71	11.53	MAP.RECvsMAP.REO	0.405	0.88	0.458	0.940
						SCZ.ERPvsSCZ.REO	0.101	0.89	0.114	0.940
						SCZ.RECvsSCZ.REO	1.985	1.45	1.368	0.940
						CON.ERPvsCON.REO	-0.327	0.80	-0.410	0.933
		Task	11.10	10.93	11.54	CON.RECvsCON.REO	0.096	0.80	0.121	0.933
T	C4	REC	11.52	10.85	11.95	MAP.ERPvsMAP.REO	0.245	0.88	0.279	0.933
		REO	11.42	10.68	11.23	MAP.RECvsMAP.REO	0.171	0.88	0.195	0.933
						SCZ.ERPvsSCZ.REO	0.309	0.88	0.351	0.933
						SCZ.RECvsSCZ.REO	0.987	1.44	0.686	0.933
						CON.ERPvsCON.REO	0.306	0.74	0.415	0.944
		Task	11.15	10.96	11.69	CON.RECvsCON.REO	-0.043	0.74	-0.058	0.954
T	P3	REC	10.80	10.78	11.85	MAP.ERPvsMAP.REO	0.376	0.81	0.464	0.944
		REO	10.84	10.59	11.50	MAP.RECvsMAP.REO	0.190	0.81	0.234	0.944
						SCZ.ERPvsSCZ.REO	0.187	0.81	0.230	0.944
						SCZ.RECvsSCZ.REO	1.051	1.34	0.786	0.944
						CON.ERPvsCON.REO	0.072	0.75	0.095	0.998
		Task	11.15	10.55	11.48	CON.RECvsCON.REO	-0.588	0.75	-0.784	0.998
T	P4	REC	10.49	10.56	11.83	MAP.ERPvsMAP.REO	0.028	0.82	0.033	0.998
		REO	11.08	10.53	11.27	MAP.RECvsMAP.REO	0.029	0.82	0.035	0.998
						SCZ.ERPvsSCZ.REO	0.208	0.83	0.251	0.998
						SCZ.RECvsSCZ.REO	0.804	1.36	0.593	0.998
						CON.ERPvsCON.REO	-0.529	1.16	-0.456	0.730
		Task	12.03	11.92	12.85	CON.RECvsCON.REO	6.032	1.16	5.201	0.000
A	FP1	REC	18.59	15.23	14.41	MAP.ERPvsMAP.REO	0.221	1.27	0.174	0.862
		REO	12.56	11.69	11.35	MAP.RECvsMAP.REO	3.536	1.27	2.774	0.018
						SCZ.ERPvsSCZ.REO	1.506	1.28	1.177	0.361
						SCZ.RECvsSCZ.REO	1.686	2.10	0.805	0.542
						CON.ERPvsCON.REO	-0.342	1.21	-0.283	0.778
		Task	12.21	12.65	12.75	CON.RECvsCON.REO	6.530	1.21	5.403	0.000
A	FP2	REC	19.09	16.15	14.05	MAP.ERPvsMAP.REO	0.461	1.33	0.347	0.778
		REO	12.56	12.19	11.37	MAP.RECvsMAP.REO	3.967	1.33	2.986	0.009
						SCZ.ERPvsSCZ.REO	1.382	1.33	1.037	0.478
						SCZ.RECvsSCZ.REO	0.986	2.18	0.452	0.778
						CON.ERPvsCON.REO	-2.196	1.46	-1.504	0.201
		Task	14.80	13.62	14.96	CON.RECvsCON.REO	4.989	1.46	3.417	0.003
A	F3	REC	21.99	17.35	17.94	MAP.ERPvsMAP.REO	-1.203	1.60	-0.750	0.511
		REO	17.00	14.82	14.68	MAP.RECvsMAP.REO	2.525	1.60	1.574	0.201
						SCZ.ERPvsSCZ.REO	0.281	1.61	0.175	0.861
						SCZ.RECvsSCZ.REO	3.013	2.64	1.142	0.327
						CON.ERPvsCON.REO	-2.512	1.46	-1.716	0.158
		Task	15.46	13.60	15.11	CON.RECvsCON.REO	4.862	1.46	3.321	0.005
A	F4	REC	22.83	17.32	18.23	MAP.ERPvsMAP.REO	-1.191	1.61	-0.740	0.517
		REO	17.97	14.79	15.38	MAP.RECvsMAP.REO	2.522	1.61	1.567	0.178
						SCZ.ERPvsSCZ.REO	-0.264	1.61	-0.163	0.871
						SCZ.RECvsSCZ.REO	2.692	2.64	1.018	0.398

Frequency Band	Electrode	State	Group Means CON	Group Means MAP	Group Means SCZ	Comparisons	Estimate	Std.Error	t.value	p.value
						CON.ERPvsCON.REO	-0.466	1.19	-0.393	0.765
		Task	13.70	12.34	14.54	CON.RECvsCON.REO	3.287	1.19	2.772	0.027
A	F7	REC	17.45	15.08	15.66	MAP.ERPvsMAP.REO	-0.390	1.30	-0.299	0.765
		REO	14.17	12.73	13.24	MAP.RECvsMAP.REO	2.348	1.30	1.801	0.165
						SCZ.ERPvsSCZ.REO	1.295	1.31	0.990	0.572
						SCZ.RECvsSCZ.REO	1.499	2.14	0.700	0.624
						CON.ERPvsCON.REO	-0.916	1.22	-0.753	0.537
		Task	13.52	12.23	14.48	CON.RECvsCON.REO	3.602	1.22	2.958	0.015
A	F8	REC	18.04	15.00	16.33	MAP.ERPvsMAP.REO	-0.743	1.34	-0.555	0.579
		REO	14.44	12.97	13.52	MAP.RECvsMAP.REO	2.031	1.34	1.517	0.287
						SCZ.ERPvsSCZ.REO	0.956	1.34	0.712	0.537
						SCZ.RECvsSCZ.REO	2.806	2.20	1.276	0.305
						CON.ERPvsCON.REO	-2.984	1.67	-1.785	0.113
		Task	16.49	13.92	15.87	CON.RECvsCON.REO	5.311	1.67	3.176	0.008
A	C3	REC	24.79	18.28	20.45	MAP.ERPvsMAP.REO	-0.976	1.84	-0.531	0.670
		REO	19.47	14.89	16.33	MAP.RECvsMAP.REO	3.390	1.84	1.844	0.113
						SCZ.ERPvsSCZ.REO	-0.466	1.84	-0.253	0.801
						SCZ.RECvsSCZ.REO	3.806	3.02	1.260	0.269
						CON.ERPvsCON.REO	-3.186	1.58	-2.013	0.082
		Task	16.57	13.46	15.55	CON.RECvsCON.REO	5.536	1.58	3.498	0.003
A	C4	REC	25.30	17.68	19.15	MAP.ERPvsMAP.REO	-1.259	1.74	-0.724	0.591
		REO	19.76	14.71	15.82	MAP.RECvsMAP.REO	2.964	1.74	1.704	0.135
						SCZ.ERPvsSCZ.REO	-0.269	1.75	-0.154	0.878
						SCZ.RECvsSCZ.REO	1.820	2.86	0.636	0.591
						CON.ERPvsCON.REO	-3.514	1.95	-1.805	0.109
		Task	18.05	15.34	17.68	CON.RECvsCON.REO	8.658	1.95	4.448	0.000
A	P3	REC	30.23	21.64	23.57	MAP.ERPvsMAP.REO	-1.382	2.14	-0.646	0.584
		REO	21.57	16.72	17.37	MAP.RECvsMAP.REO	4.918	2.14	2.298	0.040
						SCZ.ERPvsSCZ.REO	0.317	2.15	0.148	0.883
						SCZ.RECvsSCZ.REO	4.831	3.53	1.369	0.222
						CON.ERPvsCON.REO	-3.270	1.83	-1.785	0.113
		Task	18.30	14.97	16.99	CON.RECvsCON.REO	8.089	1.83	4.417	0.000
A	P4	REC	29.66	20.15	23.14	MAP.ERPvsMAP.REO	-1.250	2.01	-0.621	0.602
		REO	21.57	16.22	17.09	MAP.RECvsMAP.REO	3.925	2.01	1.950	0.094
						SCZ.ERPvsSCZ.REO	-0.099	2.02	-0.049	0.961
						SCZ.RECvsSCZ.REO	3.626	3.31	1.096	0.353
						CON.ERPvsCON.REO	0.528	1.94	0.272	0.977
		Task	14.72	12.49	13.12	CON.RECvsCON.REO	4.846	1.94	2.495	0.120
B	FP1	REC	19.04	15.42	13.06	MAP.ERPvsMAP.REO	0.071	2.13	0.033	0.977
		REO	14.19	12.42	10.02	MAP.RECvsMAP.REO	3.002	2.13	1.407	0.257
						SCZ.ERPvsSCZ.REO	3.103	2.14	1.449	0.257
						SCZ.RECvsSCZ.REO	-6.360	3.51	-1.813	0.213
						CON.ERPvsCON.REO	0.311	1.75	0.177	0.913
		Task	14.17	12.30	13.39	CON.RECvsCON.REO	4.499	1.75	2.567	0.080
B	FP2	REC	18.35	15.41	12.90	MAP.ERPvsMAP.REO	-0.211	1.93	-0.109	0.913
		REO	13.86	12.51	9.69	MAP.RECvsMAP.REO	2.899	1.93	1.505	0.201
						SCZ.ERPvsSCZ.REO	3.696	1.93	1.912	0.161
						SCZ.RECvsSCZ.REO	-5.734	3.17	-1.811	0.161

Frequency Band	Electrode	State	Group Means CON	Group Means MAP	Group Means SCZ	Comparisons	Estimate	Std.Error	t.value	p.value
						CON.ERPvsCON.REO	-1.409	2.08	-0.676	0.839
		Task	18.94	15.76	15.59	CON.RECvsCON.REO	0.565	2.08	0.271	0.885
B	F3	REC	20.91	17.19	16.87	MAP.ERPvsMAP.REO	-2.459	2.29	-1.074	0.839
		REO	20.35	18.22	15.58	MAP.RECvsMAP.REO	-1.032	2.29	-0.451	0.839
						SCZ.ERPvsSCZ.REO	0.012	2.30	0.005	0.996
						SCZ.RECvsSCZ.REO	-5.426	3.76	-1.442	0.839
						CON.ERPvsCON.REO	-1.431	2.08	-0.689	0.885
		Task	19.92	14.42	16.06	CON.RECvsCON.REO	-0.460	2.08	-0.222	0.928
B	F4	REC	20.89	17.26	18.17	MAP.ERPvsMAP.REO	-2.854	2.28	-1.250	0.647
		REO	21.35	17.28	16.88	MAP.RECvsMAP.REO	-0.017	2.28	-0.008	0.994
						SCZ.ERPvsSCZ.REO	-0.823	2.29	-0.359	0.926
						SCZ.RECvsSCZ.REO	-4.788	3.75	-1.276	0.647
						CON.ERPvsCON.REO	-1.184	2.04	-0.581	0.830
		Task	17.38	14.64	16.50	CON.RECvsCON.REO	0.486	2.04	0.238	0.830
B	F7	REC	19.05	16.99	17.13	MAP.ERPvsMAP.REO	-1.870	2.24	-0.834	0.830
		REO	18.56	16.51	15.47	MAP.RECvsMAP.REO	0.482	2.24	0.215	0.830
						SCZ.ERPvsSCZ.REO	1.022	2.25	0.454	0.830
						SCZ.RECvsSCZ.REO	-2.151	3.68	-0.584	0.830
						CON.ERPvsCON.REO	0.377	1.86	0.203	0.839
		Task	17.46	14.20	16.86	CON.RECvsCON.REO	1.745	1.86	0.939	0.825
B	F8	REC	18.83	16.54	17.72	MAP.ERPvsMAP.REO	-1.629	2.04	-0.798	0.825
		REO	17.08	15.83	16.05	MAP.RECvsMAP.REO	0.710	2.04	0.348	0.825
						SCZ.ERPvsSCZ.REO	0.807	2.05	0.394	0.825
						SCZ.RECvsSCZ.REO	-1.147	3.36	-0.342	0.825
						CON.ERPvsCON.REO	-1.928	2.17	-0.888	0.699
		Task	19.34	15.97	17.45	CON.RECvsCON.REO	0.962	2.17	0.443	0.819
B	C3	REC	22.23	18.47	19.48	MAP.ERPvsMAP.REO	-3.515	2.39	-1.473	0.699
		REO	21.27	19.49	17.85	MAP.RECvsMAP.REO	-1.018	2.39	-0.427	0.819
						SCZ.ERPvsSCZ.REO	-0.392	2.39	-0.164	0.870
						SCZ.RECvsSCZ.REO	-1.367	3.92	-0.349	0.819
						CON.ERPvsCON.REO	-1.549	2.16	-0.718	0.744
		Task	18.48	15.69	17.53	CON.RECvsCON.REO	1.471	2.16	0.682	0.744
B	C4	REC	21.50	19.20	20.25	MAP.ERPvsMAP.REO	-2.892	2.37	-1.221	0.547
		REO	20.03	18.59	17.85	MAP.RECvsMAP.REO	0.617	2.37	0.261	0.892
						SCZ.ERPvsSCZ.REO	-0.323	2.38	-0.136	0.892
						SCZ.RECvsSCZ.REO	1.144	3.89	0.294	0.892
						CON.ERPvsCON.REO	-1.591	1.69	-0.943	0.624
		Task	17.32	14.39	16.34	CON.RECvsCON.REO	1.061	1.69	0.629	0.781
B	P3	REC	19.97	16.75	18.41	MAP.ERPvsMAP.REO	-2.804	1.85	-1.512	0.589
		REO	18.91	17.19	15.38	MAP.RECvsMAP.REO	-0.437	1.85	-0.236	0.814
						SCZ.ERPvsSCZ.REO	0.957	1.86	0.514	0.781
						SCZ.RECvsSCZ.REO	-0.856	3.06	-0.280	0.814
						CON.ERPvsCON.REO	-0.507	1.69	-0.301	0.860
		Task	17.31	15.04	16.32	CON.RECvsCON.REO	1.222	1.69	0.724	0.662
B	P4	REC	19.04	16.78	17.58	MAP.ERPvsMAP.REO	-1.464	1.85	-0.790	0.662
		REO	17.82	16.50	15.06	MAP.RECvsMAP.REO	0.284	1.85	0.153	0.879
						SCZ.ERPvsSCZ.REO	1.256	1.86	0.675	0.662
						SCZ.RECvsSCZ.REO	-1.990	3.05	-0.653	0.662

C.3 Potential Confounding Factors

C.3.1 Spearman correlations of frequency band power measures with demographic variables during Resting Eyes Closed State

			A		B		D		T	
Electrode	**State**	**Potential Confounding Variables**	**rho**	**p-values**	**rho**	**p-values**	**rho**	**p-values**	**rho**	**p-values**
FP1	REC	Age on Day of Testing	-0.076	0.513	0.009	0.940	0.020	0.864	-0.060	0.605
		Years at School	0.040	0.728	0.176	0.126	-0.094	0.415	0.028	0.809
		Years of Tertiary Education	0.065	0.575	0.104	0.368	-0.070	0.547	-0.077	0.508
		Total Years of Education	0.019	0.871	0.116	0.315	-0.047	0.687	-0.042	0.719
		Weight	-0.129	0.265	-0.173	0.132	0.121	0.296	0.023	0.842
		BMI	-0.044	0.702	-0.114	0.323	0.021	0.853	0.105	0.363
		B7 ASRS PartB above cut off	0.009	0.937	0.038	0.743	-0.027	0.815	0.068	0.561
		B9 ASSIST Subscore Tobacco	-0.149	0.201	-0.182	0.119	0.114	0.332	0.149	0.202
		B9 ASSIST Subscore Cannabis	-0.060	0.609	-0.055	0.642	0.054	0.645	0.067	0.569
		B9 ASSIST Subscore Methamphetamine	-0.144	0.219	-0.096	0.412	0.127	0.279	-0.036	0.757
		B9 ASSIST Subscore Methaqualone	-0.071	0.543	-0.006	0.957	0.026	0.827	0.043	0.712
		B9 ASSIST Total Score	-0.102	0.385	-0.106	0.367	0.095	0.418	0.068	0.564
FP2	REC	Age on Day of Testing	-0.078	0.501	0.017	0.882	0.034	0.771	-0.063	0.589
		Years at School	0.030	0.795	0.182	0.112	-0.106	0.361	0.072	0.531
		Years of Tertiary Education	0.095	0.413	0.114	0.323	-0.105	0.364	0.045	0.697
		Total Years of Education	0.043	0.711	0.137	0.235	-0.090	0.439	0.068	0.559
		Weight	-0.130	0.260	-0.177	0.124	0.122	0.289	-0.015	0.895
		BMI	-0.061	0.595	-0.106	0.358	0.034	0.769	0.056	0.629
		B7 ASRS PartB above cut off	0.040	0.735	0.089	0.443	-0.077	0.509	0.101	0.385
		B9 ASSIST Subscore Tobacco	-0.170	0.146	-0.196	0.092	0.132	0.259	0.126	0.280
		B9 ASSIST Subscore Cannabis	-0.097	0.407	-0.123	0.295	0.113	0.335	0.004	0.974
		B9 ASSIST Subscore Methamphetamine	-0.111	0.345	-0.079	0.498	0.096	0.413	-0.042	0.722
		B9 ASSIST Subscore Methaqualone	-0.117	0.318	-0.090	0.442	0.111	0.342	-0.067	0.568
		B9 ASSIST Total Score	-0.072	0.540	-0.113	0.335	0.068	0.565	0.100	0.395
F3	REC	Age on Day of Testing	0.009	0.937	0.128	0.267	-0.084	0.468	-0.002	0.989
		Years at School	-0.035	0.764	0.112	0.332	-0.065	0.572	0.062	0.593
		Years of Tertiary Education	-0.007	0.950	0.012	0.920	-0.024	0.833	0.051	0.659
		Total Years of Education	-0.046	0.693	0.041	0.723	-0.023	0.841	0.052	0.656
		Weight	-0.088	0.447	-0.124	0.282	0.059	0.612	-0.022	0.846
		BMI	-0.002	0.989	-0.043	0.708	-0.069	0.552	0.127	0.270
		B7 ASRS PartB above cut off	0.082	0.484	0.080	0.493	-0.042	0.720	0.020	0.866
		B9 ASSIST Subscore Tobacco	-0.240	**0.037***	-0.283	**0.014***	0.218	0.061	-0.006	0.958
		B9 ASSIST Subscore Cannabis	-0.079	0.503	-0.063	0.590	0.094	0.420	-0.018	0.878
		B9 ASSIST Subscore Methamphetamine	-0.186	0.111	-0.111	0.342	0.212	0.068	-0.152	0.192
		B9 ASSIST Subscore Methaqualone	-0.135	0.249	-0.073	0.534	0.118	0.315	-0.024	0.839
		B9 ASSIST Total Score	-0.122	0.295	-0.128	0.274	0.145	0.213	0.001	0.991
F4	REC	Age on Day of Testing	0.010	0.931	0.153	0.183	-0.087	0.451	-0.001	0.994
		Years at School	0.031	0.791	0.163	0.156	-0.113	0.328	0.106	0.358
		Years of Tertiary Education	0.033	0.778	0.013	0.912	-0.087	0.450	0.162	0.159
		Total Years of Education	0.017	0.880	0.076	0.510	-0.088	0.449	0.141	0.220
		Weight	-0.127	0.272	-0.189	0.099	0.128	0.266	0.007	0.953
		BMI	-0.049	0.670	-0.096	0.406	-0.001	0.996	0.129	0.264
		B7 ASRS PartB above cut off	0.111	0.339	0.122	0.294	-0.124	0.287	0.056	0.634
		B9 ASSIST Subscore Tobacco	-0.237	**0.040***	-0.277	**0.015***	0.226	0.051	-0.011	0.928
		B9 ASSIST Subscore Cannabis	-0.098	0.403	-0.113	0.336	0.118	0.315	0.020	0.866
		B9 ASSIST Subscore Methamphetamine	-0.234	**0.043***	-0.136	0.244	0.212	0.067	-0.206	0.076
		B9 ASSIST Subscore Methaqualone	-0.189	0.104	-0.100	0.396	0.172	0.140	-0.118	0.314
		B9 ASSIST Total Score	-0.098	0.402	-0.152	0.194	0.119	0.311	0.020	0.864
F7	REC	Age on Day of Testing	0.072	0.536	0.225	**0.049***	-0.166	0.150	0.171	0.136
		Years at School	0.044	0.703	0.099	0.392	-0.087	0.454	0.111	0.336
		Years of Tertiary Education	0.133	0.249	0.088	0.448	-0.111	0.339	0.111	0.336
		Total Years of Education	0.068	0.556	0.068	0.554	-0.076	0.513	0.109	0.346
		Weight	-0.018	0.877	0.015	0.896	-0.020	0.860	0.086	0.455
		BMI	0.003	0.982	0.022	0.848	-0.064	0.579	0.164	0.154
		B7 ASRS PartB above cut off	0.004	0.971	0.062	0.596	0.004	0.971	0.119	0.306
		B9 ASSIST Subscore Tobacco	-0.123	0.292	-0.190	0.103	0.107	0.359	0.091	0.436
		B9 ASSIST Subscore Cannabis	-0.091	0.438	-0.109	0.351	0.082	0.486	0.008	0.945
		B9 ASSIST Subscore Methamphetamine	-0.133	0.255	-0.054	0.644	0.109	0.353	-0.047	0.688
		B9 ASSIST Subscore Methaqualone	-0.143	0.220	-0.044	0.707	0.081	0.491	-0.076	0.519
		B9 ASSIST Total Score	-0.118	0.314	-0.143	0.221	0.102	0.384	0.089	0.446
		Age on Day of Testing	0.096	0.405	0.263	**0.020***	-0.179	0.120	0.048	0.676
		Years at School	0.038	0.743	0.082	0.477	-0.066	0.566	0.061	0.598

F8	REC	Years of Tertiary Education	0.060	0.606	0.034	0.767	-0.049	0.674	0.115	0.321
		Total Years of Education	0.029	0.803	0.033	0.773	-0.032	0.780	0.087	0.451
		Weight	0.027	0.819	-0.036	0.755	-0.018	0.877	0.118	0.309
		BMI	0.107	0.353	0.075	0.518	-0.137	0.234	0.222	0.052
		B7 ASRS PartB above cut off	0.106	0.362	0.088	0.449	-0.085	0.467	0.104	0.372
		B9 ASSIST Subscore Tobacco	-0.168	0.150	-0.283	**0.013***	0.179	0.125	0.108	0.355
		B9 ASSIST Subscore Cannabis	-0.093	0.427	-0.120	0.305	0.093	0.430	0.036	0.759
		B9 ASSIST Subscore Methamphetamine	-0.224	0.053	-0.130	0.267	0.177	0.129	-0.138	0.236
		B9 ASSIST Subscore Methaqualone	-0.161	0.169	-0.097	0.409	0.120	0.304	-0.085	0.469
		B9 ASSIST Total Score	-0.113	0.334	-0.189	0.104	0.142	0.224	0.008	0.947
C3	REC	Age on Day of Testing	0.007	0.950	0.167	0.146	-0.082	0.479	0.033	0.776
		Years at School	0.088	0.447	0.185	0.107	-0.128	0.267	0.161	0.163
		Years of Tertiary Education	0.127	0.270	0.128	0.268	-0.107	0.353	0.142	0.219
		Total Years of Education	0.109	0.344	0.150	0.193	-0.109	0.344	0.151	0.188
		Weight	-0.115	0.321	-0.044	0.704	0.113	0.326	-0.024	0.839
		BMI	0.006	0.958	-0.021	0.857	-0.013	0.914	0.072	0.535
		B7 ASRS PartB above cut off	0.081	0.485	0.117	0.316	-0.080	0.493	0.034	0.772
		B9 ASSIST Subscore Tobacco	-0.270	**0.019***	-0.241	**0.036***	0.224	0.053	0.092	0.430
		B9 ASSIST Subscore Cannabis	-0.116	0.323	-0.057	0.627	0.086	0.463	-0.014	0.907
		B9 ASSIST Subscore Methamphetamine	-0.237	**0.040***	-0.126	0.281	0.205	0.077	-0.108	0.357
		B9 ASSIST Subscore Methaqualone	-0.206	0.076	-0.142	0.223	0.180	0.122	-0.013	0.910
		B9 ASSIST Total Score	-0.105	0.368	-0.130	0.268	0.103	0.378	0.078	0.504
C4	REC	Age on Day of Testing	0.004	0.976	0.198	0.084	-0.081	0.481	0.019	0.868
		Years at School	0.096	0.409	0.147	0.201	-0.144	0.213	0.129	0.263
		Years of Tertiary Education	0.114	0.322	0.007	0.954	-0.087	0.452	0.249	**0.029***
		Total Years of Education	0.113	0.327	0.061	0.598	-0.111	0.338	0.197	0.086
		Weight	-0.136	0.237	-0.068	0.556	0.132	0.252	0.005	0.963
		BMI	-0.045	0.697	-0.027	0.813	0.027	0.816	0.100	0.388
		B7 ASRS PartB above cut off	0.045	0.699	0.139	0.231	-0.073	0.531	0.049	0.673
		B9 ASSIST Subscore Tobacco	-0.295	**0.010***	-0.219	0.059	0.250	**0.030***	0.048	0.681
		B9 ASSIST Subscore Cannabis	-0.138	0.237	-0.106	0.366	0.131	0.263	0.035	0.764
		B9 ASSIST Subscore Methamphetamine	-0.276	**0.016***	-0.076	0.515	0.199	0.087	-0.162	0.164
		B9 ASSIST Subscore Methaqualone	-0.217	0.062	-0.073	0.532	0.179	0.125	-0.086	0.464
		B9 ASSIST Total Score	-0.119	0.311	-0.139	0.234	0.136	0.246	0.068	0.563
P3	REC	Age on Day of Testing	-0.018	0.878	0.149	0.198	-0.044	0.706	0.134	0.247
		Years at School	0.052	0.656	0.142	0.220	-0.113	0.331	0.027	0.816
		Years of Tertiary Education	0.052	0.655	0.113	0.331	-0.063	0.589	0.070	0.547
		Total Years of Education	0.059	0.614	0.103	0.378	-0.082	0.483	0.040	0.733
		Weight	-0.184	0.112	-0.018	0.879	0.158	0.172	-0.019	0.868
		BMI	-0.073	0.532	0.045	0.697	0.017	0.884	0.034	0.773
		B7 ASRS PartB above cut off	0.003	0.980	0.138	0.237	-0.032	0.783	0.003	0.977
		B9 ASSIST Subscore Tobacco	-0.313	**0.006***	-0.243	**0.036***	0.268	**0.020***	0.151	0.200
		B9 ASSIST Subscore Cannabis	-0.165	0.161	-0.116	0.324	0.159	0.176	0.008	0.945
		B9 ASSIST Subscore Methamphetamine	-0.266	**0.021***	-0.165	0.159	0.271	**0.019***	-0.067	0.571
		B9 ASSIST Subscore Methaqualone	-0.170	0.147	-0.127	0.283	0.175	0.137	0.024	0.839
		B9 ASSIST Total Score	-0.174	0.137	-0.197	0.093	0.212	0.070	0.089	0.451
P4	REC	Age on Day of Testing	-0.054	0.641	0.129	0.262	-0.009	0.939	0.048	0.678
		Years at School	0.081	0.486	0.189	0.100	-0.141	0.220	0.118	0.306
		Years of Tertiary Education	0.107	0.355	0.085	0.461	-0.124	0.284	0.097	0.400
		Total Years of Education	0.100	0.386	0.122	0.291	-0.130	0.259	0.107	0.355
		Weight	-0.088	0.444	-0.028	0.808	0.055	0.633	0.003	0.982
		BMI	-0.022	0.849	0.007	0.950	-0.045	0.698	0.080	0.488
		B7 ASRS PartB above cut off	-0.040	0.733	0.125	0.283	-0.037	0.749	0.016	0.894
		B9 ASSIST Subscore Tobacco	-0.330	**0.003***	-0.177	0.128	0.246	**0.033***	0.160	0.171
		B9 ASSIST Subscore Cannabis	-0.093	0.427	-0.007	0.955	0.063	0.591	0.080	0.497
		B9 ASSIST Subscore Methamphetamine	-0.342	**0.002***	-0.118	0.314	0.280	**0.014***	-0.077	0.514
		B9 ASSIST Subscore Methaqualone	-0.173	0.139	-0.072	0.539	0.148	0.205	-0.028	0.811
		B9 ASSIST Total Score	-0.156	0.181	-0.082	0.485	0.131	0.261	0.128	0.273

C.3.2 Spearman correlations of frequency band power measures with demographic variables during Resting Eyes Open State

			A		B		D		T	
Electrode	**State**	**Potential Confounding Variables**	**rho**	**p-values**	**rho**	**p-values**	**rho**	**p-values**	**rho**	**p-values**
FP1	REO	Age on Day of Testing	0.005	0.967	-0.021	0.857	-0.016	0.893	0.019	0.871
		Years at School	0.081	0.490	-0.005	0.964	-0.102	0.383	0.149	0.203
		Years of Tertiary Education	-0.041	0.728	-0.019	0.870	0.027	0.817	-0.072	0.542
		Total Years of Education	0.034	0.775	-0.027	0.820	-0.052	0.658	0.061	0.601
		Weight	-0.035	0.768	0.053	0.652	0.040	0.735	-0.185	0.112
		BMI	0.032	0.782	0.073	0.535	-0.026	0.828	-0.145	0.213
		B7 ASRS PartB above cut off	-0.122	0.300	-0.030	0.799	0.101	0.390	0.049	0.681
		B9 ASSIST Subscore Tobacco	-0.089	0.453	-0.061	0.606	0.057	0.631	-0.050	0.673
		B9 ASSIST Subscore Cannabis	-0.052	0.664	-0.043	0.719	0.054	0.648	-0.158	0.181
		B9 ASSIST Subscore Methamphetamine	-0.030	0.801	0.016	0.895	-0.001	0.992	-0.016	0.891
		B9 ASSIST Subscore Methaqualone	-0.104	0.381	-0.068	0.566	0.061	0.606	-0.112	0.344
		B9 ASSIST Total Score	-0.151	0.203	-0.076	0.525	0.136	0.253	-0.169	0.153
FP2	REO	Age on Day of Testing	0.048	0.683	-0.006	0.961	-0.068	0.560	0.086	0.463
		Years at School	0.059	0.616	0.056	0.630	-0.104	0.373	0.147	0.208
		Years of Tertiary Education	-0.009	0.940	0.014	0.902	-0.022	0.851	0.056	0.635
		Total Years of Education	0.054	0.648	0.037	0.754	-0.097	0.408	0.155	0.184
		Weight	-0.005	0.967	0.018	0.880	0.034	0.774	-0.158	0.175
		BMI	0.037	0.752	0.029	0.803	-0.024	0.837	-0.102	0.382
		B7 ASRS PartB above cut off	-0.064	0.586	-0.008	0.945	0.066	0.577	0.066	0.574
		B9 ASSIST Subscore Tobacco	-0.104	0.379	-0.105	0.379	0.100	0.401	-0.094	0.430
		B9 ASSIST Subscore Cannabis	-0.136	0.251	-0.072	0.543	0.123	0.298	-0.208	0.077
		B9 ASSIST Subscore Methamphetamine	-0.042	0.727	-0.051	0.669	0.012	0.920	0.000	0.997
		B9 ASSIST Subscore Methaqualone	-0.162	0.171	-0.138	0.246	0.109	0.358	-0.144	0.225
		B9 ASSIST Total Score	-0.168	0.155	-0.103	0.386	0.148	0.211	-0.144	0.224
F3	REO	Age on Day of Testing	0.153	0.191	0.162	0.165	-0.200	0.086	0.031	0.794
		Years at School	0.142	0.224	0.144	0.218	-0.155	0.184	0.111	0.342
		Years of Tertiary Education	0.077	0.511	0.087	0.457	-0.093	0.426	0.054	0.645
		Total Years of Education	0.146	0.211	0.134	0.252	-0.158	0.176	0.128	0.275
		Weight	0.006	0.960	0.050	0.672	-0.058	0.624	-0.112	0.337
		BMI	-0.023	0.845	0.046	0.693	-0.074	0.526	-0.048	0.679
		B7 ASRS PartB above cut off	0.036	0.764	0.020	0.867	-0.003	0.979	0.016	0.890
		B9 ASSIST Subscore Tobacco	-0.164	0.166	-0.138	0.246	0.098	0.408	-0.034	0.776
		B9 ASSIST Subscore Cannabis	-0.147	0.213	-0.104	0.381	0.060	0.611	-0.125	0.290
		B9 ASSIST Subscore Methamphetamine	-0.084	0.479	-0.057	0.632	-0.004	0.973	0.074	0.531
		B9 ASSIST Subscore Methaqualone	-0.179	0.130	-0.053	0.657	0.014	0.905	-0.110	0.355
		B9 ASSIST Total Score	-0.144	0.225	-0.123	0.298	0.077	0.516	-0.055	0.646
F4	REO	Age on Day of Testing	0.121	0.302	0.174	0.136	-0.158	0.177	0.020	0.862
		Years at School	0.208	0.073	0.208	0.073	-0.254	**0.027***	0.168	0.149
		Years of Tertiary Education	0.146	0.212	0.112	0.339	-0.128	0.273	0.148	0.204
		Total Years of Education	0.231	**0.046***	0.191	0.101	-0.244	**0.035***	0.216	0.062
		Weight	-0.028	0.811	-0.028	0.810	0.011	0.923	-0.047	0.689
		BMI	-0.064	0.587	0.001	0.994	-0.010	0.932	-0.016	0.894
		B7 ASRS PartB above cut off	0.037	0.752	0.004	0.970	-0.001	0.993	0.043	0.713
		B9 ASSIST Subscore Tobacco	-0.182	0.123	-0.203	0.085	0.163	0.168	0.003	0.981
		B9 ASSIST Subscore Cannabis	-0.095	0.423	-0.119	0.315	0.057	0.633	-0.053	0.656
		B9 ASSIST Subscore Methamphetamine	-0.176	0.136	-0.131	0.269	0.103	0.384	0.025	0.831
		B9 ASSIST Subscore Methaqualone	-0.200	0.090	-0.103	0.385	0.073	0.537	-0.124	0.297
		B9 ASSIST Total Score	-0.158	0.182	-0.162	0.170	0.114	0.337	-0.056	0.636
F7	REO	Age on Day of Testing	0.124	0.291	0.151	0.195	-0.170	0.146	0.073	0.532
		Years at School	0.289	**0.011***	0.136	0.243	-0.260	**0.024***	0.233	**0.044***
		Years of Tertiary Education	0.293	**0.010***	0.142	0.223	-0.244	**0.035***	0.222	0.056
		Total Years of Education	0.348	**0.002***	0.152	0.192	-0.294	**0.010***	0.291	**0.011***
		Weight	0.159	0.174	0.187	0.108	-0.180	0.123	-0.068	0.562
		BMI	0.093	0.425	0.087	0.455	-0.110	0.345	-0.022	0.852
		B7 ASRS PartB above cut off	-0.018	0.879	0.003	0.978	0.046	0.697	0.076	0.522
		B9 ASSIST Subscore Tobacco	-0.042	0.726	-0.068	0.568	0.023	0.846	-0.018	0.881
		B9 ASSIST Subscore Cannabis	0.007	0.956	-0.029	0.810	0.011	0.928	-0.122	0.305
		B9 ASSIST Subscore Methamphetamine	-0.095	0.423	-0.058	0.625	0.045	0.702	0.011	0.929
		B9 ASSIST Subscore Methaqualone	-0.198	0.094	-0.111	0.349	0.109	0.360	-0.139	0.242
		B9 ASSIST Total Score	-0.100	0.399	-0.089	0.455	0.088	0.458	-0.083	0.486
		Age on Day of Testing	0.204	0.079	0.220	0.058	-0.240	**0.038***	0.109	0.350
		Years at School	0.193	0.098	0.042	0.719	-0.154	0.187	0.193	0.097

F8	REO	Years of Tertiary Education	0.211	0.070	0.061	0.604	-0.119	0.308	0.175	0.134
		Total Years of Education	0.260	**0.024***	0.062	0.600	-0.174	0.136	0.229	**0.048***
		Weight	0.119	0.309	0.127	0.279	-0.115	0.327	-0.059	0.615
		BMI	0.054	0.642	0.112	0.337	-0.085	0.469	-0.078	0.508
		B7 ASRS PartB above cut off	0.083	0.481	0.051	0.665	-0.055	0.643	0.059	0.617
		B9 ASSIST Subscore Tobacco	-0.051	0.670	-0.087	0.464	0.060	0.614	0.041	0.732
		B9 ASSIST Subscore Cannabis	-0.008	0.948	-0.042	0.723	0.005	0.964	-0.098	0.411
		B9 ASSIST Subscore Methamphetamine	-0.095	0.422	-0.068	0.566	0.068	0.566	0.015	0.899
		B9 ASSIST Subscore Methaqualone	-0.189	0.110	-0.079	0.508	0.114	0.339	-0.132	0.264
		B9 ASSIST Total Score	-0.059	0.620	-0.130	0.273	0.091	0.445	-0.059	0.623
C3	REO	Age on Day of Testing	0.056	0.631	0.141	0.227	-0.139	0.235	0.020	0.867
		Years at School	0.202	0.082	0.139	0.235	-0.193	0.097	0.179	0.124
		Years of Tertiary Education	0.068	0.565	0.113	0.336	-0.107	0.360	0.154	0.187
		Total Years of Education	0.195	0.094	0.147	0.209	-0.190	0.103	0.229	**0.048***
		Weight	0.037	0.753	0.157	0.178	-0.107	0.361	-0.086	0.462
		BMI	0.037	0.752	0.132	0.257	-0.112	0.339	-0.053	0.652
		B7 ASRS PartB above cut off	-0.090	0.445	-0.006	0.962	0.070	0.555	0.036	0.761
		B9 ASSIST Subscore Tobacco	-0.233	**0.047***	-0.128	0.281	0.146	0.219	-0.075	0.526
		B9 ASSIST Subscore Cannabis	-0.098	0.410	-0.055	0.647	0.007	0.951	-0.156	0.188
		B9 ASSIST Subscore Methamphetamine	-0.177	0.135	-0.030	0.798	0.061	0.610	-0.034	0.775
		B9 ASSIST Subscore Methaqualone	-0.174	0.141	-0.063	0.596	0.047	0.691	-0.130	0.274
		B9 ASSIST Total Score	-0.218	0.064	-0.139	0.241	0.147	0.215	-0.102	0.393
C4	REO	Age on Day of Testing	0.103	0.380	0.164	0.161	-0.151	0.195	0.061	0.605
		Years at School	0.155	0.184	0.134	0.251	-0.182	0.118	0.158	0.175
		Years of Tertiary Education	0.090	0.440	0.049	0.674	-0.081	0.488	0.187	0.107
		Total Years of Education	0.181	0.120	0.109	0.352	-0.172	0.139	0.230	**0.046***
		Weight	0.033	0.778	0.154	0.187	-0.095	0.418	-0.082	0.483
		BMI	0.023	0.847	0.130	0.266	-0.089	0.446	-0.038	0.743
		B7 ASRS PartB above cut off	-0.066	0.576	0.011	0.927	0.028	0.816	0.074	0.528
		B9 ASSIST Subscore Tobacco	-0.253	**0.030***	-0.128	0.280	0.182	0.124	-0.036	0.765
		B9 ASSIST Subscore Cannabis	-0.156	0.189	-0.070	0.554	0.086	0.470	-0.130	0.274
		B9 ASSIST Subscore Methamphetamine	-0.181	0.126	-0.015	0.897	0.070	0.555	-0.013	0.910
		B9 ASSIST Subscore Methaqualone	-0.191	0.106	-0.074	0.532	0.119	0.316	-0.158	0.183
		B9 ASSIST Total Score	-0.213	0.070	-0.138	0.243	0.161	0.173	-0.065	0.584
P3	REO	Age on Day of Testing	0.071	0.548	0.130	0.265	-0.128	0.275	0.034	0.769
		Years at School	0.152	0.193	0.128	0.273	-0.163	0.161	0.176	0.131
		Years of Tertiary Education	0.049	0.673	0.122	0.297	-0.065	0.577	0.150	0.198
		Total Years of Education	0.147	0.209	0.129	0.268	-0.148	0.205	0.231	**0.046***
		Weight	0.014	0.908	0.142	0.223	-0.047	0.691	-0.093	0.425
		BMI	0.021	0.855	0.086	0.463	-0.055	0.640	-0.065	0.582
		B7 ASRS PartB above cut off	-0.091	0.439	-0.023	0.845	0.088	0.455	0.060	0.612
		B9 ASSIST Subscore Tobacco	-0.213	0.070	-0.060	0.615	0.144	0.226	-0.039	0.744
		B9 ASSIST Subscore Cannabis	-0.117	0.326	-0.034	0.777	0.042	0.725	-0.085	0.472
		B9 ASSIST Subscore Methamphetamine	-0.177	0.134	-0.023	0.847	0.079	0.509	-0.023	0.846
		B9 ASSIST Subscore Methaqualone	-0.177	0.133	-0.070	0.557	0.077	0.519	-0.135	0.255
		B9 ASSIST Total Score	-0.196	0.096	-0.112	0.345	0.140	0.237	-0.093	0.433
P4	REO	Age on Day of Testing	0.055	0.641	0.105	0.371	-0.100	0.394	0.024	0.839
		Years at School	0.164	0.160	0.159	0.173	-0.198	0.089	0.183	0.116
		Years of Tertiary Education	0.079	0.501	0.102	0.386	-0.096	0.413	0.127	0.276
		Total Years of Education	0.173	0.139	0.136	0.244	-0.185	0.112	0.219	0.059
		Weight	0.022	0.850	0.144	0.217	-0.074	0.531	-0.095	0.417
		BMI	-0.010	0.931	0.084	0.474	-0.050	0.671	-0.047	0.691
		B7 ASRS PartB above cut off	-0.116	0.323	0.028	0.810	0.054	0.650	0.046	0.694
		B9 ASSIST Subscore Tobacco	-0.222	0.059	-0.077	0.516	0.154	0.192	-0.045	0.705
		B9 ASSIST Subscore Cannabis	-0.122	0.305	-0.025	0.832	0.048	0.685	-0.123	0.300
		B9 ASSIST Subscore Methamphetamine	-0.205	0.082	-0.023	0.846	0.105	0.375	-0.038	0.750
		B9 ASSIST Subscore Methaqualone	-0.173	0.143	-0.063	0.596	0.091	0.445	-0.130	0.272
		B9 ASSIST Total Score	-0.205	0.082	-0.105	0.377	0.146	0.216	-0.104	0.380

C.3.3 Spearman correlations of frequency band power measures with demographic variables during Task Performance State

Electrode	State	Potential Confounding Variables	rho	p-values	rho	p-values	rho	p-values	rho	p-values
FP1	ERP	Age on Day of Testing	0.153	0.179	0.103	0.369	-0.159	0.162	0.189	0.096
		Years at School	-0.054	0.636	0.106	0.355	-0.044	0.699	-0.138	0.224
		Years of Tertiary Education	-0.050	0.663	0.111	0.330	0.000	1.000	-0.139	0.223
		Total Years of Education	-0.057	0.620	0.114	0.316	-0.022	0.846	-0.150	0.186
		Weight	0.100	0.380	-0.029	0.802	0.024	0.836	-0.094	0.410
		BMI	0.249	**0.026***	0.099	0.384	-0.135	0.235	-0.019	0.870
		B7 ASRS PartB above cut off	-0.027	0.811	0.039	0.738	0.035	0.760	-0.125	0.275
		B9 ASSIST Subscore Tobacco	-0.121	0.294	-0.137	0.234	0.095	0.411	0.088	0.449
		B9 ASSIST Subscore Cannabis	-0.148	0.200	-0.088	0.447	0.108	0.349	-0.002	0.984
		B9 ASSIST Subscore Methamphetamine	0.011	0.922	-0.061	0.600	0.004	0.975	0.124	0.281
		B9 ASSIST Subscore Methaqualone	0.076	0.510	0.040	0.729	-0.112	0.333	0.191	0.096
		B9 ASSIST Total Score	-0.103	0.374	-0.059	0.609	0.056	0.631	0.017	0.886
FP2	ERP	Age on Day of Testing	0.097	0.394	0.089	0.437	-0.128	0.261	0.149	0.191
		Years at School	-0.054	0.635	0.124	0.276	-0.045	0.695	-0.137	0.230
		Years of Tertiary Education	-0.059	0.606	0.077	0.498	0.004	0.974	-0.118	0.299
		Total Years of Education	-0.061	0.591	0.105	0.359	-0.022	0.844	-0.135	0.236
		Weight	0.096	0.398	-0.048	0.677	0.012	0.915	-0.089	0.435
		BMI	0.199	0.079	0.051	0.655	-0.104	0.361	0.000	1.000
		B7 ASRS PartB above cut off	-0.017	0.884	0.074	0.519	-0.018	0.873	-0.115	0.318
		B9 ASSIST Subscore Tobacco	-0.072	0.534	-0.184	0.108	0.121	0.293	0.068	0.559
		B9 ASSIST Subscore Cannabis	-0.115	0.321	-0.104	0.368	0.116	0.314	-0.023	0.842
		B9 ASSIST Subscore Methamphetamine	0.005	0.964	-0.123	0.288	0.028	0.808	0.186	0.105
		B9 ASSIST Subscore Methaqualone	0.020	0.866	-0.005	0.964	-0.053	0.649	0.192	0.094
		B9 ASSIST Total Score	-0.067	0.564	-0.094	0.419	0.064	0.580	0.056	0.629
F3	ERP	Age on Day of Testing	0.134	0.239	0.156	0.170	-0.125	0.271	-0.018	0.874
		Years at School	0.062	0.590	0.191	0.091	-0.112	0.325	-0.101	0.376
		Years of Tertiary Education	-0.029	0.801	0.062	0.587	0.004	0.974	-0.098	0.388
		Total Years of Education	0.034	0.767	0.151	0.184	-0.077	0.501	-0.106	0.351
		Weight	0.042	0.713	-0.131	0.251	0.054	0.634	0.057	0.619
		BMI	0.158	0.164	-0.051	0.657	-0.067	0.557	0.184	0.105
		B7 ASRS PartB above cut off	-0.063	0.583	0.004	0.976	0.055	0.635	-0.086	0.454
		B9 ASSIST Subscore Tobacco	-0.140	0.225	-0.137	0.233	0.130	0.259	0.015	0.898
		B9 ASSIST Subscore Cannabis	-0.217	0.057	-0.150	0.192	0.155	0.178	-0.075	0.519
		B9 ASSIST Subscore Methamphetamine	-0.092	0.424	-0.133	0.249	0.113	0.329	0.009	0.940
		B9 ASSIST Subscore Methaqualone	-0.012	0.915	-0.017	0.882	-0.011	0.926	0.090	0.439
		B9 ASSIST Total Score	-0.128	0.269	-0.120	0.298	0.095	0.409	-0.003	0.980
F4	ERP	Age on Day of Testing	0.101	0.378	0.139	0.221	-0.113	0.322	-0.012	0.915
		Years at School	0.116	0.308	0.242	**0.031***	-0.166	0.143	-0.107	0.349
		Years of Tertiary Education	0.124	0.277	0.158	0.165	-0.131	0.249	-0.015	0.896
		Total Years of Education	0.158	0.165	0.237	**0.035***	-0.186	0.102	-0.053	0.644
		Weight	0.078	0.496	-0.072	0.531	0.005	0.965	0.105	0.359
		BMI	0.157	0.167	0.001	0.994	-0.096	0.398	0.182	0.108
		B7 ASRS PartB above cut off	-0.081	0.483	-0.029	0.803	0.066	0.564	-0.062	0.592
		B9 ASSIST Subscore Tobacco	-0.178	0.121	-0.240	**0.035***	0.194	0.092	0.030	0.794
		B9 ASSIST Subscore Cannabis	-0.183	0.110	-0.142	0.217	0.143	0.215	-0.047	0.687
		B9 ASSIST Subscore Methamphetamine	-0.186	0.105	-0.203	0.076	0.193	0.093	-0.015	0.898
		B9 ASSIST Subscore Methaqualone	-0.064	0.578	-0.103	0.372	0.054	0.642	0.087	0.451
		B9 ASSIST Total Score	-0.124	0.281	-0.166	0.148	0.114	0.325	0.036	0.758
F7	ERP	Age on Day of Testing	0.179	0.114	0.179	0.114	-0.179	0.115	0.176	0.120
		Years at School	0.058	0.613	0.207	0.067	-0.134	0.240	-0.049	0.668
		Years of Tertiary Education	0.169	0.137	0.179	0.115	-0.161	0.156	0.036	0.756
		Total Years of Education	0.148	0.194	0.228	**0.042***	-0.185	0.102	0.005	0.967
		Weight	0.151	0.183	0.037	0.748	-0.066	0.561	0.073	0.522
		BMI	0.244	**0.030***	0.094	0.411	-0.149	0.190	0.160	0.158
		B7 ASRS PartB above cut off	-0.055	0.634	0.006	0.957	0.070	0.545	-0.040	0.726
		B9 ASSIST Subscore Tobacco	-0.097	0.403	-0.118	0.307	0.099	0.393	0.004	0.974
		B9 ASSIST Subscore Cannabis	-0.179	0.120	-0.115	0.320	0.151	0.191	-0.059	0.608
		B9 ASSIST Subscore Methamphetamine	-0.112	0.330	-0.167	0.147	0.149	0.195	0.058	0.619
		B9 ASSIST Subscore Methaqualone	-0.014	0.903	-0.082	0.478	0.017	0.883	0.136	0.238
		B9 ASSIST Total Score	-0.129	0.264	-0.190	0.097	0.165	0.151	0.048	0.677
		Age on Day of Testing	0.253	**0.024***	0.177	0.118	-0.205	0.070	0.145	0.201
		Years at School	0.058	0.609	0.157	0.168	-0.110	0.333	-0.062	0.585
		Years of Tertiary Education	0.170	0.133	0.158	0.164	-0.129	0.256	-0.003	0.979

F8	ERP	Total Years of Education	0.147	0.196	0.181	0.110	-0.152	0.182	-0.015	0.896
		Weight	0.200	0.076	0.067	0.558	-0.120	0.291	0.098	0.392
		BMI	0.258	**0.021***	0.146	0.199	-0.216	0.056	0.125	0.272
		B7 ASRS PartB above cut off	-0.006	0.961	0.045	0.694	-0.002	0.988	-0.086	0.455
		B9 ASSIST Subscore Tobacco	-0.184	0.110	-0.205	0.073	0.181	0.115	0.003	0.980
		B9 ASSIST Subscore Cannabis	-0.142	0.218	-0.144	0.212	0.118	0.305	-0.033	0.773
		B9 ASSIST Subscore Methamphetamine	-0.135	0.242	-0.161	0.161	0.164	0.153	-0.016	0.893
		B9 ASSIST Subscore Methaqualone	-0.019	0.867	-0.079	0.496	0.033	0.777	0.072	0.532
		B9 ASSIST Total Score	-0.110	0.342	-0.163	0.158	0.124	0.282	0.053	0.649
C3	ERP	Age on Day of Testing	0.092	0.419	0.218	0.054	-0.168	0.139	0.004	0.970
		Years at School	0.126	0.269	0.212	0.060	-0.181	0.110	-0.020	0.862
		Years of Tertiary Education	0.073	0.521	0.131	0.251	-0.134	0.239	0.047	0.680
		Total Years of Education	0.138	0.224	0.196	0.084	-0.191	0.092	0.024	0.836
		Weight	0.086	0.453	0.056	0.625	-0.071	0.533	0.005	0.968
		BMI	0.198	0.081	0.086	0.448	-0.149	0.189	0.084	0.463
		B7 ASRS PartB above cut off	-0.078	0.496	0.023	0.842	0.065	0.570	-0.086	0.454
		B9 ASSIST Subscore Tobacco	-0.163	0.156	-0.116	0.317	0.155	0.179	-0.029	0.804
		B9 ASSIST Subscore Cannabis	-0.136	0.237	-0.067	0.562	0.097	0.400	-0.089	0.440
		B9 ASSIST Subscore Methamphetamine	-0.156	0.177	-0.146	0.206	0.196	0.087	-0.045	0.696
		B9 ASSIST Subscore Methaqualone	-0.083	0.472	-0.088	0.449	0.079	0.495	0.061	0.598
		B9 ASSIST Total Score	-0.100	0.387	-0.152	0.187	0.144	0.212	0.039	0.737
C4	ERP	Age on Day of Testing	0.120	0.291	0.212	0.061	-0.175	0.122	0.044	0.701
		Years at School	0.113	0.321	0.193	0.088	-0.160	0.160	-0.017	0.883
		Years of Tertiary Education	0.093	0.415	0.149	0.190	-0.139	0.222	0.095	0.407
		Total Years of Education	0.139	0.223	0.198	0.081	-0.183	0.106	0.059	0.605
		Weight	0.121	0.289	0.084	0.460	-0.087	0.444	0.073	0.524
		BMI	0.218	0.053	0.128	0.261	-0.168	0.139	0.141	0.214
		B7 ASRS PartB above cut off	-0.067	0.557	0.008	0.943	0.054	0.636	-0.022	0.851
		B9 ASSIST Subscore Tobacco	-0.258	**0.023***	-0.187	0.104	0.215	0.060	-0.018	0.874
		B9 ASSIST Subscore Cannabis	-0.161	0.162	-0.064	0.579	0.095	0.413	-0.054	0.640
		B9 ASSIST Subscore Methamphetamine	-0.212	0.064	-0.167	0.146	0.194	0.090	-0.051	0.657
		B9 ASSIST Subscore Methaqualone	-0.075	0.515	-0.080	0.489	0.063	0.589	0.056	0.628
		B9 ASSIST Total Score	-0.158	0.170	-0.132	0.254	0.123	0.287	0.059	0.610
P3	ERP	Age on Day of Testing	0.050	0.662	0.219	0.052	-0.134	0.240	-0.083	0.469
		Years at School	0.088	0.442	0.203	0.073	-0.126	0.270	-0.030	0.790
		Years of Tertiary Education	0.079	0.490	0.214	0.058	-0.148	0.194	0.031	0.786
		Total Years of Education	0.109	0.341	0.228	**0.043***	-0.159	0.161	0.014	0.904
		Weight	0.063	0.582	0.049	0.671	-0.091	0.426	0.030	0.793
		BMI	0.190	0.093	0.144	0.204	-0.217	0.055	0.096	0.397
		B7 ASRS PartB above cut off	-0.087	0.451	-0.030	0.796	0.109	0.344	-0.128	0.264
		B9 ASSIST Subscore Tobacco	-0.199	0.083	-0.230	**0.044***	0.214	0.061	-0.059	0.609
		B9 ASSIST Subscore Cannabis	-0.132	0.252	-0.095	0.413	0.099	0.394	-0.060	0.603
		B9 ASSIST Subscore Methamphetamine	-0.168	0.144	-0.196	0.087	0.207	0.071	-0.124	0.281
		B9 ASSIST Subscore Methaqualone	-0.080	0.488	-0.109	0.347	0.077	0.506	0.013	0.911
		B9 ASSIST Total Score	-0.112	0.332	-0.200	0.081	0.145	0.208	-0.030	0.794
P4	ERP	Age on Day of Testing	0.067	0.559	0.261	**0.019***	-0.173	0.127	0.036	0.752
		Years at School	0.130	0.254	0.191	0.092	-0.165	0.146	0.006	0.961
		Years of Tertiary Education	0.111	0.330	0.182	0.108	-0.157	0.166	0.115	0.312
		Total Years of Education	0.151	0.184	0.207	0.067	-0.190	0.093	0.082	0.473
		Weight	0.066	0.562	0.070	0.542	-0.080	0.485	0.066	0.561
		BMI	0.157	0.167	0.110	0.336	-0.162	0.153	0.126	0.268
		B7 ASRS PartB above cut off	-0.122	0.286	0.000	0.998	0.082	0.475	-0.043	0.709
		B9 ASSIST Subscore Tobacco	-0.202	0.078	-0.186	0.105	0.205	0.074	-0.081	0.482
		B9 ASSIST Subscore Cannabis	-0.162	0.159	-0.104	0.366	0.126	0.276	-0.104	0.367
		B9 ASSIST Subscore Methamphetamine	-0.178	0.122	-0.150	0.194	0.193	0.092	-0.151	0.189
		B9 ASSIST Subscore Methaqualone	-0.100	0.385	-0.054	0.643	0.073	0.527	-0.054	0.642
		B9 ASSIST Total Score	-0.140	0.226	-0.139	0.227	0.130	0.260	-0.026	0.824

C.3.4 ANCOVA of frequency band power measures that were significantly correlated with demographic variables

Electrode	State	Potential Confounding Variables	rho	p-values	rho	p-values	rho	p-values	rho	p-values
FP1	ERP	Age on Day of Testing	0.153	0.179	0.103	0.369	-0.159	0.162	0.189	0.096
		Years at School	-0.054	0.636	0.106	0.355	-0.044	0.699	-0.138	0.224
		Years of Tertiary Education	-0.050	0.663	0.111	0.330	0.000	1.000	-0.139	0.223
		Total Years of Education	-0.057	0.620	0.114	0.316	-0.022	0.846	-0.150	0.186
		Weight	0.100	0.380	-0.029	0.802	0.024	0.836	-0.094	0.410
		BMI	0.249	**0.026***	0.099	0.384	-0.135	0.235	-0.019	0.870
		B7 ASRS PartB above cut off	-0.027	0.811	0.039	0.738	0.035	0.760	-0.125	0.275
		B9 ASSIST Subscore Tobacco	-0.121	0.294	-0.137	0.234	0.095	0.411	0.088	0.449
		B9 ASSIST Subscore Cannabis	-0.148	0.200	-0.088	0.447	0.108	0.349	-0.002	0.984
		B9 ASSIST Subscore Methamphetamine	0.011	0.922	-0.061	0.600	0.004	0.975	0.124	0.281
		B9 ASSIST Subscore Methaqualone	0.076	0.510	0.040	0.729	-0.112	0.333	0.191	0.096
		B9 ASSIST Total Score	-0.103	0.374	-0.059	0.609	0.056	0.631	0.017	0.886
FP2	ERP	Age on Day of Testing	0.097	0.394	0.089	0.437	-0.128	0.261	0.149	0.191
		Years at School	-0.054	0.635	0.124	0.276	-0.045	0.695	-0.137	0.230
		Years of Tertiary Education	-0.059	0.606	0.077	0.498	0.004	0.974	-0.118	0.299
		Total Years of Education	-0.061	0.591	0.105	0.359	-0.022	0.844	-0.135	0.236
		Weight	0.096	0.398	-0.048	0.677	0.012	0.915	-0.089	0.435
		BMI	0.199	0.079	0.051	0.655	-0.104	0.361	0.000	1.000
		B7 ASRS PartB above cut off	-0.017	0.884	0.074	0.519	-0.018	0.873	-0.115	0.318
		B9 ASSIST Subscore Tobacco	-0.072	0.534	-0.184	0.108	0.121	0.293	0.068	0.559
		B9 ASSIST Subscore Cannabis	-0.115	0.321	-0.104	0.368	0.116	0.314	-0.023	0.842
		B9 ASSIST Subscore Methamphetamine	0.005	0.964	-0.123	0.288	0.028	0.808	0.186	0.105
		B9 ASSIST Subscore Methaqualone	0.020	0.866	-0.005	0.964	-0.053	0.649	0.192	0.094
		B9 ASSIST Total Score	-0.067	0.564	-0.094	0.419	0.064	0.580	0.056	0.629
F3	ERP	Age on Day of Testing	0.134	0.239	0.156	0.170	-0.125	0.271	-0.018	0.874
		Years at School	0.062	0.590	0.191	0.091	-0.112	0.325	-0.101	0.376
		Years of Tertiary Education	-0.029	0.801	0.062	0.587	0.004	0.974	-0.098	0.388
		Total Years of Education	0.034	0.767	0.151	0.184	-0.077	0.501	-0.106	0.351
		Weight	0.042	0.713	-0.131	0.251	0.054	0.634	0.057	0.619
		BMI	0.158	0.164	-0.051	0.657	-0.067	0.557	0.184	0.105
		B7 ASRS PartB above cut off	-0.063	0.583	0.004	0.976	0.055	0.635	-0.086	0.454
		B9 ASSIST Subscore Tobacco	-0.140	0.225	-0.137	0.233	0.130	0.259	0.015	0.898
		B9 ASSIST Subscore Cannabis	-0.217	0.057	-0.150	0.192	0.155	0.178	-0.075	0.519
		B9 ASSIST Subscore Methamphetamine	-0.092	0.424	-0.133	0.249	0.113	0.329	0.009	0.940
		B9 ASSIST Subscore Methaqualone	-0.012	0.915	-0.017	0.882	-0.011	0.926	0.090	0.439
		B9 ASSIST Total Score	-0.128	0.269	-0.120	0.298	0.095	0.409	-0.003	0.980
F4	ERP	Age on Day of Testing	0.101	0.378	0.139	0.221	-0.113	0.322	-0.012	0.915
		Years at School	0.116	0.308	0.242	**0.031***	-0.166	0.143	-0.107	0.349
		Years of Tertiary Education	0.124	0.277	0.158	0.165	-0.131	0.249	-0.015	0.896
		Total Years of Education	0.158	0.165	0.237	**0.035***	-0.186	0.102	-0.053	0.644
		Weight	0.078	0.496	-0.072	0.531	0.005	0.965	0.105	0.359
		BMI	0.157	0.167	0.001	0.994	-0.096	0.398	0.182	0.108
		B7 ASRS PartB above cut off	-0.081	0.483	-0.029	0.803	0.066	0.564	-0.062	0.592
		B9 ASSIST Subscore Tobacco	-0.178	0.121	-0.240	**0.035***	0.194	0.092	0.030	0.794
		B9 ASSIST Subscore Cannabis	-0.183	0.110	-0.142	0.217	0.143	0.215	-0.047	0.687
		B9 ASSIST Subscore Methamphetamine	-0.186	0.105	-0.203	0.076	0.193	0.093	-0.015	0.898
		B9 ASSIST Subscore Methaqualone	-0.064	0.578	-0.103	0.372	0.054	0.642	0.087	0.451
		B9 ASSIST Total Score	-0.124	0.281	-0.166	0.148	0.114	0.325	0.036	0.758
F7	ERP	Age on Day of Testing	0.179	0.114	0.179	0.114	-0.179	0.115	0.176	0.120
		Years at School	0.058	0.613	0.207	0.067	-0.134	0.240	-0.049	0.668
		Years of Tertiary Education	0.169	0.137	0.179	0.115	-0.161	0.156	0.036	0.756
		Total Years of Education	0.148	0.194	0.228	**0.042***	-0.185	0.102	0.005	0.967
		Weight	0.151	0.183	0.037	0.748	-0.066	0.561	0.073	0.522
		BMI	0.244	**0.030***	0.094	0.411	-0.149	0.190	0.160	0.158
		B7 ASRS PartB above cut off	-0.055	0.634	0.006	0.957	0.070	0.545	-0.040	0.726
		B9 ASSIST Subscore Tobacco	-0.097	0.403	-0.118	0.307	0.099	0.393	0.004	0.974
		B9 ASSIST Subscore Cannabis	-0.179	0.120	-0.115	0.320	0.151	0.191	-0.059	0.608
		B9 ASSIST Subscore Methamphetamine	-0.112	0.330	-0.167	0.147	0.149	0.195	0.058	0.619
		B9 ASSIST Subscore Methaqualone	-0.014	0.903	-0.082	0.478	0.017	0.883	0.136	0.238
		B9 ASSIST Total Score	-0.129	0.264	-0.190	0.097	0.165	0.151	0.048	0.677
		Age on Day of Testing	0.253	**0.024***	0.177	0.118	-0.205	0.070	0.145	0.201
		Years at School	0.058	0.609	0.157	0.168	-0.110	0.333	-0.062	0.585
		Years of Tertiary Education	0.170	0.133	0.158	0.164	-0.129	0.256	-0.003	0.979

C.3.5 Kruskal-Wallis Group comparison of Psychological scales and Clinical variables

Clinical and Medication Variables	MAP (N=24)			SCZ (N=27)			Kruskal-Wallis Main Effects		
	Median	Min	Max	Median	Min	Max	Chi-squared	df	p-value
Duration of Diagnosis (yrs)	1	0.25	13	7	1	22	13.31	1	**0.0002***
Extrapyramidal side effects Score	0	0	9	1	0	6	1.45	1	0.2273
PANSS Total Score	45.5	30	79	48.5	30	103	0.73	1	0.3926
PANSS Positive Subscale Score	8	7	30	12	7	34	4.69	1	**0.0301***
PANSS Negative Subscale Score	13	7	27	13	7	30	0.01	1	0.9224
PANSS General Psychopathology Score	22.5	16	41	23	16	50	0.62	1	0.4304
CDSS Total Score	1	0	9	3	0	8	2.27	1	0.1312
YMRS Total Score	1.5	0	5	1.5	0	19	0.01	1	0.9358
HAMD Total Score	3	0	12	4	0	15	0.91	1	0.3382
Clinical Global Impression Severity Score	2	1	4	3	1	6	2.98	1	0.0841
Global Assessment of Functioning Score	65	31	90	60	30	85	1.14	1	0.2838
Cumulative antipsychotic dose expressed as chlorpromazine equivalents	112.5	0	450	200	0	1500	0.9091	1	0.3404

C.3.6 Spearman correlations between frequency band power measures vs variables that were significantly different between groups

			A		B		D		T	
Electrode	State	Potential Confounding Variables	rho	p-values	rho	p-values	rho	p-values	rho	p-values
FP1	ERP	B1_PANSS_Positive_Subscale_Score	0.167	0.245	0.033	0.822	-0.062	0.668	-0.034	0.814
FP2	ERP	B1_PANSS_Positive_Subscale_Score	0.119	0.409	0.100	0.491	-0.088	0.542	-0.072	0.618
F3	ERP	B1_PANSS_Positive_Subscale_Score	0.176	0.220	-0.027	0.850	-0.043	0.767	0.117	0.416
F4	ERP	B1_PANSS_Positive_Subscale_Score	0.133	0.358	0.082	0.569	-0.111	0.444	0.063	0.665
F7	ERP	B1_PANSS_Positive_Subscale_Score	0.179	0.213	0.005	0.973	-0.046	0.754	0.174	0.228
F8	ERP	B1_PANSS_Positive_Subscale_Score	0.184	0.200	0.136	0.345	-0.144	0.318	0.055	0.706
C3	ERP	B1_PANSS_Positive_Subscale_Score	0.210	0.144	0.051	0.725	-0.102	0.483	0.081	0.575
C4	ERP	B1_PANSS_Positive_Subscale_Score	0.226	0.114	0.079	0.588	-0.114	0.430	0.106	0.463
P3	ERP	B1_PANSS_Positive_Subscale_Score	0.104	0.474	-0.022	0.880	-0.053	0.715	0.087	0.549
P4	ERP	B1_PANSS_Positive_Subscale_Score	0.117	0.420	0.005	0.971	-0.061	0.674	0.143	0.323
FP1	ERP	Years_with_Diagnosis	0.175	0.224	0.143	0.322	-0.133	0.356	0.030	0.834
FP2	ERP	Years_with_Diagnosis	0.022	0.878	0.160	0.267	-0.097	0.502	-0.091	0.530
F3	ERP	Years_with_Diagnosis	0.161	0.263	0.135	0.349	-0.117	0.418	-0.057	0.693
F4	ERP	Years_with_Diagnosis	0.107	0.459	0.164	0.255	-0.149	0.302	-0.062	0.669
F7	ERP	Years_with_Diagnosis	0.229	0.110	0.214	0.136	-0.173	0.230	0.077	0.593
F8	ERP	Years_with_Diagnosis	0.257	0.072	0.217	0.131	-0.260	0.068	0.052	0.720
C3	ERP	Years_with_Diagnosis	0.152	0.291	0.184	0.201	-0.157	0.277	-0.042	0.773
C4	ERP	Years_with_Diagnosis	0.206	0.152	0.180	0.212	-0.167	0.245	-0.004	0.978
P3	ERP	Years_with_Diagnosis	0.106	0.463	0.201	0.162	-0.144	0.318	-0.110	0.447
P4	ERP	Years_with_Diagnosis	0.104	0.471	0.197	0.171	-0.138	0.341	-0.062	0.670
FP1	REC	B1_PANSS_Positive_Subscale_Score	0.095	0.522	0.031	0.835	-0.080	0.590	0.096	0.515
FP2	REC	B1_PANSS_Positive_Subscale_Score	0.092	0.532	0.018	0.904	-0.080	0.591	0.050	0.736
F3	REC	B1_PANSS_Positive_Subscale_Score	0.243	0.097	0.060	0.685	-0.147	0.320	0.130	0.380
F4	REC	B1_PANSS_Positive_Subscale_Score	0.200	0.173	0.132	0.371	-0.205	0.163	0.151	0.305
F7	REC	B1_PANSS_Positive_Subscale_Score	0.145	0.326	0.058	0.693	-0.103	0.486	0.131	0.376
F8	REC	B1_PANSS_Positive_Subscale_Score	0.195	0.184	0.147	0.318	-0.209	0.154	0.109	0.460
C3	REC	B1_PANSS_Positive_Subscale_Score	0.210	0.152	0.149	0.313	-0.210	0.151	0.088	0.552
C4	REC	B1_PANSS_Positive_Subscale_Score	0.245	0.094	0.109	0.461	-0.167	0.256	0.154	0.297
P3	REC	B1_PANSS_Positive_Subscale_Score	0.217	0.144	0.145	0.332	-0.182	0.221	0.207	0.163
P4	REC	B1_PANSS_Positive_Subscale_Score	0.240	0.100	0.089	0.546	-0.200	0.174	0.119	0.421
FP1	REC	Years_with_Diagnosis	-0.069	0.641	0.006	0.968	0.045	0.760	-0.103	0.484
FP2	REC	Years_with_Diagnosis	-0.169	0.250	-0.089	0.549	0.157	0.285	-0.172	0.242
F3	REC	Years_with_Diagnosis	0.002	0.989	-0.012	0.935	-0.001	0.996	-0.004	0.980
F4	REC	Years_with_Diagnosis	-0.005	0.976	0.064	0.664	-0.039	0.794	-0.002	0.988
F7	REC	Years_with_Diagnosis	0.046	0.758	0.084	0.570	-0.056	0.706	0.059	0.689
F8	REC	Years_with_Diagnosis	0.008	0.959	0.092	0.534	-0.066	0.656	-0.010	0.945
C3	REC	Years_with_Diagnosis	0.021	0.889	0.068	0.646	-0.046	0.757	0.046	0.755
C4	REC	Years_with_Diagnosis	0.004	0.978	0.114	0.439	-0.036	0.806	0.030	0.840
P3	REC	Years_with_Diagnosis	0.090	0.547	0.103	0.493	-0.117	0.432	0.124	0.407
P4	REC	Years_with_Diagnosis	-0.019	0.896	0.051	0.731	0.000	0.999	-0.037	0.804
FP1	REO	B1_PANSS_Positive_Subscale_Score	0.031	0.838	0.034	0.823	-0.071	0.639	0.009	0.952
FP2	REO	B1_PANSS_Positive_Subscale_Score	0.058	0.701	0.016	0.918	-0.064	0.674	0.103	0.496
F3	REO	B1_PANSS_Positive_Subscale_Score	0.122	0.418	0.021	0.889	-0.139	0.355	0.186	0.217

			A		B		D		T	
Electrode	**State**	**Potential Confounding Variables**	**rho**	**p-values**	**rho**	**p-values**	**rho**	**p-values**	**rho**	**p-values**
F4	REO	B1_PANSS_Positive_Subscale_Score	0.116	0.443	0.085	0.573	-0.182	0.226	0.204	0.175
F7	REO	B1_PANSS_Positive_Subscale_Score	-0.015	0.921	-0.006	0.968	0.004	0.981	0.134	0.376
F8	REO	B1_PANSS_Positive_Subscale_Score	0.172	0.253	0.108	0.476	-0.198	0.188	0.085	0.574
C3	REO	B1_PANSS_Positive_Subscale_Score	0.137	0.366	0.076	0.617	-0.112	0.458	0.248	0.097
C4	**REO**	**B1_PANSS_Positive_Subscale_Score**	0.162	0.283	0.050	0.739	-0.146	0.332	0.331	**0.024***
P3	REO	B1_PANSS_Positive_Subscale_Score	0.064	0.671	0.064	0.674	-0.121	0.423	0.265	0.075
P4	REO	B1_PANSS_Positive_Subscale_Score	0.038	0.802	0.011	0.942	-0.094	0.533	0.251	0.092
FP1	REO	Years_with_Diagnosis	-0.067	0.659	-0.162	0.281	0.100	0.509	0.033	0.828
FP2	REO	Years_with_Diagnosis	-0.067	0.657	-0.169	0.262	0.087	0.563	0.061	0.687
F3	REO	Years_with_Diagnosis	0.095	0.530	-0.058	0.699	-0.001	0.992	0.059	0.699
F4	REO	Years_with_Diagnosis	0.110	0.468	0.045	0.768	-0.028	0.852	0.020	0.895
F7	REO	Years_with_Diagnosis	0.071	0.639	-0.005	0.976	-0.003	0.983	0.052	0.733
F8	REO	Years_with_Diagnosis	0.178	0.237	0.067	0.660	-0.100	0.508	0.078	0.608
C3	REO	Years_with_Diagnosis	0.075	0.622	-0.058	0.703	0.053	0.725	0.068	0.655
C4	REO	Years_with_Diagnosis	0.093	0.538	0.001	0.996	-0.033	0.825	0.093	0.540
P3	REO	Years_with_Diagnosis	0.008	0.956	-0.054	0.722	0.038	0.801	0.031	0.838
P4	REO	Years_with_Diagnosis	0.011	0.943	-0.052	0.733	0.055	0.714	0.030	0.844

C.3.7 ANCOVA and Multiple comparisons of all count medication variables between MAP and SCZ

Frequency Power Band	Prescribed Medications	Electrode Position	State	ANCOVA Main Effects				Multiple Comparisons MAP vs SCZ			
				F-statistic	DF1	DF2	p-value	Estimate	Std.Error	t-value	p-value
A	Prescribed clozapine	FP1	REO	0.07	2	43	0.9284	-0.23	1.24	-0.19	0.8520
A	Prescribed clozapine	FP2	REO	0.23	2	43	0.7941	-0.73	1.36	-0.54	0.5930
A	Prescribed clozapine	F3	REO	0.03	2	43	0.9741	-0.29	1.76	-0.17	0.8700
A	Prescribed clozapine	F4	REO	0.09	2	43	0.9137	0.45	1.70	0.26	0.7940
A	Prescribed clozapine	F7	REO	0.08	2	43	0.9256	0.53	1.42	0.37	0.7120
A	Prescribed clozapine	F8	REO	0.32	2	43	0.7275	0.14	1.48	0.09	0.9280
A	Prescribed clozapine	C3	REO	0.48	2	43	0.6243	1.80	1.85	0.97	0.3370
A	Prescribed clozapine	C4	REO	0.33	2	43	0.7228	1.40	1.75	0.80	0.4270
A	Prescribed clozapine	P3	REO	0.11	2	43	0.8979	0.97	2.31	0.42	0.6750
A	Prescribed clozapine	P4	REO	0.17	2	43	0.8446	1.20	2.16	0.56	0.5820
A	Prescribed First Generation Antipsychotics	FP1	REO	0.07	2	43	0.935	-0.23	1.29	-0.18	0.8620
A	Prescribed First Generation Antipsychotics	FP2	REO	0.29	2	43	0.75	-1.07	1.41	-0.76	0.4510
A	Prescribed First Generation Antipsychotics	F3	REO	0.19	2	43	0.8304	-0.67	1.83	-0.37	0.7170
A	Prescribed First Generation Antipsychotics	F4	REO	0.34	2	43	0.7145	-0.03	1.75	-0.02	0.9860
A	Prescribed First Generation Antipsychotics	F7	REO	0.10	2	43	0.9028	0.35	1.48	0.24	0.8140
A	Prescribed First Generation Antipsychotics	F8	REO	0.10	2	43	0.9055	0.69	1.55	0.45	0.6580
A	Prescribed First Generation Antipsychotics	C3	REO	0.76	2	43	0.4734	0.63	1.91	0.33	0.7420
A	Prescribed First Generation Antipsychotics	C4	REO	0.63	2	43	0.5386	0.34	1.81	0.19	0.8520
A	Prescribed First Generation Antipsychotics	P3	REO	0.35	2	43	0.7037	-0.25	2.39	-0.10	0.9180
A	Prescribed First Generation Antipsychotics	P4	REO	0.18	2	43	0.8374	0.42	2.25	0.19	0.8510
A	Prescribed haloperidol	FP1	REO	0.10	2	43	0.9084	-0.58	1.36	-0.43	0.6700
A	Prescribed haloperidol	FP2	REO	0.96	2	43	0.3905	-1.80	1.47	-1.23	0.2250
A	Prescribed haloperidol	F3	REO	0.59	2	43	0.5569	-1.28	1.91	-0.67	0.5040
A	Prescribed haloperidol	F4	REO	0.69	2	43	0.509	-0.54	1.84	-0.30	0.7690
A	Prescribed haloperidol	F7	REO	0.74	2	43	0.4831	-0.47	1.54	-0.30	0.7630
A	Prescribed haloperidol	F8	REO	0.57	2	43	0.5702	-0.33	1.62	-0.21	0.8380
A	Prescribed haloperidol	C3	REO	0.80	2	43	0.4555	0.41	2.02	0.20	0.8410
A	Prescribed haloperidol	C4	REO	0.63	2	43	0.5373	0.17	1.91	0.09	0.9300
A	Prescribed haloperidol	P3	REO	0.29	2	43	0.7518	-0.32	2.53	-0.13	0.9000
A	Prescribed haloperidol	P4	REO	0.19	2	43	0.8309	0.30	2.37	0.13	0.8990
A	Prescribed Second Generation Antipsychotics	FP1	REO	0.11	2	43	0.8942	-0.18	1.23	-0.14	0.8870
A	Prescribed Second Generation Antipsychotics	FP2	REO	0.22	2	43	0.8047	-0.83	1.35	-0.62	0.5410
A	Prescribed Second Generation Antipsychotics	F3	REO	0.72	2	43	0.4947	-0.94	1.72	-0.55	0.5860
A	Prescribed Second Generation Antipsychotics	F4	REO	0.42	2	43	0.6566	0.03	1.67	0.02	0.9850
A	Prescribed Second Generation Antipsychotics	F7	REO	0.08	2	43	0.919	0.44	1.41	0.31	0.7560
A	Prescribed Second Generation Antipsychotics	F8	REO	0.16	2	43	0.8562	0.33	1.48	0.22	0.8270
A	Prescribed Second Generation Antipsychotics	C3	REO	1.69	2	43	0.1965	0.31	1.79	0.17	0.8630

Frequency Power Band	Prescribed Medications	Electrode Position	State	ANCOVA Main Effects				Multiple Comparisons MAP vs SCZ			
				F-statistic	DF1	DF2	p-value	Estimate	Std.Error	t-value	p-value
A	Prescribed Second Generation Antipsychotics	C4	REO	1.61	2	43	0.2116	0.01	1.69	0.01	0.9960
A	Prescribed Second Generation Antipsychotics	P3	REO	2.26	2	43	0.117	-1.16	2.19	-0.53	0.6011
A	Prescribed Second Generation Antipsychotics	P4	REO	1.47	2	43	0.2404	-0.49	2.09	-0.24	0.8150
B	Prescribed clozapine	FP1	REO	0.83	2	43	0.4432	-2.68	2.11	-1.27	0.2100
B	Prescribed clozapine	FP2	REO	1.11	2	43	0.3389	-2.81	2.07	-1.36	0.1820
B	Prescribed clozapine	F3	REO	0.66	2	43	0.5204	-3.47	3.08	-1.13	0.2650
B	Prescribed clozapine	F4	REO	0.01	2	43	0.9875	-0.34	2.90	-0.12	0.9080
B	Prescribed clozapine	F7	REO	0.09	2	43	0.9149	-0.86	2.86	-0.30	0.7640
B	Prescribed clozapine	F8	REO	0.09	2	43	0.9101	-0.25	2.72	-0.09	0.9280
B	Prescribed clozapine	C3	REO	0.15	2	43	0.8622	-1.44	3.41	-0.42	0.6740
B	Prescribed clozapine	C4	REO	0.09	2	43	0.9105	-0.25	3.32	-0.08	0.9400
B	Prescribed clozapine	P3	REO	0.28	2	43	0.7544	-1.97	2.68	-0.74	0.4660
B	Prescribed clozapine	P4	REO	0.19	2	43	0.8237	-1.33	2.56	-0.52	0.6070
B	Prescribed First Generation Antipsychotics	FP1	REO	0.79	2	43	0.4607	-2.21	2.20	-1.01	0.3190
B	Prescribed First Generation Antipsychotics	FP2	REO	1.11	2	43	0.3389	-2.82	2.15	-1.31	0.1970
B	Prescribed First Generation Antipsychotics	F3	REO	0.68	2	43	0.5123	-3.70	3.20	-1.16	0.2540
B	Prescribed First Generation Antipsychotics	F4	REO	0.56	2	43	0.573	-1.89	2.98	-0.64	0.5290
B	Prescribed First Generation Antipsychotics	F7	REO	0.19	2	43	0.8246	-1.71	2.96	-0.58	0.5670
B	Prescribed First Generation Antipsychotics	F8	REO	0.15	2	43	0.8602	-0.51	2.82	-0.18	0.8580
B	Prescribed First Generation Antipsychotics	C3	REO	0.42	2	43	0.6567	-2.91	3.52	-0.83	0.4140
B	Prescribed First Generation Antipsychotics	C4	REO	0.70	2	43	0.5038	-2.61	3.41	-0.77	0.4480
B	Prescribed First Generation Antipsychotics	P3	REO	0.33	2	43	0.7193	-2.26	2.78	-0.81	0.4210
B	Prescribed First Generation Antipsychotics	P4	REO	0.32	2	43	0.726	-2.09	2.66	-0.79	0.4350
B	Prescribed haloperidol	FP1	REO	0.77	2	43	0.4679	-2.44	2.32	-1.05	0.2980
B	Prescribed haloperidol	FP2	REO	1.18	2	43	0.3183	-3.26	2.27	-1.44	0.1570
B	Prescribed haloperidol	F3	REO	0.66	2	43	0.5217	-3.88	3.38	-1.15	0.2570
B	Prescribed haloperidol	F4	REO	0.33	2	43	0.7238	-1.78	3.16	-0.56	0.5760
B	Prescribed haloperidol	F7	REO	0.53	2	43	0.5896	-2.67	3.10	-0.86	0.3940
B	Prescribed haloperidol	F8	REO	0.20	2	43	0.8188	-0.81	2.97	-0.27	0.7870
B	Prescribed haloperidol	C3	REO	0.28	2	43	0.7593	-2.72	3.73	-0.73	0.4690
B	Prescribed haloperidol	C4	REO	0.49	2	43	0.6135	-2.66	3.61	-0.74	0.4660
B	Prescribed haloperidol	P3	REO	0.31	2	43	0.737	-2.23	2.94	-0.76	0.4510
B	Prescribed haloperidol	P4	REO	0.43	2	43	0.6523	-2.51	2.79	-0.90	0.3740
B	Prescribed Second Generation Antipsychotics	FP1	REO	0.89	2	43	0.4187	-2.79	2.09	-1.33	0.1900
B	Prescribed Second Generation Antipsychotics	FP2	REO	1.15	2	43	0.3265	-3.04	2.05	-1.48	0.1460
B	Prescribed Second Generation Antipsychotics	F3	REO	0.88	2	43	0.4214	-3.76	3.04	-1.23	0.2240
B	Prescribed Second Generation Antipsychotics	F4	REO	0.71	2	43	0.4984	-1.71	2.84	-0.60	0.5500

Frequency Power Band	Prescribed Medications	Electrode Position	State	ANCOVA Main Effects				Multiple Comparisons MAP vs SCZ			
				F-statistic	DF1	DF2	p-value	Estimate	Std.Error	t-value	p-value
B	Prescribed Second Generation Antipsychotics	F7	REO	0.35	2	43	0.7073	-1.84	2.82	-0.65	0.5170
B	Prescribed Second Generation Antipsychotics	F8	REO	0.89	2	43	0.4199	-1.16	2.65	-0.44	0.6650
B	Prescribed Second Generation Antipsychotics	C3	REO	0.96	2	43	0.3918	-3.30	3.32	-0.99	0.3260
B	Prescribed Second Generation Antipsychotics	C4	REO	2.00	2	43	0.1484	-3.19	3.16	-1.01	0.3190
B	Prescribed Second Generation Antipsychotics	P3	REO	0.82	2	43	0.4462	-2.88	2.63	-1.10	0.2790
B	Prescribed Second Generation Antipsychotics	P4	REO	1.27	2	43	0.2903	-2.86	2.48	-1.15	0.2550
D	Prescribed clozapine	FP1	REO	0.38	2	43	0.6839	2.75	3.14	0.88	0.3860
D	Prescribed clozapine	FP2	REO	0.61	2	43	0.5462	3.54	3.35	1.06	0.2970
D	Prescribed clozapine	F3	REO	0.56	2	43	0.5769	4.38	4.49	0.98	0.3350
D	Prescribed clozapine	F4	REO	0.01	2	43	0.9909	0.05	4.46	0.01	0.9910
D	Prescribed clozapine	F7	REO	0.01	2	43	0.9927	0.39	4.12	0.10	0.9240
D	Prescribed clozapine	F8	REO	0.22	2	43	0.8036	0.42	4.17	0.10	0.9210
D	Prescribed clozapine	C3	REO	0.02	2	43	0.978	-0.94	4.95	-0.19	0.8500
D	Prescribed clozapine	C4	REO	0.04	2	43	0.9561	-1.34	4.83	-0.28	0.7830
D	Prescribed clozapine	P3	REO	0.00	2	43	0.9983	0.25	4.68	0.05	0.9570
D	Prescribed clozapine	P4	REO	0.01	2	43	0.9886	-0.44	4.59	-0.10	0.9240
D	Prescribed First Generation Antipsychotics	FP1	REO	0.43	2	43	0.6523	1.59	3.26	0.49	0.6290
D	Prescribed First Generation Antipsychotics	FP2	REO	0.61	2	43	0.5499	3.43	3.49	0.99	0.3300
D	Prescribed First Generation Antipsychotics	F3	REO	0.42	2	43	0.6593	4.25	4.69	0.91	0.3700
D	Prescribed First Generation Antipsychotics	F4	REO	0.30	2	43	0.7426	1.52	4.61	0.33	0.7430
D	Prescribed First Generation Antipsychotics	F7	REO	0.01	2	43	0.9899	0.49	4.29	0.11	0.9100
D	Prescribed First Generation Antipsychotics	F8	REO	0.02	2	43	0.985	-0.62	4.36	-0.14	0.8870
D	Prescribed First Generation Antipsychotics	C3	REO	0.21	2	43	0.815	0.92	5.13	0.18	0.8590
D	Prescribed First Generation Antipsychotics	C4	REO	0.39	2	43	0.6762	1.14	4.98	0.23	0.8200
D	Prescribed First Generation Antipsychotics	P3	REO	0.05	2	43	0.9532	0.95	4.86	0.20	0.8450
D	Prescribed First Generation Antipsychotics	P4	REO	0.02	2	43	0.9782	0.30	4.77	0.06	0.9500
D	Prescribed haloperidol	FP1	REO	0.33	2	43	0.7239	2.45	3.45	0.71	0.4810
D	Prescribed haloperidol	FP2	REO	0.91	2	43	0.4087	4.94	3.65	1.35	0.1840
D	Prescribed haloperidol	F3	REO	0.52	2	43	0.5976	4.95	4.94	1.00	0.3220
D	Prescribed haloperidol	F4	REO	0.28	2	43	0.7568	1.83	4.87	0.38	0.7090
D	Prescribed haloperidol	F7	REO	0.37	2	43	0.6961	2.33	4.49	0.52	0.6060
D	Prescribed haloperidol	F8	REO	0.24	2	43	0.7886	1.03	4.57	0.23	0.8230
D	Prescribed haloperidol	C3	REO	0.15	2	43	0.8584	0.99	5.42	0.18	0.8560
D	Prescribed haloperidol	C4	REO	0.36	2	43	0.703	1.46	5.26	0.28	0.7830
D	Prescribed haloperidol	P3	REO	0.05	2	43	0.9467	1.17	5.13	0.23	0.8200
D	Prescribed haloperidol	P4	REO	0.10	2	43	0.9095	1.04	5.02	0.21	0.8380
D	Prescribed Second Generation Antipsychotics	FP1	REO	0.32	2	43	0.7259	2.32	3.12	0.74	0.4620

Frequency Power Band	Prescribed Medications	Electrode Position	State	ANCOVA Main Effects				Multiple Comparisons MAP vs SCZ			
				F-statistic	DF1	DF2	p-value	Estimate	Std.Error	t-value	p-value
D	Prescribed Second Generation Antipsychotics	FP2	REO	0.62	2	43	0.542	3.60	3.33	1.08	0.2860
D	Prescribed Second Generation Antipsychotics	F3	REO	0.93	2	43	0.4011	4.99	4.43	1.13	0.2660
D	Prescribed Second Generation Antipsychotics	F4	REO	0.50	2	43	0.608	1.54	4.39	0.35	0.7270
D	Prescribed Second Generation Antipsychotics	F7	REO	0.09	2	43	0.9185	0.87	4.09	0.21	0.8320
D	Prescribed Second Generation Antipsychotics	F8	REO	0.35	2	43	0.7086	0.66	4.13	0.16	0.8750
D	Prescribed Second Generation Antipsychotics	C3	REO	1.03	2	43	0.3671	2.07	4.81	0.43	0.6690
D	Prescribed Second Generation Antipsychotics	C4	REO	1.78	2	43	0.1808	2.47	4.61	0.54	0.5951
D	Prescribed Second Generation Antipsychotics	P3	REO	1.10	2	43	0.343	2.88	4.53	0.63	0.5290
D	Prescribed Second Generation Antipsychotics	P4	REO	1.10	2	43	0.3438	2.41	4.45	0.54	0.5910
T	B1 PANSS Positive Subscale Score	C4	REO	1.90	2	43	0.1626	0.24	0.93	0.26	0.7978
T	Prescribed clozapine	FP1	REO	0.23	2	43	0.7921	0.17	1.21	0.14	0.8910
T	Prescribed clozapine	FP2	REO	0.20	2	43	0.8223	0.00	1.15	0.00	0.9990
T	Prescribed clozapine	F3	REO	0.32	2	43	0.7312	-0.62	1.31	-0.48	0.6370
T	Prescribed clozapine	F4	REO	0.05	2	43	0.9541	-0.16	1.24	-0.13	0.9000
T	Prescribed clozapine	F7	REO	0.39	2	43	0.6813	-0.06	1.09	-0.06	0.9560
T	Prescribed clozapine	F8	REO	0.11	2	43	0.896	-0.31	1.07	-0.29	0.7760
T	Prescribed clozapine	C3	REO	0.46	2	43	0.6345	0.59	1.10	0.53	0.5960
T	Prescribed clozapine	C4	REO	0.54	2	43	0.5852	0.19	1.03	0.18	0.8580
T	Prescribed clozapine	P3	REO	0.51	2	43	0.6036	0.74	1.08	0.69	0.4970
T	Prescribed clozapine	P4	REO	0.40	2	43	0.6748	0.57	1.04	0.54	0.5910
T	Prescribed First Generation Antipsychotics	FP1	REO	0.31	2	43	0.7323	0.85	1.26	0.68	0.5020
T	Prescribed First Generation Antipsychotics	FP2	REO	0.09	2	43	0.9126	0.46	1.20	0.39	0.7010
T	Prescribed First Generation Antipsychotics	F3	REO	0.14	2	43	0.869	0.11	1.36	0.08	0.9340
T	Prescribed First Generation Antipsychotics	F4	REO	0.22	2	43	0.8053	0.40	1.29	0.31	0.7560
T	Prescribed First Generation Antipsychotics	F7	REO	0.61	2	43	0.5503	0.88	1.13	0.77	0.4430
T	Prescribed First Generation Antipsychotics	F8	REO	0.55	2	43	0.5787	0.44	1.10	0.40	0.6910
T	Prescribed First Generation Antipsychotics	C3	REO	0.84	2	43	0.4402	1.36	1.13	1.20	0.2380
T	Prescribed First Generation Antipsychotics	C4	REO	0.83	2	43	0.4444	1.13	1.07	1.06	0.2950
T	Prescribed First Generation Antipsychotics	P3	REO	1.19	2	43	0.315	1.56	1.10	1.41	0.1660
T	Prescribed First Generation Antipsychotics	P4	REO	1.05	2	43	0.358	1.37	1.07	1.28	0.2090
T	Prescribed haloperidol	FP1	REO	0.09	2	43	0.91	0.57	1.33	0.43	0.6700
T	Prescribed haloperidol	FP2	REO	0.05	2	43	0.9509	0.13	1.26	0.10	0.9190
T	Prescribed haloperidol	F3	REO	0.16	2	43	0.8518	0.22	1.44	0.15	0.8810
T	Prescribed haloperidol	F4	REO	0.22	2	43	0.8044	0.49	1.36	0.36	0.7180
T	Prescribed haloperidol	F7	REO	0.33	2	43	0.724	0.80	1.20	0.67	0.5090
T	Prescribed haloperidol	F8	REO	0.06	2	43	0.9375	0.11	1.18	0.10	0.9240
T	Prescribed haloperidol	C3	REO	0.63	2	43	0.5398	1.32	1.20	1.10	0.2760

Frequency Power Band	Prescribed Medications	Electrode Position	State	ANCOVA Main Effects				Multiple Comparisons MAP vs SCZ			
				F-statistic	DF1	DF2	p-value	Estimate	Std.Error	t-value	p-value
T	Prescribed haloperidol	C4	REO	0.46	2	43	0.6336	1.03	1.14	0.91	0.3700
T	Prescribed haloperidol	P3	REO	0.69	2	43	0.5064	1.38	1.18	1.17	0.2470
T	Prescribed haloperidol	P4	REO	0.53	2	43	0.5901	1.17	1.14	1.03	0.3110
T	Prescribed Second Generation Antipsychotics	FP1	REO	0.17	2	43	0.8434	0.64	1.20	0.53	0.5970
T	Prescribed Second Generation Antipsychotics	FP2	REO	0.03	2	43	0.9689	0.27	1.14	0.24	0.8150
T	Prescribed Second Generation Antipsychotics	F3	REO	0.03	2	43	0.9724	-0.29	1.31	-0.22	0.8230
T	Prescribed Second Generation Antipsychotics	F4	REO	0.04	2	43	0.9593	0.14	1.24	0.11	0.9120
T	Prescribed Second Generation Antipsychotics	F7	REO	0.19	2	43	0.8318	0.53	1.09	0.49	0.6300
T	Prescribed Second Generation Antipsychotics	F8	REO	0.24	2	43	0.7894	0.17	1.06	0.16	0.8710
T	Prescribed Second Generation Antipsychotics	C3	REO	0.36	2	43	0.7009	0.92	1.09	0.84	0.4040
T	Prescribed Second Generation Antipsychotics	C4	REO	0.24	2	43	0.7853	0.71	1.03	0.68	0.4980
T	Prescribed Second Generation Antipsychotics	P3	REO	0.61	2	43	0.5497	1.16	1.07	1.09	0.2830
T	Prescribed Second Generation Antipsychotics	P4	REO	0.43	2	43	0.6521	0.95	1.04	0.92	0.3650
A	Prescribed clozapine	FP1	REC	0.16	2	45	0.8506	-0.60	1.86	-0.32	0.7490
A	Prescribed clozapine	FP2	REC	0.70	2	45	0.5023	-1.87	2.01	-0.93	0.3570
A	Prescribed clozapine	F3	REC	0.09	2	45	0.9115	0.86	2.12	0.40	0.6880
A	Prescribed clozapine	F4	REC	0.19	2	45	0.8318	1.27	2.17	0.58	0.5620
A	Prescribed clozapine	F7	REC	0.11	2	45	0.8969	0.78	1.73	0.45	0.6520
A	Prescribed clozapine	F8	REC	0.39	2	45	0.6817	1.52	1.74	0.87	0.3880
A	Prescribed clozapine	C3	REC	0.57	2	45	0.5721	2.47	2.34	1.05	0.2970
A	Prescribed clozapine	C4	REC	0.28	2	45	0.7539	1.65	2.22	0.74	0.4610
A	Prescribed clozapine	P3	REC	0.24	2	44	0.7845	2.12	3.13	0.68	0.5020
A	Prescribed clozapine	P4	REC	0.79	2	45	0.4603	3.35	2.70	1.24	0.2220
A	Prescribed First Generation Antipsychotics	FP1	REC	0.24	2	45	0.7897	-1.30	1.95	-0.67	0.5090
A	Prescribed First Generation Antipsychotics	FP2	REC	1.40	2	45	0.2583	-3.35	2.08	-1.61	0.1150
A	Prescribed First Generation Antipsychotics	F3	REC	0.14	2	45	0.8699	0.11	2.23	0.05	0.9610
A	Prescribed First Generation Antipsychotics	F4	REC	0.28	2	45	0.7563	0.24	2.28	0.11	0.9150
A	Prescribed First Generation Antipsychotics	F7	REC	0.07	2	45	0.9338	0.54	1.82	0.30	0.7680
A	Prescribed First Generation Antipsychotics	F8	REC	0.35	2	45	0.7048	1.30	1.83	0.71	0.4830
A	Prescribed First Generation Antipsychotics	C3	REC	1.02	2	45	0.3692	0.96	2.44	0.39	0.6950
A	Prescribed First Generation Antipsychotics	C4	REC	0.68	2	45	0.5118	0.43	2.31	0.18	0.8540
A	Prescribed First Generation Antipsychotics	P3	REC	0.90	2	44	0.414	0.14	3.20	0.05	0.9640
A	Prescribed First Generation Antipsychotics	P4	REC	1.07	2	45	0.3529	1.86	2.83	0.66	0.5140
A	Prescribed haloperidol	FP1	REC	0.67	2	45	0.5163	-2.03	2.03	-1.00	0.3230
A	Prescribed haloperidol	FP2	REC	2.59	2	45	0.086	-4.45	2.14	-2.08	**0.0430***
A	Prescribed haloperidol	F3	REC	0.32	2	45	0.7271	-0.39	2.33	-0.17	0.8690
A	Prescribed haloperidol	F4	REC	0.50	2	45	0.61	-0.28	2.39	-0.12	0.9080

Frequency Power Band	Prescribed Medications	Electrode Position	State	ANCOVA Main Effects				Multiple Comparisons MAP vs SCZ			
				F-statistic	DF1	DF2	p-value	Estimate	Std.Error	t-value	p-value
A	Prescribed haloperidol	F7	REC	0.24	2	45	0.7873	-0.05	1.90	-0.03	0.9780
A	Prescribed haloperidol	F8	REC	0.86	2	45	0.4293	0.25	1.90	0.13	0.8960
A	Prescribed haloperidol	C3	REC	1.21	2	45	0.3091	0.49	2.55	0.19	0.8480
A	Prescribed haloperidol	C4	REC	0.84	2	45	0.4401	0.02	2.42	0.01	0.9940
A	Prescribed haloperidol	P3	REC	1.04	2	44	0.3632	-0.43	3.36	-0.13	0.8990
A	Prescribed haloperidol	P4	REC	0.75	2	45	0.4794	2.74	2.99	0.92	0.3640
A	Prescribed Second Generation Antipsychotics	FP1	REC	0.82	2	45	0.4488	-1.74	1.84	-0.95	0.3490
A	Prescribed Second Generation Antipsychotics	FP2	REC	2.43	2	45	0.0999	-3.63	1.95	-1.86	0.0691
A	Prescribed Second Generation Antipsychotics	F3	REC	0.46	2	45	0.6333	-0.22	2.11	-0.11	0.9170
A	Prescribed Second Generation Antipsychotics	F4	REC	0.78	2	45	0.4637	-0.14	2.16	-0.07	0.9480
A	Prescribed Second Generation Antipsychotics	F7	REC	0.23	2	45	0.798	0.17	1.73	0.10	0.9240
A	Prescribed Second Generation Antipsychotics	F8	REC	0.78	2	45	0.4661	0.66	1.73	0.38	0.7050
A	Prescribed Second Generation Antipsychotics	C3	REC	1.52	2	45	0.2304	0.81	2.31	0.35	0.7280
A	Prescribed Second Generation Antipsychotics	C4	REC	1.19	2	45	0.3133	0.22	2.19	0.10	0.9190
A	Prescribed Second Generation Antipsychotics	P3	REC	6.86	2	44	**0.0025***	-2.58	2.78	-0.93	0.3586
A	Prescribed Second Generation Antipsychotics	P4	REC	1.27	2	45	0.2896	1.83	2.69	0.68	0.4990
A	Prescribed clozapine	FP1	ERP	1.98	2	47	0.1499	0.23	1.05	0.21	0.8316
B	Prescribed clozapine	FP1	REC	0.87	2	45	0.4256	-1.67	2.33	-0.72	0.4770
B	Prescribed clozapine	FP2	REC	1.36	2	45	0.2682	-1.47	2.26	-0.65	0.5190
B	Prescribed clozapine	F3	REC	0.68	2	45	0.514	0.76	2.28	0.34	0.7390
B	Prescribed clozapine	F4	REC	1.09	2	45	0.3455	2.28	2.34	0.97	0.3360
B	Prescribed clozapine	F7	REC	0.59	2	45	0.5595	1.14	2.23	0.51	0.6110
B	Prescribed clozapine	F8	REC	0.70	2	45	0.4995	2.13	2.24	0.96	0.3450
B	Prescribed clozapine	C3	REC	0.41	2	45	0.6634	1.80	2.43	0.74	0.4630
B	Prescribed clozapine	C4	REC	0.80	2	45	0.4573	2.40	2.75	0.87	0.3880
B	Prescribed clozapine	P3	REC	0.89	2	44	0.4173	2.64	2.20	1.20	0.2370
B	Prescribed clozapine	P4	REC	0.43	2	45	0.656	1.55	2.19	0.71	0.4830
B	Prescribed First Generation Antipsychotics	FP1	REC	0.82	2	45	0.4449	-3.15	2.46	-1.28	0.2060
B	Prescribed First Generation Antipsychotics	FP2	REC	1.67	2	45	0.1994	-4.11	2.36	-1.74	0.0887
B	Prescribed First Generation Antipsychotics	F3	REC	0.49	2	45	0.6136	-1.50	2.41	-0.62	0.5360
B	Prescribed First Generation Antipsychotics	F4	REC	0.65	2	45	0.528	-0.40	2.49	-0.16	0.8730
B	Prescribed First Generation Antipsychotics	F7	REC	0.38	2	45	0.6833	-0.88	2.36	-0.38	0.7090
B	Prescribed First Generation Antipsychotics	F8	REC	0.52	2	45	0.5967	0.18	2.36	0.08	0.9400
B	Prescribed First Generation Antipsychotics	C3	REC	0.78	2	45	0.4642	-0.46	2.53	-0.18	0.8560
B	Prescribed First Generation Antipsychotics	C4	REC	1.14	2	45	0.3287	-1.04	2.87	-0.36	0.7190
B	Prescribed First Generation Antipsychotics	P3	REC	0.74	2	44	0.4833	0.66	2.29	0.29	0.7740
B	Prescribed First Generation Antipsychotics	P4	REC	1.25	2	45	0.2977	-0.93	2.26	-0.41	0.6830

Frequency Power Band	Prescribed Medications	Electrode Position	State	ANCOVA Main Effects				Multiple Comparisons MAP vs SCZ			
				F-statistic	DF1	DF2	p-value	Estimate	Std.Error	t-value	p-value
B	Prescribed haloperidol	FP1	REC	1.94	2	45	0.1562	-4.65	2.52	-1.85	0.0715
B	Prescribed haloperidol	FP2	REC	3.09	2	45	0.0551	-5.44	2.41	-2.25	**0.0292***
B	Prescribed haloperidol	F3	REC	0.98	2	45	0.3847	-2.29	2.50	-0.91	0.3650
B	Prescribed haloperidol	F4	REC	0.98	2	45	0.3845	-1.04	2.60	-0.40	0.6900
B	Prescribed haloperidol	F7	REC	1.20	2	45	0.31	-1.99	2.44	-0.82	0.4180
B	Prescribed haloperidol	F8	REC	1.01	2	45	0.371	-0.63	2.45	-0.26	0.7990
B	Prescribed haloperidol	C3	REC	1.05	2	45	0.3579	-1.05	2.64	-0.40	0.6930
B	Prescribed haloperidol	C4	REC	1.78	2	45	0.1796	-2.06	2.98	-0.69	0.4927
B	Prescribed haloperidol	P3	REC	0.83	2	44	0.4427	0.33	2.40	0.14	0.8910
B	Prescribed haloperidol	P4	REC	1.01	2	45	0.3734	-1.05	2.39	-0.44	0.6630
B	Prescribed Second Generation Antipsychotics	FP1	REC	1.09	2	45	0.3437	-3.32	2.33	-1.42	0.1620
B	Prescribed Second Generation Antipsychotics	FP2	REC	1.45	2	45	0.2466	-3.64	2.27	-1.61	0.1150
B	Prescribed Second Generation Antipsychotics	F3	REC	0.05	2	45	0.9538	-0.58	2.32	-0.25	0.8030
B	Prescribed Second Generation Antipsychotics	F4	REC	0.24	2	45	0.7909	0.36	2.40	0.15	0.8810
B	Prescribed Second Generation Antipsychotics	F7	REC	0.49	2	45	0.6137	-0.80	2.25	-0.35	0.7250
B	Prescribed Second Generation Antipsychotics	F8	REC	1.27	2	45	0.2902	-0.22	2.22	-0.10	0.9230
B	Prescribed Second Generation Antipsychotics	C3	REC	0.62	2	45	0.5401	-0.04	2.43	-0.02	0.9880
B	Prescribed Second Generation Antipsychotics	C4	REC	1.01	2	45	0.3735	-0.53	2.75	-0.19	0.8470
B	Prescribed Second Generation Antipsychotics	P3	REC	0.55	2	44	0.5804	1.00	2.24	0.45	0.6570
B	Prescribed Second Generation Antipsychotics	P4	REC	0.17	2	45	0.8479	0.40	2.21	0.18	0.8560
D	Prescribed clozapine	FP1	REC	0.23	2	45	0.7994	2.36	4.22	0.56	0.5780
D	Prescribed clozapine	FP2	REC	0.65	2	45	0.5256	3.79	4.45	0.85	0.3990
D	Prescribed clozapine	F3	REC	0.15	2	45	0.8589	-2.35	4.46	-0.53	0.6010
D	Prescribed clozapine	F4	REC	0.55	2	45	0.5834	-4.45	4.48	-0.99	0.3260
D	Prescribed clozapine	F7	REC	0.21	2	45	0.8105	-2.37	3.97	-0.60	0.5530
D	Prescribed clozapine	F8	REC	0.54	2	45	0.5867	-4.01	3.87	-1.04	0.3050
D	Prescribed clozapine	C3	REC	0.53	2	45	0.5901	-4.87	4.77	-1.02	0.3130
D	Prescribed clozapine	C4	REC	0.48	2	45	0.6205	-4.69	4.83	-0.97	0.3370
D	Prescribed clozapine	P3	REC	0.57	2	44	0.5706	-5.38	5.09	-1.06	0.2960
D	Prescribed clozapine	P4	REC	0.78	2	45	0.4644	-5.83	4.69	-1.24	0.2200
D	Prescribed First Generation Antipsychotics	FP1	REC	0.32	2	45	0.727	3.54	4.43	0.80	0.4280
D	Prescribed First Generation Antipsychotics	FP2	REC	1.38	2	45	0.2623	7.27	4.61	1.58	0.1220
D	Prescribed First Generation Antipsychotics	F3	REC	0.35	2	45	0.7081	0.02	4.67	0.01	0.9960
D	Prescribed First Generation Antipsychotics	F4	REC	0.70	2	45	0.5006	-1.02	4.70	-0.22	0.8280
D	Prescribed First Generation Antipsychotics	F7	REC	0.15	2	45	0.8588	-0.88	4.18	-0.21	0.8330
D	Prescribed First Generation Antipsychotics	F8	REC	0.54	2	45	0.5874	-2.62	4.07	-0.64	0.5230
D	Prescribed First Generation Antipsychotics	C3	REC	1.07	2	45	0.3511	-1.70	4.96	-0.34	0.7330

Frequency Power Band	Prescribed Medications	Electrode Position	State	ANCOVA Main Effects				Multiple Comparisons MAP vs SCZ			
				F-statistic	DF1	DF2	p-value	Estimate	Std.Error	t-value	p-value
D	Prescribed First Generation Antipsychotics	C4	REC	1.07	2	45	0.3527	-0.61	5.01	-0.12	0.9040
D	Prescribed First Generation Antipsychotics	P3	REC	1.06	2	44	0.3543	-2.02	5.22	-0.39	0.7010
D	Prescribed First Generation Antipsychotics	P4	REC	1.30	2	45	0.2826	-2.43	4.88	-0.50	0.6210
D	Prescribed haloperidol	FP1	REC	1.11	2	45	0.3396	5.98	4.58	1.31	0.1980
D	Prescribed haloperidol	FP2	REC	2.82	2	45	0.0703	9.96	4.70	2.12	**0.0397***
D	Prescribed haloperidol	F3	REC	0.82	2	45	0.4478	1.66	4.86	0.34	0.7350
D	Prescribed haloperidol	F4	REC	1.18	2	45	0.3154	0.53	4.89	0.11	0.9140
D	Prescribed haloperidol	F7	REC	0.81	2	45	0.4507	1.34	4.32	0.31	0.7590
D	Prescribed haloperidol	F8	REC	1.48	2	45	0.2396	-0.06	4.19	-0.01	0.9890
D	Prescribed haloperidol	C3	REC	1.58	2	45	0.2177	-0.09	5.16	-0.02	0.9870
D	Prescribed haloperidol	C4	REC	1.76	2	45	0.1836	1.31	5.19	0.25	0.8020
D	Prescribed haloperidol	P3	REC	1.36	2	44	0.2663	-0.73	5.46	-0.13	0.8950
D	Prescribed haloperidol	P4	REC	1.01	2	45	0.3737	-2.81	5.16	-0.55	0.5890
D	Prescribed Second Generation Antipsychotics	FP1	REC	0.81	2	45	0.4516	4.46	4.19	1.07	0.2930
D	Prescribed Second Generation Antipsychotics	FP2	REC	1.76	2	45	0.1844	7.19	4.37	1.65	0.1060
D	Prescribed Second Generation Antipsychotics	F3	REC	0.37	2	45	0.6897	-0.24	4.46	-0.05	0.9580
D	Prescribed Second Generation Antipsychotics	F4	REC	0.82	2	45	0.4487	-1.22	4.48	-0.27	0.7870
D	Prescribed Second Generation Antipsychotics	F7	REC	0.40	2	45	0.6723	-0.28	3.97	-0.07	0.9440
D	Prescribed Second Generation Antipsychotics	F8	REC	1.18	2	45	0.3174	-1.48	3.83	-0.39	0.7010
D	Prescribed Second Generation Antipsychotics	C3	REC	1.31	2	45	0.2802	-1.82	4.72	-0.39	0.7010
D	Prescribed Second Generation Antipsychotics	C4	REC	1.34	2	45	0.273	-0.79	4.76	-0.17	0.8690
D	Prescribed Second Generation Antipsychotics	P3	REC	3.58	2	44	**0.0363***	0.65	4.84	0.13	0.8942
D	Prescribed Second Generation Antipsychotics	P4	REC	0.94	2	45	0.3966	-3.69	4.70	-0.79	0.4360
T	Prescribed clozapine	FP1	REC	2.12	2	45	0.1321	-0.09	0.92	-0.10	0.9200
T	Prescribed clozapine	FP2	REC	1.26	2	45	0.2922	-0.44	0.98	-0.45	0.6540
T	Prescribed clozapine	F3	REC	2.20	2	45	0.1227	0.73	1.07	0.68	0.4980
T	Prescribed clozapine	F4	REC	1.41	2	45	0.2554	0.90	1.04	0.86	0.3950
T	Prescribed clozapine	F7	REC	1.08	2	45	0.3498	0.44	0.95	0.47	0.6430
T	Prescribed clozapine	F8	REC	1.57	2	45	0.2187	0.36	0.91	0.40	0.6920
T	Prescribed clozapine	C3	REC	1.64	2	45	0.2062	0.60	1.02	0.59	0.5620
T	Prescribed clozapine	C4	REC	1.27	2	45	0.2909	0.64	1.03	0.62	0.5410
T	Prescribed clozapine	P3	REC	1.27	2	44	0.2923	0.63	0.99	0.63	0.5310
T	Prescribed clozapine	P4	REC	1.34	2	45	0.273	0.93	1.00	0.94	0.3550
T	Prescribed First Generation Antipsychotics	FP1	REC	0.41	2	45	0.663	0.91	1.01	0.91	0.3710
T	Prescribed First Generation Antipsychotics	FP2	REC	0.02	2	45	0.9776	0.19	1.06	0.18	0.8550
T	Prescribed First Generation Antipsychotics	F3	REC	0.99	2	45	0.3795	1.37	1.15	1.19	0.2400
T	Prescribed First Generation Antipsychotics	F4	REC	0.96	2	45	0.3911	1.18	1.11	1.07	0.2920

Frequency Power Band	Prescribed Medications	Electrode Position	State	ANCOVA Main Effects				Multiple Comparisons MAP vs SCZ			
				F-statistic	DF1	DF2	p-value	Estimate	Std.Error	t-value	p-value
T	Prescribed First Generation Antipsychotics	F7	REC	0.76	2	45	0.4725	1.23	1.00	1.23	0.2260
T	Prescribed First Generation Antipsychotics	F8	REC	0.69	2	45	0.5054	1.14	0.97	1.17	0.2460
T	Prescribed First Generation Antipsychotics	C3	REC	0.74	2	45	0.481	1.20	1.10	1.10	0.2780
T	Prescribed First Generation Antipsychotics	C4	REC	0.69	2	45	0.5057	1.22	1.10	1.11	0.2710
T	Prescribed First Generation Antipsychotics	P3	REC	0.74	2	44	0.4844	1.22	1.04	1.17	0.2500
T	Prescribed First Generation Antipsychotics	P4	REC	1.07	2	45	0.3532	1.50	1.06	1.42	0.1620
T	Prescribed haloperidol	FP1	REC	0.27	2	45	0.7642	0.70	1.06	0.66	0.5130
T	Prescribed haloperidol	FP2	REC	0.11	2	45	0.8937	-0.07	1.11	-0.07	0.9490
T	Prescribed haloperidol	F3	REC	1.15	2	45	0.3251	1.02	1.20	0.85	0.4020
T	Prescribed haloperidol	F4	REC	1.26	2	45	0.2937	0.79	1.16	0.68	0.4980
T	Prescribed haloperidol	F7	REC	0.52	2	45	0.5977	0.71	1.06	0.67	0.5070
T	Prescribed haloperidol	F8	REC	0.88	2	45	0.4235	0.43	1.02	0.43	0.6710
T	Prescribed haloperidol	C3	REC	1.06	2	45	0.3538	0.64	1.14	0.56	0.5770
T	Prescribed haloperidol	C4	REC	0.82	2	45	0.4457	0.74	1.15	0.64	0.5250
T	Prescribed haloperidol	P3	REC	0.78	2	44	0.4633	0.82	1.10	0.75	0.4570
T	Prescribed haloperidol	P4	REC	1.01	2	45	0.3728	1.11	1.11	1.00	0.3210
T	Prescribed Second Generation Antipsychotics	FP1	REC	0.27	2	45	0.7646	0.60	0.97	0.62	0.5400
T	Prescribed Second Generation Antipsychotics	FP2	REC	0.06	2	45	0.942	0.08	1.01	0.08	0.9380
T	Prescribed Second Generation Antipsychotics	F3	REC	1.30	2	45	0.2814	1.04	1.09	0.95	0.3450
T	Prescribed Second Generation Antipsychotics	F4	REC	1.20	2	45	0.3121	0.99	1.05	0.94	0.3510
T	Prescribed Second Generation Antipsychotics	F7	REC	0.49	2	45	0.6134	0.91	0.96	0.94	0.3500
T	Prescribed Second Generation Antipsychotics	F8	REC	0.63	2	45	0.5396	1.03	0.93	1.11	0.2720
T	Prescribed Second Generation Antipsychotics	C3	REC	0.77	2	45	0.4696	1.05	1.05	1.00	0.3210
T	Prescribed Second Generation Antipsychotics	C4	REC	0.67	2	45	0.5191	1.10	1.05	1.05	0.3000
T	Prescribed Second Generation Antipsychotics	P3	REC	0.75	2	44	0.4788	0.93	1.02	0.91	0.3660
T	Prescribed Second Generation Antipsychotics	P4	REC	1.07	2	45	0.3521	1.46	1.01	1.45	0.1550
A	Prescribed clozapine	FP2	ERP	0.80	2	47	0.4546	-0.42	1.05	-0.39	0.6950
A	Prescribed clozapine	F3	ERP	3.68	2	47	**0.0328***	0.12	1.28	0.10	0.9229
A	Prescribed clozapine	F4	ERP	3.87	2	47	**0.0279***	0.23	1.32	0.18	0.8599
A	Prescribed clozapine	F7	ERP	5.80	2	47	**0.0056***	1.08	1.10	0.98	0.3311
A	Prescribed clozapine	F8	ERP	5.91	2	47	**0.0051***	1.11	1.11	1.00	0.3240
A	Prescribed clozapine	C3	ERP	5.99	2	47	**0.0048***	0.35	1.34	0.26	0.7976
A	Prescribed clozapine	C4	ERP	3.55	2	47	**0.0367***	0.98	1.37	0.72	0.4774
A	Prescribed clozapine	P3	ERP	5.69	2	47	**0.0061***	0.35	1.71	0.20	0.8407
A	Prescribed clozapine	P4	ERP	5.52	2	47	**0.0070***	0.21	1.54	0.14	0.8904
A	Prescribed First Generation Antipsychotics	FP1	ERP	1.08	2	47	0.3488	0.39	1.10	0.35	0.7260
A	Prescribed First Generation Antipsychotics	FP2	ERP	2.03	2	47	0.1426	-0.84	1.06	-0.80	0.4305

Frequency Power Band	Prescribed Medications	Electrode Position	State	ANCOVA Main Effects				Multiple Comparisons MAP vs SCZ			
				F-statistic	DF1	DF2	p-value	Estimate	Std.Error	t-value	p-value
A	Prescribed First Generation Antipsychotics	F3	ERP	2.60	2	47	0.0851	0.17	1.34	0.12	0.9023
A	Prescribed First Generation Antipsychotics	F4	ERP	2.18	2	47	0.1247	0.45	1.40	0.32	0.7492
A	Prescribed First Generation Antipsychotics	F7	ERP	4.24	2	47	**0.0203***	1.17	1.16	1.01	0.3194
A	Prescribed First Generation Antipsychotics	F8	ERP	3.66	2	47	**0.0332***	1.36	1.19	1.14	0.2598
A	Prescribed First Generation Antipsychotics	C3	ERP	3.02	2	47	0.0585	0.70	1.46	0.48	0.6349
A	Prescribed First Generation Antipsychotics	C4	ERP	3.68	2	47	**0.0329***	0.76	1.41	0.54	0.5921
A	Prescribed First Generation Antipsychotics	P3	ERP	2.44	2	47	0.0979	0.94	1.86	0.51	0.6148
A	Prescribed First Generation Antipsychotics	P4	ERP	2.16	2	47	0.1268	0.82	1.69	0.49	0.6280
A	Prescribed haloperidol	FP1	ERP	1.37	2	47	0.2649	-0.01	1.21	-0.01	0.9960
A	Prescribed haloperidol	FP2	ERP	1.64	2	47	0.2041	-1.13	1.17	-0.96	0.3416
A	Prescribed haloperidol	F3	ERP	1.48	2	47	0.2379	0.19	1.51	0.12	0.9020
A	Prescribed haloperidol	F4	ERP	1.42	2	47	0.2521	0.42	1.56	0.27	0.7870
A	Prescribed haloperidol	F7	ERP	3.56	2	47	**0.0363***	0.95	1.29	0.74	0.4640
A	Prescribed haloperidol	F8	ERP	3.63	2	47	**0.0343***	0.98	1.31	0.75	0.4570
A	Prescribed haloperidol	C3	ERP	1.82	2	47	0.1726	0.79	1.64	0.48	0.6330
A	Prescribed haloperidol	C4	ERP	2.36	2	47	0.1053	0.76	1.58	0.48	0.6320
A	Prescribed haloperidol	P3	ERP	1.60	2	47	0.2122	0.98	2.08	0.47	0.6400
A	Prescribed haloperidol	P4	ERP	1.48	2	47	0.2374	0.80	1.88	0.43	0.6710
A	Prescribed Second Generation Antipsychotics	FP1	ERP	2.31	2	47	0.1102	0.18	1.04	0.18	0.8600
A	Prescribed Second Generation Antipsychotics	FP2	ERP	1.84	2	47	0.1704	-0.64	1.03	-0.62	0.5370
A	Prescribed Second Generation Antipsychotics	F3	ERP	4.22	2	47	**0.0206***	0.08	1.26	0.06	0.9490
A	Prescribed Second Generation Antipsychotics	F4	ERP	3.95	2	47	**0.0259***	0.27	1.31	0.20	0.8409
A	Prescribed Second Generation Antipsychotics	F7	ERP	5.10	2	47	**0.0099***	1.21	1.10	1.10	0.2790
A	Prescribed Second Generation Antipsychotics	F8	ERP	6.01	2	47	**0.0047***	1.14	1.10	1.03	0.3088
A	Prescribed Second Generation Antipsychotics	C3	ERP	5.64	2	47	**0.0064***	0.45	1.35	0.34	0.7388
A	Prescribed Second Generation Antipsychotics	C4	ERP	5.32	2	47	**0.0083***	0.71	1.32	0.54	0.5927
A	Prescribed Second Generation Antipsychotics	P3	ERP	7.10	2	47	**0.0020***	0.20	1.66	0.12	0.9050
A	Prescribed Second Generation Antipsychotics	P4	ERP	5.59	2	47	**0.0066***	0.27	1.53	0.17	0.8626
B	Prescribed clozapine	FP1	ERP	0.33	2	47	0.7195	0.12	1.84	0.06	0.9500
B	Prescribed clozapine	FP2	ERP	0.22	2	47	0.8013	1.14	1.78	0.64	0.5250
B	Prescribed clozapine	F3	ERP	0.67	2	47	0.5163	-1.03	1.92	-0.54	0.5940
B	Prescribed clozapine	F4	ERP	0.67	2	47	0.5177	1.15	1.88	0.61	0.5440
B	Prescribed clozapine	F7	ERP	0.47	2	47	0.6255	1.65	2.15	0.77	0.4470
B	Prescribed clozapine	F8	ERP	1.07	2	47	0.3506	2.22	2.11	1.05	0.2980
B	Prescribed clozapine	C3	ERP	0.47	2	47	0.6268	0.98	2.12	0.46	0.6450
B	Prescribed clozapine	C4	ERP	0.46	2	47	0.6363	1.34	2.48	0.54	0.5900
B	Prescribed clozapine	P3	ERP	1.74	2	47	0.1865	1.11	1.62	0.69	0.4960

Frequency Power Band	Prescribed Medications	Electrode Position	State	ANCOVA Main Effects				Multiple Comparisons MAP vs SCZ			
				F-statistic	DF1	DF2	p-value	Estimate	Std.Error	t-value	p-value
B	Prescribed clozapine	P4	ERP	0.97	2	47	0.3858	0.41	1.90	0.21	0.8320
B	Prescribed First Generation Antipsychotics	FP1	ERP	1.38	2	47	0.2623	-0.69	1.85	-0.37	0.7110
B	Prescribed First Generation Antipsychotics	FP2	ERP	2.15	2	47	0.1276	-0.44	1.76	-0.25	0.8056
B	Prescribed First Generation Antipsychotics	F3	ERP	1.66	2	47	0.2021	-1.72	1.93	-0.89	0.3771
B	Prescribed First Generation Antipsychotics	F4	ERP	2.12	2	47	0.1309	0.13	1.87	0.07	0.9467
B	Prescribed First Generation Antipsychotics	F7	ERP	2.44	2	47	0.098	0.00	2.12	0.00	0.9998
B	Prescribed First Generation Antipsychotics	F8	ERP	2.77	2	47	0.0728	0.91	2.10	0.43	0.6677
B	Prescribed First Generation Antipsychotics	C3	ERP	3.08	2	47	0.0555	-0.67	2.07	-0.32	0.7485
B	Prescribed First Generation Antipsychotics	C4	ERP	1.76	2	47	0.184	-0.01	2.48	0.00	0.9977
B	Prescribed First Generation Antipsychotics	P3	ERP	2.74	2	47	0.0748	0.56	1.63	0.34	0.7343
B	Prescribed First Generation Antipsychotics	P4	ERP	2.13	2	47	0.13	-0.34	1.91	-0.18	0.8576
B	Prescribed haloperidol	FP1	ERP	2.45	2	47	0.0972	-1.88	1.99	-0.94	0.3511
B	Prescribed haloperidol	FP2	ERP	2.93	2	47	0.0631	-1.47	1.91	-0.77	0.4456
B	Prescribed haloperidol	F3	ERP	2.65	2	47	0.0815	-2.94	2.09	-1.41	0.1650
B	Prescribed haloperidol	F4	ERP	2.47	2	47	0.0953	-0.73	2.05	-0.36	0.7233
B	Prescribed haloperidol	F7	ERP	3.43	2	47	**0.0407***	-1.35	2.29	-0.59	0.5596
B	Prescribed haloperidol	F8	ERP	2.45	2	47	0.0977	0.36	2.32	0.16	0.8766
B	Prescribed haloperidol	C3	ERP	3.96	2	47	**0.0259***	-2.00	2.24	-0.89	0.3758
B	Prescribed haloperidol	C4	ERP	2.06	2	47	0.1387	-1.06	2.71	-0.39	0.6964
B	Prescribed haloperidol	P3	ERP	3.01	2	47	0.0587	-0.18	1.79	-0.10	0.9222
B	Prescribed haloperidol	P4	ERP	2.61	2	47	0.084	-1.31	2.08	-0.63	0.5310
B	Prescribed Second Generation Antipsychotics	FP1	ERP	2.30	2	47	0.1117	-0.76	1.76	-0.43	0.6674
B	Prescribed Second Generation Antipsychotics	FP2	ERP	1.48	2	47	0.2389	0.06	1.73	0.04	0.9710
B	Prescribed Second Generation Antipsychotics	F3	ERP	2.39	2	47	0.1026	-1.69	1.85	-0.91	0.3660
B	Prescribed Second Generation Antipsychotics	F4	ERP	3.49	2	47	**0.0387***	0.01	1.77	0.01	0.9963
B	Prescribed Second Generation Antipsychotics	F7	ERP	3.18	2	47	0.0507	0.10	2.02	0.05	0.9625
B	Prescribed Second Generation Antipsychotics	F8	ERP	4.71	2	47	**0.0136***	0.67	1.96	0.34	0.7351
B	Prescribed Second Generation Antipsychotics	C3	ERP	4.72	2	47	**0.0136***	-0.68	1.94	-0.35	0.7278
B	Prescribed Second Generation Antipsychotics	C4	ERP	4.25	2	47	**0.0202***	-0.56	2.29	-0.24	0.8087
B	Prescribed Second Generation Antipsychotics	P3	ERP	6.79	2	47	**0.0026***	0.07	1.47	0.05	0.9618
B	Prescribed Second Generation Antipsychotics	P4	ERP	5.23	2	47	**0.0089***	-0.78	1.75	-0.45	0.6585
D	Prescribed clozapine	FP1	ERP	1.11	2	47	0.3377	0.03	2.71	0.01	0.9920
D	Prescribed clozapine	FP2	ERP	0.24	2	47	0.7886	0.21	2.69	0.08	0.9390
D	Prescribed clozapine	F3	ERP	2.65	2	47	0.0814	0.83	3.11	0.27	0.7900
D	Prescribed clozapine	F4	ERP	2.59	2	47	0.0861	-1.43	3.16	-0.45	0.6532
D	Prescribed clozapine	F7	ERP	2.41	2	47	0.1008	-3.19	3.03	-1.06	0.2970
D	Prescribed clozapine	F8	ERP	3.18	2	47	0.0509	-3.65	3.02	-1.21	0.2330

Frequency Power Band	Prescribed Medications	Electrode Position	State	ANCOVA Main Effects				Multiple Comparisons MAP vs SCZ			
				F-statistic	DF1	DF2	p-value	Estimate	Std.Error	t-value	p-value
D	Prescribed clozapine	C3	ERP	3.00	2	47	0.0596	-1.58	3.35	-0.47	0.6402
D	Prescribed clozapine	C4	ERP	1.97	2	47	0.1513	-2.50	3.63	-0.69	0.4940
D	Prescribed clozapine	P3	ERP	5.49	2	47	**0.0072***	-1.59	3.14	-0.51	0.6145
D	Prescribed clozapine	P4	ERP	4.10	2	47	**0.0228***	-1.07	3.26	-0.33	0.7440
D	Prescribed First Generation Antipsychotics	FP1	ERP	1.41	2	47	0.2535	0.52	2.77	0.19	0.8530
D	Prescribed First Generation Antipsychotics	FP2	ERP	3.04	2	47	0.0575	2.36	2.62	0.90	0.3721
D	Prescribed First Generation Antipsychotics	F3	ERP	2.56	2	47	0.088	1.24	3.21	0.39	0.7000
D	Prescribed First Generation Antipsychotics	F4	ERP	2.98	2	47	0.0605	-0.78	3.22	-0.24	0.8108
D	Prescribed First Generation Antipsychotics	F7	ERP	3.84	2	47	**0.0286***	-1.94	3.03	-0.64	0.5256
D	Prescribed First Generation Antipsychotics	F8	ERP	3.76	2	47	**0.0307***	-2.93	3.08	-0.95	0.3450
D	Prescribed First Generation Antipsychotics	C3	ERP	3.52	2	47	**0.0377***	-0.80	3.41	-0.23	0.8161
D	Prescribed First Generation Antipsychotics	C4	ERP	2.99	2	47	0.06	-1.28	3.66	-0.35	0.7292
D	Prescribed First Generation Antipsychotics	P3	ERP	3.09	2	47	0.0549	-2.27	3.37	-0.68	0.5030
D	Prescribed First Generation Antipsychotics	P4	ERP	2.51	2	47	0.0922	-1.51	3.45	-0.44	0.6631
D	Prescribed haloperidol	FP1	ERP	2.36	2	47	0.1056	2.19	2.99	0.73	0.4666
D	Prescribed haloperidol	FP2	ERP	3.07	2	47	0.0558	3.62	2.88	1.26	0.2142
D	Prescribed haloperidol	F3	ERP	2.21	2	47	0.1205	2.28	3.55	0.64	0.5236
D	Prescribed haloperidol	F4	ERP	2.55	2	47	0.0887	0.11	3.57	0.03	0.9750
D	Prescribed haloperidol	F7	ERP	4.30	2	47	**0.0194***	-0.35	3.30	-0.11	0.9153
D	Prescribed haloperidol	F8	ERP	3.76	2	47	**0.0305***	-1.81	3.38	-0.54	0.5947
D	Prescribed haloperidol	C3	ERP	3.25	2	47	**0.0476***	0.47	3.77	0.12	0.9022
D	Prescribed haloperidol	C4	ERP	2.70	2	47	0.078	-0.16	4.05	-0.04	0.9678
D	Prescribed haloperidol	P3	ERP	2.58	2	47	0.0866	-1.65	3.74	-0.44	0.6610
D	Prescribed haloperidol	P4	ERP	2.45	2	47	0.0975	-0.40	3.80	-0.11	0.9170
D	Prescribed Second Generation Antipsychotics	FP1	ERP	2.68	2	47	0.079	0.78	2.61	0.30	0.7666
D	Prescribed Second Generation Antipsychotics	FP2	ERP	2.06	2	47	0.139	1.48	2.58	0.57	0.5706
D	Prescribed Second Generation Antipsychotics	F3	ERP	3.67	2	47	**0.0330***	1.17	3.04	0.39	0.7022
D	Prescribed Second Generation Antipsychotics	F4	ERP	4.66	2	47	**0.0143***	-0.61	3.03	-0.20	0.8419
D	Prescribed Second Generation Antipsychotics	F7	ERP	4.40	2	47	**0.0177***	-2.21	2.90	-0.76	0.4500
D	Prescribed Second Generation Antipsychotics	F8	ERP	5.86	2	47	**0.0054***	-2.55	2.87	-0.89	0.3778
D	Prescribed Second Generation Antipsychotics	C3	ERP	5.85	2	47	**0.0054***	-0.52	3.17	-0.16	0.8703
D	Prescribed Second Generation Antipsychotics	C4	ERP	5.44	2	47	**0.0075***	-0.76	3.39	-0.23	0.8231
D	Prescribed Second Generation Antipsychotics	P3	ERP	8.65	2	47	**0.0006***	-0.86	2.96	-0.29	0.7721
D	Prescribed Second Generation Antipsychotics	P4	ERP	6.20	2	47	**0.0041***	-0.46	3.12	-0.15	0.8841
T	Prescribed clozapine	FP1	ERP	0.33	2	47	0.7179	-0.37	0.72	-0.51	0.6110
T	Prescribed clozapine	FP2	ERP	0.92	2	47	0.4073	-0.93	0.72	-1.31	0.1970
T	Prescribed clozapine	F3	ERP	2.55	2	47	0.0887	0.07	0.74	0.10	0.9236

Frequency Power Band	Prescribed Medications	Electrode Position	State	ANCOVA Main Effects				Multiple Comparisons MAP vs SCZ			
				F-statistic	DF1	DF2	p-value	Estimate	Std.Error	t-value	p-value
T	Prescribed clozapine	F4	ERP	1.83	2	47	0.1713	0.05	0.80	0.06	0.9535
T	Prescribed clozapine	F7	ERP	1.07	2	47	0.3526	0.47	0.73	0.64	0.5270
T	Prescribed clozapine	F8	ERP	0.86	2	47	0.4281	0.32	0.71	0.45	0.6550
T	Prescribed clozapine	C3	ERP	2.16	2	47	0.1262	0.25	0.78	0.32	0.7535
T	Prescribed clozapine	C4	ERP	1.40	2	47	0.256	0.18	0.78	0.23	0.8200
T	Prescribed clozapine	P3	ERP	2.81	2	47	0.0706	0.13	0.72	0.18	0.8560
T	Prescribed clozapine	P4	ERP	2.41	2	47	0.1004	0.45	0.72	0.62	0.5361
T	Prescribed First Generation Antipsychotics	FP1	ERP	0.04	2	47	0.9568	-0.21	0.75	-0.29	0.7750
T	Prescribed First Generation Antipsychotics	FP2	ERP	1.26	2	47	0.2918	-1.08	0.73	-1.48	0.1450
T	Prescribed First Generation Antipsychotics	F3	ERP	0.92	2	47	0.4038	0.32	0.79	0.40	0.6910
T	Prescribed First Generation Antipsychotics	F4	ERP	0.85	2	47	0.4329	0.20	0.84	0.24	0.8140
T	Prescribed First Generation Antipsychotics	F7	ERP	0.59	2	47	0.5564	0.77	0.76	1.01	0.3160
T	Prescribed First Generation Antipsychotics	F8	ERP	0.42	2	47	0.6563	0.67	0.74	0.91	0.3690
T	Prescribed First Generation Antipsychotics	C3	ERP	0.56	2	47	0.5775	0.77	0.82	0.93	0.3560
T	Prescribed First Generation Antipsychotics	C4	ERP	0.38	2	47	0.686	0.52	0.82	0.64	0.5240
T	Prescribed First Generation Antipsychotics	P3	ERP	0.55	2	47	0.5827	0.77	0.78	0.99	0.3270
T	Prescribed First Generation Antipsychotics	P4	ERP	0.96	2	47	0.3886	1.03	0.76	1.35	0.1820
T	Prescribed haloperidol	FP1	ERP	0.08	2	47	0.9223	-0.31	0.82	-0.38	0.7080
T	Prescribed haloperidol	FP2	ERP	0.81	2	47	0.452	-1.03	0.81	-1.27	0.2100
T	Prescribed haloperidol	F3	ERP	0.50	2	47	0.6122	0.47	0.88	0.54	0.5910
T	Prescribed haloperidol	F4	ERP	0.57	2	47	0.5676	0.19	0.93	0.21	0.8370
T	Prescribed haloperidol	F7	ERP	0.59	2	47	0.5586	0.74	0.83	0.89	0.3760
T	Prescribed haloperidol	F8	ERP	0.42	2	47	0.6568	0.47	0.81	0.58	0.5680
T	Prescribed haloperidol	C3	ERP	0.56	2	47	0.5768	0.75	0.91	0.83	0.4130
T	Prescribed haloperidol	C4	ERP	0.39	2	47	0.6784	0.46	0.90	0.52	0.6080
T	Prescribed haloperidol	P3	ERP	0.57	2	47	0.5712	0.84	0.86	0.99	0.3290
T	Prescribed haloperidol	P4	ERP	0.91	2	47	0.4085	0.91	0.84	1.08	0.2850
T	Prescribed Second Generation Antipsychotics	FP1	ERP	0.04	2	47	0.9566	-0.20	0.72	-0.28	0.7790
T	Prescribed Second Generation Antipsychotics	FP2	ERP	0.83	2	47	0.4403	-0.90	0.71	-1.26	0.2130
T	Prescribed Second Generation Antipsychotics	F3	ERP	0.74	2	47	0.4836	0.44	0.77	0.57	0.5730
T	Prescribed Second Generation Antipsychotics	F4	ERP	0.64	2	47	0.5294	0.33	0.82	0.41	0.6850
T	Prescribed Second Generation Antipsychotics	F7	ERP	0.77	2	47	0.4672	0.90	0.73	1.24	0.2230
T	Prescribed Second Generation Antipsychotics	F8	ERP	0.58	2	47	0.5642	0.75	0.71	1.05	0.2980
T	Prescribed Second Generation Antipsychotics	C3	ERP	0.56	2	47	0.5749	0.75	0.80	0.94	0.3530
T	Prescribed Second Generation Antipsychotics	C4	ERP	0.35	2	47	0.7069	0.61	0.79	0.77	0.4460
T	Prescribed Second Generation Antipsychotics	P3	ERP	0.65	2	47	0.5287	0.59	0.75	0.79	0.4340
T	Prescribed Second Generation Antipsychotics	P4	ERP	0.92	2	47	0.4043	0.97	0.74	1.31	0.1980

D Appendix: Electroencephalography: Event Related Potentials

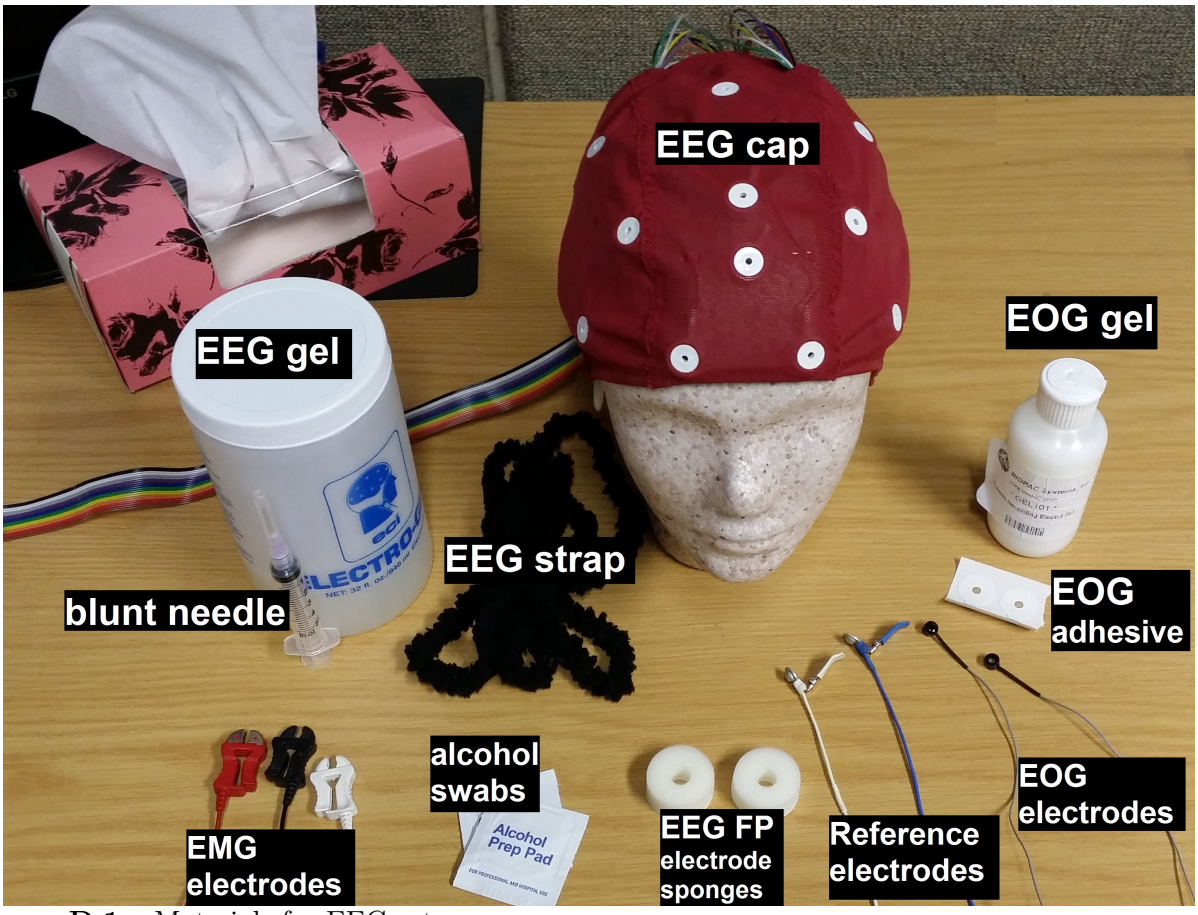


Figure D.1 – Materials for EEG set-up

D.1 Kruskal-Wallis Tests: Group comparisons of each ERP measure

D.1.1 Behavioural responses

Variable Names are dot separated as:
Stimulus.Electrode _Position.Component_Name.Component_Window. followed by either Amp(Amplitude
(Unit for Amplitude), OR, Lat(Latency).ms (Unit for latency).
A.S3.RT=Reaction time to respond to S3 stimulus;
S3.Response=Number responses to Target S3 stimulus;
S3.Omit= Number of omissions of Target S3 stimulus (delayed response=omission);
NonT.Response=Number of responses to Non-Target stimulus (not S3);
A.TrickS.Responses= Number of responses to Trick S stimulus;
S1.Response= Number of responses to S1 stimulus;
A.S2.Responses= Number of responses to S2 stimulus;
A.Total.Correct= Of the number of Target responses, number which were correct;

A.S3.Delayed.Response= Of the number of Target responses, number which were delayed;
A.S3.Delayed.RT= Reaction times of delayed Target S3 responses;
A.Omissions= Number of omissions of Target S3 stimulus (delayed response does NOT count as omission).
* indicate $p < 0.05$.

Variable Name	Kruskal-Wallis chi-squared	df	p-value
S3.Response	15.07	2	**0.0005***
A.S3.RT	13.82	2	**0.0010***
A.Total.Correct	18.21	2	**0.0001***
A.S3.Delayed.Response	13.68	2	**0.0011***
A.S3.Delayed.RT	12.00	2	**0.0024***
S3.Omit	15.07	2	**0.0005***
A.Omissions	12.15	2	**0.0023***
S1.Response	2.23	2	0.3278
A.S2.Responses	7.61	2	**0.0223***
A.TrickS.Responses	4.47	2	0.1069
NonT.Response	17.75	2	**0.0001***

Table D.1 – Group Comparisons of behavioural measures during Sustained Attention Task. A.S3.RT=Reaction time to respond to S3 stimulus; S3.Response=Number responses to Target S3 stimulus; S3.Omit=Number of omissions of Target S3 stimulus (delayed response=omission); NonT.Response=Number of responses to Non-Target stimulus (not S3); A.TrickS.Responses=Number of responses to Trick S stimulus; S1.Response=Number of responses to S1 stimulus; A.S2.Responses=Number of responses to S2 stimulus; A.Total.Correct=Of the number of Target responses, number which were correct; A.S3.Delayed.Response=Of the number of Target responses, number which were delayed; A.S3.Delayed.RT=Reaction times of delayed Target S3 responses; A.Omissions=Number of omissions of Target S3 stimulus (delayed response does NOT count as omission)

D.1.2 Group comparisons of each ERP measure

Variable Name	Kruskal-Wallis chi-squared	df	p-value	
S1.FP1.P50.0to100msAmp.mV	2.27	2	0.3213	
S1.FP1.P50.0to100msLat.ms	1.75	2	0.4169	
S1.FP2.P50.0to100msAmp.mV	1.54	2	0.4637	
S1.FP2.P50.0to100msLat.ms	0.67	2	0.7145	
S1.F3.P50.0to100msAmp.mV	6.14	2	**0.0463***	*
S1.F3.P50.0to100msLat.ms	0.47	2	0.7915	
S1.F4.P50.0to100msAmp.mV	3.12	2	0.2098	
S1.F4.P50.0to100msLat.ms	1.58	2	0.4547	
S1.F7.P50.0to100msAmp.mV	10.01	2	**0.0067***	*
S1.F7.P50.0to100msLat.ms	0.91	2	0.6334	
S1.F8.P50.0to100msAmp.mV	0.80	2	0.6719	
S1.F8.P50.0to100msLat.ms	4.23	2	0.1206	
S1.P3.Nc.0to100msAmp.mV	0.57	2	0.7532	
S1.P3.Nc.0to100msLat.ms	1.95	2	0.3781	
S1.P4.Nc.0to100msAmp.mV	1.07	2	0.5861	
S1.P4.Nc.0to100msLat.ms	0.75	2	0.6877	
S1.C3.P1.50to140msAmp.mV	1.38	2	0.5016	
S1.C3.P1.50to140msLat.ms	2.81	2	0.2456	
S1.C4.P1.50to140msAmp.mV	1.31	2	0.5205	
S1.C4.P1.50to140msLat.ms	4.66	2	0.0974	
S1.P3.P1.50to150msAmp.mV	0.00	2	0.9994	
S1.P3.P1.50to150msLat.ms	1.66	2	0.4358	
S1.P4.P1.50to150msAmp.mV	0.26	2	0.8802	
S1.P4.P1.50to150msLat.ms	5.58	2	0.0615	
S1.Fp1.N1.75to200msAmp.mV	5.96	2	0.0508	
S1.Fp1.N1.75to200msLat.ms	5.92	2	0.0517	
S1.Fp2.N1.75to200msAmp.mV	6.89	2	**0.0319***	*
S1.Fp2.N1.75to200msLat.ms	1.49	2	0.4751	
S1.F3.N1.75to200msAmp.mV	4.70	2	0.0952	
S1.F3.N1.75to200msLat.ms	0.92	2	0.6321	
S1.F4.N1.75to200msAmp.mV	4.18	2	0.1237	
S1.F4.N1.75to200msLat.ms	2.19	2	0.3337	
S1.F7.N1.75to200msAmp.mV	5.85	2	0.0536	
S1.F7.N1.75to200msLat.ms	4.11	2	0.1281	
S1.F8.N1.75to200msAmp.mV	1.26	2	0.5328	
S1.F8.N1.75to200msLat.ms	1.09	2	0.5794	
S1.C3.N1.100to150msAmp.mV	0.61	2	0.7390	
S1.C3.N1.100to150msLat.ms	0.16	2	0.9247	
S1.C4.N1.100to150msAmp.mV	2.71	2	0.2581	
S1.C4.N1.100to150msLat.ms	1.67	2	0.4330	
S1.P3.N1.120to180msAmp.mV	1.00	2	0.6077	
S1.P3.N1.120to180msLat.ms	4.42	2	0.1097	
S1.P4.N1.120to180msAmp.mV	1.65	2	0.4393	
S1.P4.N1.120to180msLat.ms	1.53	2	0.4655	
S1.C3.P2.150to300msAmp.mV	1.24	2	0.5381	
S1.C3.P2.150to300msLat.ms	1.23	2	0.5403	
S1.C4.P2.150to300msAmp.mV	3.46	2	0.1772	
S1.C4.P2.150to300msLat.ms	1.84	2	0.3987	
S1.FP1.P2.150to350msAmp.mV	5.04	2	0.0803	
S1.FP1.P2.150to350msLat.ms	0.93	2	0.6281	
S1.FP2.P2.150to350msAmp.mV	3.90	2	0.1420	
S1.FP2.P2.150to350msLat.ms	3.61	2	0.1649	
S1.F3.P2.150to350msAmp.mV	2.89	2	0.2355	
S1.F3.P2.150to350msLat.ms	0.86	2	0.6508	
S1.F4.P2.150to350msAmp.mV	5.98	2	0.0504	
S1.F4.P2.150to350msLat.ms	2.79	2	0.2481	
S1.F7.P2.150to350msAmp.mV	4.69	2	0.0957	

S1.F7.P2.150to350msLat.ms	2.25	2	0.3243	
S1.F8.P2.150to350msAmp.mV	0.70	2	0.7055	
S1.F8.P2.150to350msLat.ms	1.87	2	0.3924	
S1.FP1.P2.150to400msAmp.mV	4.55	2	0.1027	
S1.FP1.P2.150to400msLat.ms	0.19	2	0.9094	
S1.FP2.P2.150to400msAmp.mV	4.29	2	0.1171	
S1.FP2.P2.150to400msLat.ms	3.47	2	0.1766	
S1.F3.P2.150to400msAmp.mV	2.26	2	0.3234	
S1.F3.P2.150to400msLat.ms	1.04	2	0.5956	
S1.F4.P2.150to400msAmp.mV	6.74	2	**0.0343***	*
S1.F4.P2.150to400msLat.ms	2.60	2	0.2729	
S1.F7.P2.150to400msAmp.mV	4.92	2	0.0853	
S1.F7.P2.150to400msLat.ms	1.45	2	0.4839	
S1.F8.P2.150to400msAmp.mV	0.24	2	0.8886	
S1.F8.P2.150to400msLat.ms	4.59	2	0.1007	
S1.P3.P2.150to250msAmp.mV	4.07	2	0.1308	
S1.P3.P2.150to250msLat.ms	0.17	2	0.9187	
S1.P4.P2.150to250msAmp.mV	2.16	2	0.3396	
S1.P4.P2.150to250msLat.ms	1.59	2	0.4519	
S1.P3.N2.200to350msAmp.mV	1.49	2	0.4757	
S1.P3.N2.200to350msLat.ms	1.95	2	0.3768	
S1.P4.N2.200to350msAmp.mV	0.93	2	0.6282	
S1.P4.N2.200to350msLat.ms	0.61	2	0.7371	
S1.C3.P3.300to550.msAmp.mV	2.10	2	0.3499	
S1.C3.P3.300to550.msLat.ms	0.02	2	0.9907	
S1.C4.P3.300to550.msAmp.mV	8.36	2	**0.0152***	*
S1.C4.P3.300to550.msLat.ms	0.42	2	0.8121	
S1.P3.P3.300to550msAmp.mV	1.39	2	0.5000	
S1.P3.P3.300to550msLat.ms	0.32	2	0.8540	
S1.P4.P3.300to550msAmp.mV	1.63	2	0.4423	
S1.P4.P3.300to550msLat.ms	2.10	2	0.3501	

Variable Name	**Kruskal-Wallis chi-squared**	**df**	**p-value**	
S2.C3.Nc.0to100msAmp.mV	8.04	2	**0.0179***	*
S2.C3.Nc.0to100msLat.ms	0.33	2	0.8485	
S2.C4.Nc.0to100msAmp.mV	4.00	2	0.1353	
S2.C4.Nc.0to100msLat.ms	2.21	2	0.3310	
S2.FP1.P1.0to150msAmp.mV	0.42	2	0.8113	
S2.FP1.P1.0to150msLat.ms	0.19	2	0.9108	
S2.FP2.P1.0to150msAmp.mV	0.50	2	0.7781	
S2.FP2.P1.0to150msLat.ms	1.90	2	0.3876	
S2.F3.P1.0to150msAmp.mV	3.91	2	0.1413	
S2.F3.P1.0to150msLat.ms	0.73	2	0.6928	
S2.F4.P1.0to150msAmp.mV	5.70	2	0.0578	
S2.F4.P1.0to150msLat.ms	0.77	2	0.6791	
S2.F7.P1.0to150msAmp.mV	1.43	2	0.4891	
S2.F7.P1.0to150msLat.ms	0.40	2	0.8187	
S2.F8.P1.0to150msAmp.mV	0.57	2	0.7534	
S2.F8.P1.0to150msLat.ms	2.09	2	0.3512	
S2.P3.Nc.0to100msAmp.mV	4.37	2	0.1125	
S2.P3.Nc.0to100msLat.ms	0.15	2	0.9262	
S2.P4.Nc.0to100msAmp.mV	3.41	2	0.1818	
S2.P4.Nc.0to100msLat.ms	0.60	2	0.7393	
S2.FP1.N1.75to200msAmp.mV	0.32	2	0.8510	
S2.FP1.N1.75to200msLat.ms	1.31	2	0.5192	
S2.FP2.N1.75to200msAmp.mV	0.46	2	0.7952	
S2.FP2.N1.75to200msLat.ms	5.27	2	0.0716	
S2.F3.N1.75to200msAmp.mV	0.10	2	0.9527	
S2.F3.N1.75to200msLat.ms	0.50	2	0.7800	

S2.F4.N1.75to200msAmp.mV	1.72	2	0.4231
S2.F4.N1.75to200msLat.ms	1.71	2	0.4245
S2.F7.N1.75to200msAmp.mV	3.78	2	0.1514
S2.F7.N1.75to200msLat.ms	2.84	2	0.2420
S2.F8.N1.75to200msAmp.mV	1.12	2	0.5721
S2.F8.N1.75to200msLat.ms	2.93	2	0.2313
S2.C3.N2.100to250msAmp.mV	2.55	2	0.2798
S2.C3.N2.100to250msLat.ms	2.27	2	0.3210
S2.C4.N2.100to250msAmp.mV	3.22	2	0.1995
S2.C4.N2.100to250msLat.ms	0.25	2	0.8822
S2.P3.N2.100to300msAmp.mV	2.23	2	0.3285
S2.P3.N2.100to300msLat.ms	1.62	2	0.4458
S2.P4.N2.100to300msAmp.mV	1.66	2	0.4370
S2.P4.N2.100to300msLat.ms	1.31	2	0.5189
S2.FP1.P3.150to450msAmp.mV	1.33	2	0.5154
S2.FP1.P3.150to450msLat.ms	4.57	2	0.1020
S2.FP2.P3.150to450msAmp.mV	2.48	2	0.2887
S2.FP2.P3.150to450msLat.ms	3.19	2	0.2032
S2.F3.P3.150to450msAmp.mV	0.84	2	0.6583
S2.F3.P3.150to450msLat.ms	4.16	2	0.1249
S2.F4.P3.150to450msAmp.mV	0.28	2	0.8705
S2.F4.P3.150to450msLat.ms	0.04	2	0.9825
S2.F7.P3.150to450msAmp.mV	1.11	2	0.5754
S2.F7.P3.150to450msLat.ms	1.58	2	0.4532
S2.F8.P3.150to450msAmp.mV	0.17	2	0.9205
S2.F8.P3.150to450msLat.ms	0.11	2	0.9478
S2.C3.P3.250to500msAmp.mV	1.03	2	0.5990
S2.C3.P3.250to500msLat.ms	2.84	2	0.2423
S2.C4.P3.250to500msAmp.mV	1.66	2	0.4361
S2.C4.P3.250to500msLat.ms	0.35	2	0.8397
S2.P3.P3.250to500msAmp.mV	1.09	2	0.5789
S2.P3.P3.250to500msLat.ms	9.73	2	**0.0077*** *
S2.P4.P3.250to500msAmp.mV	3.56	2	0.1687
S2.P4.P3.250to500msLat.ms	2.50	2	0.2866

Variable Name	**Kruskal-Wallis chi-squared**	**df**	**p-value**
S3.C3.Nc.0to100msAmp.mV	0.90	2	0.6388
S3.C3.Nc.0to100msLat.ms	0.57	2	0.7509
S3.C4.Nc.0to100msAmp.mV	0.28	2	0.8701
S3.C4.Nc.0to100msLat.ms	2.91	2	0.2331
S3.P3.P50.0to60msAmp.mV	3.65	2	0.1612
S3.P3.P50.0to60msLat.ms	3.08	2	0.2139
S3.P4.P50.0to60msAmp.mV	2.53	2	0.2819
S3.P4.P50.0to60msLat.ms	2.91	2	0.2328
S3.FP1.P1.50to180msAmp.mV	1.13	2	0.5689
S3.FP1.P1.50to180msLat.ms	5.01	2	0.0816
S3.FP2.P1.50to180msAmp.mV	1.22	2	0.5428
S3.FP2.P1.50to180msLat.ms	0.27	2	0.8726
S3.F3.P1.50to180msAmp.mV	1.34	2	0.5107
S3.F3.P1.50to180msLat.ms	1.70	2	0.4276
S3.F4.P1.50to180msAmp.mV	0.70	2	0.7035
S3.F4.P1.50to180msLat.ms	0.30	2	0.8606
S3.F7.P1.50to180msAmp.mV	2.73	2	0.2548
S3.F7.P1.50to180msLat.ms	0.44	2	0.8020
S3.F8.P1.50to180msAmp.mV	6.24	2	**0.0441*** *
S3.F8.P1.50to180msLat.ms	4.18	2	0.1235
S3.P3.N1.50to110msAmp.mV	1.20	2	0.5489
S3.P3.N1.50to110msLat.ms	2.48	2	0.2889
S3.P4.N1.50to110msAmp.mV	0.22	2	0.8966

S3.P4.N1.50to110msLat.ms	8.08	2	**0.0176***	*
S3.C3.P1.75to175msAmp.mV	1.40	2	0.4962	
S3.C3.P1.75to175msLat.ms	2.18	2	0.3366	
S3.C4.P1.75to175msAmp.mV	1.03	2	0.5989	
S3.C4.P1.75to175msLat.ms	1.19	2	0.5526	
S3.P3.P2.100to180msAmp.mV	0.09	2	0.9542	
S3.P3.P2.100to180msLat.ms	3.73	2	0.1548	
S3.P4.P2.100to180msAmp.mV	0.23	2	0.8899	
S3.P4.P2.100to180msLat.ms	0.97	2	0.6159	
S3.C3.N2.120to220msAmp.mV	0.73	2	0.6935	
S3.C3.N2.120to220msLat.ms	1.00	2	0.6055	
S3.C4.N2.120to220msAmp.mV	0.24	2	0.8876	
S3.C4.N2.120to220msLat.ms	0.04	2	0.9780	
S3.P3.N2.150to250msAmp.mV	0.40	2	0.8208	
S3.P3.N2.150to250msLat.ms	1.83	2	0.3996	
S3.P4.N2.150to250msAmp.mV	0.92	2	0.6325	
S3.P4.N2.150to250msLat.ms	2.17	2	0.3373	
S3.C3.P3.200to650msAmp.mV	1.34	2	0.5129	
S3.C3.P3.200to650msLat.ms	1.71	2	0.4242	
S3.C4.P3.200to650msAmp.mV	1.49	2	0.4756	
S3.C4.P3.200to650msLat.ms	0.76	2	0.6832	
S3.FP1.P3.200to350msAmp.mV	0.79	2	0.6727	
S3.FP1.P3.200to350msLat.ms	0.49	2	0.7839	
S3.FP2.P3.200to350msAmp.mV	0.21	2	0.9017	
S3.FP2.P3.200to350msLat.ms	0.19	2	0.9091	
S3.F3.P3.200to350msAmp.mV	0.11	2	0.9459	
S3.F3.P3.200to350msLat.ms	7.37	2	**0.0251***	*
S3.F4.P3.200to350msAmp.mV	0.11	2	0.9480	
S3.F4.P3.200to350msLat.ms	0.95	2	0.6218	
S3.F7.P3.200to350msAmp.mV	2.01	2	0.3659	
S3.F7.P3.200to350msLat.ms	0.44	2	0.8026	
S3.F8.P3.200to350msAmp.mV	8.45	2	**0.0146***	*
S3.F8.P3.200to350msLat.ms	0.03	2	0.9872	
S3.FP1.P3.200to400msAmp.mV	0.34	2	0.8443	
S3.FP1.P3.200to400msLat.ms	1.33	2	0.5132	
S3.FP2.P3.200to400msAmp.mV	0.11	2	0.9478	
S3.FP2.P3.200to400msLat.ms	0.68	2	0.7126	
S3.F3.P3.200to400msAmp.mV	0.75	2	0.6863	
S3.F3.P3.200to400msLat.ms	7.42	2	**0.0244***	*
S3.F4.P3.200to400msAmp.mV	0.46	2	0.7958	
S3.F4.P3.200to400msLat.ms	6.60	2	**0.0368***	*
S3.F7.P3.200to400msAmp.mV	1.91	2	0.3850	
S3.F7.P3.200to400msLat.ms	0.44	2	0.8006	
S3.F8.P3.200to400msAmp.mV	7.65	2	**0.0217***	*
S3.F8.P3.200to400msLat.ms	0.03	2	0.9832	
S3.FP1.Wide.200to800msAmp.mV	1.28	2	0.5264	
S3.FP1.Wide.200to800msLat.ms	0.34	2	0.8431	
S3.FP2.Wide.200to800msAmp.mV	0.11	2	0.9445	
S3.FP2.Wide.200to800msLat.ms	1.08	2	0.5835	
S3.F3.Wide.200to800msAmp.mV	2.57	2	0.2767	
S3.F3.Wide.200to800msLat.ms	2.84	2	0.2417	
S3.F4.Wide.200to800msAmp.mV	1.72	2	0.4237	
S3.F4.Wide.200to800msLat.ms	0.00	2	0.9982	
S3.F7.Wide.200to800msAmp.mV	0.10	2	0.9501	
S3.F7.Wide.200to800msLat.ms	2.64	2	0.2669	
S3.F8.Wide.200to800msAmp.mV	2.07	2	0.3553	
S3.F8.Wide.200to800msLat.ms	1.60	2	0.4488	
S3.P3.P3.200to650msAmp.mV	0.30	2	0.8618	
S3.P3.P3.200to650msLat.ms	2.31	2	0.3155	

S3.P4.P3.200to650msAmp.mV	0.31	2	0.8559	
S3.P4.P3.200to650msLat.ms	2.37	2	0.3058	
S3.FP1.LPP.400to800msAmp.mV	1.95	2	0.3771	
S3.FP1.LPP.400to800msLat.ms	0.56	2	0.7573	
S3.FP2.LPP.400to800msAmp.mV	0.24	2	0.8865	
S3.FP2.LPP.400to800msLat.ms	1.56	2	0.4590	
S3.F3.LPP.400to800msAmp.mV	2.58	2	0.2756	
S3.F3.LPP.400to800msLat.ms	0.10	2	0.9503	
S3.F4.LPP.400to800msAmp.mV	1.67	2	0.4349	
S3.F4.LPP.400to800msLat.ms	1.19	2	0.5518	
S3.F7.LPP.400to800msAmp.mV	0.11	2	0.9485	
S3.F7.LPP.400to800msLat.ms	0.43	2	0.8069	
S3.F8.LPP.400to800msAmp.mV	2.11	2	0.3486	
S3.F8.LPP.400to800msLat.ms	1.02	2	0.6001	
Variable Name	**Kruskal-Wallis chi-squared**	**df**	**p-value**	
TrickS.C3.P1.50to150msAmp.mV	4.20	2	0.1227	
TrickS.C3.P1.50to150msLat.ms	3.68	2	0.1589	
TrickS.C4.P1.50to150msAmp.mV	1.63	2	0.4427	
TrickS.C4.P1.50to150msLat.ms	1.73	2	0.4204	
TrickS.P3.N1.50to150msAmp.mV	3.21	2	0.2007	
TrickS.P3.N1.50to150msLat.ms	0.77	2	0.6815	
TrickS.P4.N1.50to150msAmp.mV	8.57	2	**0.0137***	*
TrickS.P4.N1.50to150msLat.ms	9.22	2	**0.0099***	*
TrickS.FP1.P1.75to150msAmp.mV	3.02	2	0.2210	
TrickS.FP1.P1.75to150msLat.ms	3.00	2	0.2232	
TrickS.FP2.P1.75to150msAmp.mV	0.01	2	0.9937	
TrickS.FP2.P1.75to150msLat.ms	3.10	2	0.2119	
TrickS.F3.P1.75to150msAmp.mV	0.80	2	0.6719	
TrickS.F3.P1.75to150msLat.ms	0.91	2	0.6351	
TrickS.F4.P1.75to150msAmp.mV	0.86	2	0.6493	
TrickS.F4.P1.75to150msLat.ms	1.22	2	0.5435	
TrickS.F7.P1.75to150msAmp.mV	1.16	2	0.5611	
TrickS.F7.P1.75to150msLat.ms	1.54	2	0.4636	
TrickS.F8.P1.75to150msAmp.mV	1.59	2	0.4506	
TrickS.F8.P1.75to150msLat.ms	7.16	2	**0.0279***	*
TrickS.FP1.N1.100to200msAmp.mV	5.64	2	0.0596	
TrickS.FP1.N1.100to200msLat.ms	11.23	2	**0.0036***	*
TrickS.FP2.N1.100to200msAmp.mV	0.53	2	0.7677	
TrickS.FP2.N1.100to200msLat.ms	1.66	2	0.4365	
TrickS.F3.N1.100to200msAmp.mV	1.96	2	0.3754	
TrickS.F3.N1.100to200msLat.ms	0.18	2	0.9120	
TrickS.F4.N1.100to200msAmp.mV	0.52	2	0.7724	
TrickS.F4.N1.100to200msLat.ms	0.40	2	0.8202	
TrickS.F7.N1.100to200msAmp.mV	5.01	2	0.0816	
TrickS.F7.N1.100to200msLat.ms	0.47	2	0.7905	
TrickS.F8.N1.100to200msAmp.mV	2.24	2	0.3268	
TrickS.F8.N1.100to200msLat.ms	0.85	2	0.6542	
TrickS.P3.P1.100to200msAmp.mV	4.46	2	0.1076	
TrickS.P3.P1.100to200msLat.ms	1.95	2	0.3771	
TrickS.P4.P1.100to200msAmp.mV	4.48	2	0.1063	
TrickS.P4.P1.100to200msLat.ms	2.63	2	0.2681	
TrickS.P3.N2.150to250msAmp.mV	7.32	2	**0.0256***	*
TrickS.P3.N2.150to250msLat.ms	1.82	2	0.4016	
TrickS.P4.N2.150to250msAmp.mV	5.42	2	0.0665	
TrickS.P4.N2.150to250msLat.ms	1.91	2	0.3855	
TrickS.C3.P2.175to300msAmp.mV	9.17	2	**0.0102***	*
TrickS.C3.P2.175to300msLat.ms	1.22	2	0.5442	
TrickS.C4.P2.175to300msAmp.mV	2.92	2	0.2327	

TrickS.C4.P2.175to300msLat.ms	1.70	2	0.4267	
TrickS.FP1.P3.200to450msAmp.mV	7.23	2	**0.0269***	*
TrickS.FP1.P3.200to450msLat.ms	0.58	2	0.7475	
TrickS.FP2.P3.200to450msAmp.mV	0.02	2	0.9908	
TrickS.FP2.P3.200to450msLat.ms	8.97	2	**0.0112***	*
TrickS.F3.P3.200to450msAmp.mV	0.44	2	0.8013	
TrickS.F3.P3.200to450msLat.ms	1.60	2	0.4496	
TrickS.F4.P3.200to450msAmp.mV	2.18	2	0.3369	
TrickS.F4.P3.200to450msLat.ms	11.70	2	**0.0028***	*
TrickS.F7.P3.200to450msAmp.mV	2.73	2	0.2550	
TrickS.F7.P3.200to450msLat.ms	0.83	2	0.6603	
TrickS.F8.P3.200to450msAmp.mV	0.79	2	0.6749	
TrickS.F8.P3.200to450msLat.ms	0.02	2	0.9901	
TrickS.P3.P2.200to300msAmp.mV	4.84	2	0.0890	
TrickS.P3.P2.200to300msLat.ms	2.85	2	0.2411	
TrickS.P4.P2.200to300msAmp.mV	7.24	2	**0.0268***	*
TrickS.P4.P2.200to300msLat.ms	1.05	2	0.5901	
TrickS.P3.N3.250to375msAmp.mV	5.83	2	0.0541	
TrickS.P3.N3.250to375msLat.ms	0.23	2	0.8908	
TrickS.P4.N3.250to375msAmp.mV	11.87	2	**0.0026***	*
TrickS.P4.N3.250to375msLat.ms	0.80	2	0.6717	
TrickS.C3.P3.300to600msAmp.mV	7.69	2	**0.0214***	*
TrickS.C3.P3.300to600msLat.ms	1.16	2	0.5593	
TrickS.C4.P3.300to600msAmp.mV	4.94	2	0.0844	
TrickS.C4.P3.300to600msLat.ms	1.99	2	0.3696	
TrickS.P3.P3.300to650msAmp.mV	5.57	2	0.0616	
TrickS.P3.P3.300to650msLat.ms	0.93	2	0.6281	
TrickS.P4.P3.300to650msAmp.mV	9.36	2	**0.0092***	*
TrickS.P4.P3.300to650msLat.ms	3.40	2	0.1831	

Significant Kruskal Wallis Tests Only, including non-parametric multiple comparisons. Variable Names are dot separated in the order: Stimulus; Electrode Position; Component Name; Component; Time Window; followed by either Amp(Amplitude) .mV(Unit for Amplitude), OR, Lat(Latency) .ms(Unit for latency). * indicates $p < 0.05$.

D.1.3 All significant Kruskal Wallis tests followed by post hoc Non-parametric multiple comparisons

		Descriptive Statistics												Kruskal-Wallis Main Effects			Non-parametric multiple comparisons					
		CON				MAP				SCZ							CON vs MAP		CON vs SCZ		MAP vs SCZ	
Variable Number	Name	N	Median	Min	Max	N	Median	Min	Max	N	Median	Min	Max	Chi-squared	df	p-value	Statistic	p-value	Statistic	p-value	Statistic	p-value
70	S3.RT	32	206.5	84	393	23	254	105	418	26	310	0	465	6.5458	2	0.0379 *	1.73656	0.20692	2.29792	0.06972	0.99262	0.59825
71	S3.Response	32	57	14	60	23	41	11	58	26	37.5	0	60	15.073	2	0.00053 *	**-3.86918**	**0.0008** *	**-3.64749**	**0.00219** *	-1.09587	0.53967
72	S3.Omit	32	3	0	46	23	19	2	49	26	22.5	0	60	15.073	2	0.00053 *	**3.86918**	**0.00081** *	**3.64749**	**0.00155** *	1.09587	0.53959
73	NonT.Response	32	0	0	19	23	4	0	32	26	6.5	0	48	17.746	2	0.00014 *	**4.36295**	**0.00019** *	**4.16512**	**0.00037** *	0.5763	0.86345
77	A.Total.Correct	30	56.5	16	60	24	36.5	13	58	24	31	0	60	18.206	2	0.00011 *	**-4.87918**	**<0.0001** *	**-4.02761**	**6.13E-04** *	-0.98658	6.11E-01
78	A.S3.Delayed.Response	30	1	0	28	24	5	0	41	24	9.5	0	47	13.683	2	0.00107 *	**3.63055**	**0.00224** *	**3.49347**	**0.00299** *	0.60718	0.84556
79	A.S3.Delayed.RT	30	587.2	0	796.55	24	707.96	0	957.2	24	752.93	0	1088.68	12.003	2	0.00248 *	**3.00758**	**0.01273** *	**3.44986**	**0.00418** *	0.90199	0.65635
80	A.S2.Responses	30	0	0	28	24	3.5	0	44	24	5	0	33	7.6106	2	0.02225 *	**2.92604**	**0.0145** *	1.96735	0.13351	-0.69261	0.77993
81	A.Omissions	30	0	0	24	24	0	0	21	24	3	0	33	12.147	2	0.0023 *	0.98935	0.60004	**4.03961**	**0.00053** *	2.19415	0.08496
83	A.S3.RT	32	222.5	84	516	24	291	105	676	25	388	61	1089	13.815	2	0.001 *	**2.76294**	**0.02407** *	**3.87835**	**0.00126** *	1.26419	0.43373
88	S1.F3.P50.0to100msAmp.mV	29	1.25	-1.09	3.34	22	1.22	-1.49	4.46	23	2.17	0	5.38	6.1417	2	0.04638 *	0.16584	0.99145	**2.54083**	**0.03896** *	2.04539	0.11463
92	S1.F7.P50.0to100msAmp.mV	29	0.78	-0.8	3.08	22	0.71	-1.8	4.29	24	1.94	-0.32	5.09	10.008	2	0.00671 *	-0.78385	0.72848	**3.09743**	**0.01045** *	**2.92479**	**0.01613** *
110	S1.Fp2.N1.75to200msAmp.mV	25	-1.53	-4.33	1.98	20	-2.59	-8.38	3.99	21	-0.39	-4.37	2.05	6.8857	2	0.03197 *	-1.64484	0.24463	1.36479	0.37474	**2.6468**	**0.03502** *
150	S1.F4.P2.150to400msAmp.mV	29	2.37	-0.7	11.01	22	1.26	-0.99	6.78	22	3.7	-0.69	6.81	6.7399	2	0.03439 *	-2.24575	0.07724	0.68113	0.79543	**2.50661**	**0.04269** *
166	S1.C4.P3.300to550.msAmp.mV	29	1.84	-1.68	5.37	22	0.84	-4.18	4.88	24	2.91	-1.74	11.69	8.3638	2	0.01527 *	-1.06843	0.54234	2.15092	0.09176	**3.16744**	**0.00853** *
172	S2.C3.Nc.0to100msAmp.mV	29	-2.88	-6.16	0.59	22	-1.5	-4.67	2.11	24	-1.47	-5.84	2.17	8.0441	2	0.01792 *	**2.83142**	**0.02025** *	2.1589	0.09333	-0.52249	0.88572
229	S2.P3.P3.250to500msLat.ms	29	372	258	492	22	352	250	488	24	437	250	500	9.7267	2	0.00773 *	-1.33091	0.38687	2.29118	0.06923	**3.24027**	**0.00751** *
250	S3.F8.P1.50to180msAmp.mV	29	1.03	-1.23	6.48	22	1.81	-1.59	13.14	23	2.84	-5.08	8.09	6.2439	2	0.04407 *	1.52372	0.30233	2.42563	0.05351	0.76355	0.75944
255	S3.P4.N1.50to110msLat.ms	29	72	50	110	22	75	50	110	23	90	50	110	8.0812	2	0.01759 *	0.52051	0.8854	**2.79115**	**0.02135** *	**2.57257**	**0.03619** *
281	S3.F3.P3.200to350msLat.ms	29	302	200	350	22	289	200	350	23	260	200	350	7.3658	2	0.02515 *	-1.08091	0.54334	**-2.83492**	**0.01877** *	-1.7606	0.19839
286	S3.F8.P3.200to350msAmp.mV	29	1.41	-1.6	10.66	22	2.5	-1.6	19.18	23	3.39	-6.03	8.34	8.4457	2	0.01466 *	1.58034	0.27792	**3.13962**	**0.00856** *	1.03972	0.586
293	S3.F3.P3.200to400msLat.ms	29	330	200	400	22	311	200	400	23	276	200	400	7.4229	2	0.02444 *	-1.4559	0.32955	**-2.84685**	**0.01858** *	-1.36386	0.37739
295	S3.F4.P3.200to400msLat.ms	29	378	200	400	22	323	204	400	22	288	200	400	6.6013	2	0.03686 *	-1.85594	0.16787	**-2.55037**	**0.03976** *	-0.96235	0.61559
298	S3.F8.P3.200to400msAmp.mV	29	1.71	-1.33	10.66	22	2.51	-1	19.18	23	4.15	-6.03	9.19	7.6543	2	0.02177 *	1.35882	0.38765	**2.9788**	**0.01409** *	1.17523	0.49626
334	TrickS.P4.N1.50to150msAmp.mV	29	-2.24	-6.89	1.62	22	-1.01	-5.24	2.56	24	-2.71	-7.52	3.15	8.5703	2	0.01377 *	2.35525	0.06088	-0.98384	0.61062	**-2.93327**	**0.01509** *
335	TrickS.P4.N1.50to150msLat.ms	29	80	50	150	22	63	50	106	24	90	50	138	9.2249	2	0.00993 *	-1.97431	0.13573	1.50019	0.30568	**3.28058**	**0.00706** *
347	TrickS.F8.P1.75to150msLat.ms	28	94	74	150	22	107	80	150	24	112	74	150	7.1552	2	0.02794 *	**2.77935**	**0.02131** *	2.15661	0.09149	-0.39988	0.92831
349	TrickS.FP1.N1.100to200msLat.ms	29	150	100	200	21	132	100	164	23	148	128	200	11.225	2	0.00365 *	**-2.87309**	**0.01846** *	0.6755	0.8001	**4.17302**	**0.00045** *
364	TrickS.P3.N2.150to250msAmp.mV	29	-0.7	-4.51	4.73	22	0.3	-1.81	3.74	24	-1.3	-6.91	6.72	7.3244	2	0.02568 *	2.34169	0.0625	-0.44107	0.91937	**-2.86999**	**0.01774** *
368	TrickS.C3.P2.175to300msAmp.mV	29	1.47	-0.96	6.94	22	3.16	0.28	10.32	24	1.89	-1.78	10.13	9.1696	2	0.01021 *	**2.99993**	**0.01278** *	-0.49784	0.90244	**-2.96076**	**0.01453** *
372	TrickS.FP1.P3.200to450msAmp.mV	29	4.15	-1.62	12.12	21	5.07	-0.19	10.95	23	1.82	-3.1	12.65	7.2257	2	0.02698 *	1.60339	0.25871	-1.47809	0.31447	**-2.91118**	**0.01597** *
375	TrickS.FP2.P3.200to450msLat.ms	29	292	230	450	21	336	208	450	23	338	236	414	8.9726	2	0.01126 *	2.16912	0.09429	**3.25063**	**0.00826** *	-0.13128	0.99721
379	TrickS.F4.P3.200to450msLat.ms	29	278	216	450	21	316	200	450	24	349	208	444	11.695	2	0.00289 *	**2.76949**	**0.02291** *	**3.36515**	**0.00483** *	0.7652	0.76551
386	TrickS.P4.P2.200to300msAmp.mV	29	3.24	-2.75	7.95	22	5.23	0.56	9.71	24	2.61	-1.56	12.43	7.2386	2	0.0268 *	**2.98637**	**0.01343** *	0.38458	0.94435	-2.04578	0.11661
390	TrickS.P4.N3.250to375msAmp.mV	29	-1.5	-9.72	1.99	22	-0.09	-3.43	4.76	24	-1.71	-11.35	4.65	11.874	2	0.00264 *	**3.9673**	**0.00113** *	0.2093	0.98997	**-2.97518**	**0.01338** *
392	TrickS.C3.P3.300to600msAmp.mV	29	2.09	-4.11	6.38	22	3.78	-1.05	11.61	24	2.28	-1.8	13.09	7.6871	2	0.02142 *	**3.06002**	**0.01078** *	0.74586	0.76146	-2.0126	0.12497
398	TrickS.P4.P3.300to650msAmp.mV	29	2.84	-2.56	10.88	22	5.75	-0.57	11.52	24	3.63	-2.06	11.3	9.3638	2	0.00926 *	**3.58703**	**0.0024** *	1.12723	0.51941	-1.61072	0.2601

D.2 Potential Confounding Factors

D.2.1 Spearman Correlations of continuous variables for 3 groups

	Age on Day of Testing		Years at School		Years of Tertiary Education		Total Years of Education		Weight		BMI	
Measures	Spearma n's rho	p-values	Spearma n's rho	p-values	Spearma n's rho	p-values	Spearma n's rho	p-values	Spearma n's rho	p-values	Spearma n's rho	p-values
S3.RT	0.0675	0.5495	-0.0267	0.8131	-0.0353	0.7546	-0.0471	0.6760	0.3399	0.0019 *	0.3289	0.0027 *
S3.Response	0.0853	0.4490	0.3506	0.0013 *	0.3257	0.0030 *	0.3963	0.0003 *	-0.1426	0.2042	-0.2121	0.0574
S3.Omit	-0.0853	0.4490	-0.3506	0.0013 *	-0.3257	0.0030 *	-0.3963	0.0003 *	0.1426	0.2042	0.2121	0.0574
NonT.Response	-0.0146	0.8973	-0.1857	0.0970	-0.2261	0.0424 *	-0.2513	0.0236 *	0.1978	0.0767	0.2630	0.0177 *
TrickS.Response	-0.0531	0.6380	-0.1044	0.3536	-0.0618	0.5839	-0.1004	0.3727	0.2294	0.0394 *	0.2591	0.0195 *
S1.Response	-0.0496	0.6603	-0.1963	0.0790	-0.1477	0.1883	-0.2120	0.0574	0.0476	0.6733	0.0599	0.5956
S2.Response	-0.1118	0.3204	-0.2364	0.0336 *	-0.1727	0.1232	-0.2405	0.0305 *	-0.0129	0.9086	0.0557	0.6213
A.Total.Correct	0.0395	0.7311	0.3696	0.0009 *	0.3511	0.0016 *	0.4087	0.0002 *	-0.1498	0.1905	-0.2377	0.0361 *
A.S3.Delayed.Response	0.0220	0.8482	-0.1668	0.1444	-0.2335	0.0397 *	-0.2400	0.0343 *	0.1464	0.2008	0.2116	0.0629
A.S3.Delayed.RT	0.1108	0.3342	-0.2296	0.0431 *	-0.1399	0.2219	-0.2219	0.0509	0.2168	0.0566	0.2538	0.0250 *
A.S2.Responses	-0.0620	0.5896	-0.3440	0.0020 *	-0.2215	0.0513	-0.3225	0.0040 *	0.0629	0.5842	0.1195	0.2975
A.Omissions	0.0396	0.7304	-0.2669	0.0182 *	-0.1992	0.0804	-0.2896	0.0101 *	0.3169	0.0047 *	0.3000	0.0076 *
A.TrickS.Responses	0.0114	0.9213	-0.3517	0.0016 *	-0.2252	0.0474 *	-0.3475	0.0018 *	0.2017	0.0766	0.2426	0.0324 *
A.S3.RT	0.1400	0.2125	-0.2324	0.0368 *	-0.1705	0.1281	-0.2447	0.0277 *	0.2516	0.0235 *	0.2972	0.0070 *

	Age on Day of Testing		Years at School		Years of Tertiary Education		Total Years of Education		Weight		BMI	
Measures	Spearma n's rho	p-values	Spearma n's rho	p-values	Spearma n's rho	p-values	Spearma n's rho	p-values	Spearma n's rho	p-values	Spearma n's rho	p-values
S1.FP1.P50.0to100ms.Amp.mV.	0.1128	0.3711	0.0293	0.8170	0.1910	0.1275	0.1384	0.2717	0.0513	0.6847	0.0351	0.7809
S1.FP1.P50.0to100ms.Lat.ms.	0.0985	0.4350	-0.0421	0.7394	0.0797	0.5279	-0.0138	0.9133	-0.0097	0.9391	0.1137	0.3674
S1.FP2.P50.0to100ms.Amp.mV.	-0.0887	0.4822	0.1024	0.4168	-0.0095	0.9402	0.0549	0.6642	-0.1341	0.2867	-0.2094	0.0941
S1.FP2.P50.0to100ms.Lat.ms.	-0.1844	0.1447	0.1880	0.1368	0.1462	0.2492	0.1750	0.1667	-0.1123	0.3769	-0.0500	0.6945
S1.F3.P50.0to100ms.Amp.mV.	0.0726	0.5385	0.1295	0.2713	0.0717	0.5439	0.1302	0.2690	-0.0245	0.8357	0.0393	0.7387
S1.F3.P50.0to100ms.Lat.ms.	-0.0559	0.6362	0.1013	0.3904	0.0054	0.9633	0.0610	0.6055	-0.1031	0.3820	0.0007	0.9954
S1.F4.P50.0to100ms.Amp.mV.	0.0035	0.9767	0.1432	0.2270	0.0501	0.6735	0.1194	0.3142	0.1008	0.3962	0.1479	0.2113
S1.F4.P50.0to100ms.Lat.ms.	0.0503	0.6725	-0.0492	0.6795	0.0344	0.7728	0.0141	0.9056	-0.0887	0.4554	-0.0267	0.8226
S1.F7.P50.0to100ms.Amp.mV.	0.1337	0.2529	0.0348	0.7668	0.1016	0.3857	0.0638	0.5868	0.2613	0.0236 *	0.2751	0.0172 *
S1.F7.P50.0to100ms.Lat.ms.	0.1066	0.3626	0.0958	0.4136	0.0814	0.4878	0.1053	0.3688	-0.0028	0.9807	0.0160	0.8913
S1.F8.P50.0to100ms.Amp.mV.	0.0347	0.7692	-0.0899	0.4460	-0.0047	0.9680	-0.0519	0.6608	0.1906	0.1038	0.1807	0.1233
S1.F8.P50.0to100ms.Lat.ms.	-0.2107	0.0716	-0.0010	0.9933	-0.0834	0.4801	-0.0431	0.7156	-0.0452	0.7021	0.0203	0.8634
S1.P3.Nc.0to100ms.Amp.mV.	0.2594	0.0246 *	-0.0420	0.7205	-0.0592	0.6137	-0.0938	0.4236	-0.2674	0.0204 *	-0.2366	0.0412 *
S1.P3.Nc.0to100ms.Lat.ms.	-0.0515	0.6606	-0.0268	0.8193	0.0360	0.7593	0.0404	0.7307	0.0510	0.6636	0.0633	0.5897
S1.P4.Nc.0to100ms.Amp.mV.	0.2385	0.0407 *	0.1586	0.1771	0.0346	0.7695	0.0865	0.4638	-0.2299	0.0488 *	-0.1625	0.1662
S1.P4.Nc.0to100ms.Lat.ms.	-0.0126	0.9151	-0.1714	0.1442	-0.0657	0.5784	-0.0931	0.4302	-0.0712	0.5468	-0.0823	0.4855
S1.C3.P1.50to140ms.Amp.mV.	0.1130	0.3343	0.1257	0.2824	-0.0253	0.8296	0.0453	0.6994	-0.1615	0.1662	-0.0828	0.4793
S1.C3.P1.50to140ms.Lat.ms.	-0.0949	0.4181	0.0727	0.5355	0.0182	0.8766	0.0682	0.5613	0.0478	0.6837	-0.0505	0.6671
S1.C4.P1.50to140ms.Amp.mV.	0.1007	0.3899	0.2225	0.0550	0.0632	0.5902	0.1584	0.1748	-0.1401	0.2307	-0.0611	0.6016
S1.C4.P1.50to140ms.Lat.ms.	-0.1100	0.3473	0.2799	0.0150 *	0.1840	0.1141	0.2819	0.0143 *	-0.0818	0.4855	-0.1404	0.2296
S1.P3.P1.50to150ms.Amp.mV.	0.0756	0.5191	0.1846	0.1129	0.0478	0.6837	0.1190	0.3093	-0.3503	0.0021 *	-0.2516	0.0297 *
S1.P3.P1.50to150ms.Lat.ms.	0.0571	0.6264	-0.0462	0.6937	0.1589	0.1733	0.0907	0.4392	0.0703	0.5491	0.0896	0.4446
S1.P4.P1.50to150ms.Amp.mV.	0.0703	0.5516	0.3016	0.0090 *	0.0771	0.5139	0.2045	0.0804	-0.2039	0.0815	-0.1539	0.1899
S1.P4.P1.50to150ms.Lat.ms.	0.0563	0.6336	-0.0062	0.9582	0.1245	0.2904	0.0780	0.5090	0.0313	0.7912	0.0775	0.5115
S1.Fp1.N1.75to200ms.Amp.mV.	0.1864	0.1340	-0.0353	0.7786	0.2010	0.1056	0.1009	0.4203	0.1416	0.2566	0.1334	0.2850
S1.Fp1.N1.75to200ms.Lat.ms.	-0.0354	0.7778	-0.0994	0.4271	-0.0359	0.7745	-0.1116	0.3724	0.0874	0.4855	0.0506	0.6864
S1.Fp2.N1.75to200ms.Amp.mV.	0.1253	0.3161	0.0465	0.7108	0.0930	0.4576	0.0753	0.5482	0.0039	0.9754	-0.0388	0.7563
S1.Fp2.N1.75to200ms.Lat.ms.	-0.2065	0.0962	-0.0299	0.8116	0.1137	0.3635	0.0398	0.7510	0.1533	0.2190	0.1279	0.3063
S1.F3.N1.75to200ms.Amp.mV.	0.0325	0.7832	0.0177	0.8813	-0.0269	0.8203	0.0138	0.9071	-0.2074	0.0762	-0.1278	0.2774
S1.F3.N1.75to200ms.Lat.ms.	0.0687	0.5608	0.0023	0.9843	0.1538	0.1907	0.1034	0.3807	0.2975	0.0101 *	0.2102	0.0723
S1.F4.N1.75to200ms.Amp.mV.	0.0926	0.4356	-0.0466	0.6955	0.0602	0.6127	0.0378	0.7505	0.1050	0.3765	0.1309	0.2690
S1.F4.N1.75to200ms.Lat.ms.	-0.0391	0.7424	-0.0018	0.9882	0.1186	0.3177	0.0432	0.7168	0.1585	0.1805	0.1808	0.1259
S1.F7.N1.75to200ms.Amp.mV.	0.0786	0.5029	0.0029	0.9804	0.0389	0.7403	0.0059	0.9602	0.0974	0.4060	0.1535	0.1883
S1.F7.N1.75to200ms.Lat.ms.	0.0563	0.6313	-0.1809	0.1205	-0.1017	0.3853	-0.1541	0.1869	0.1476	0.2064	0.0652	0.5786
S1.F8.N1.75to200ms.Amp.mV.	-0.1120	0.3421	-0.0834	0.4801	0.0066	0.9553	-0.0217	0.8546	0.0432	0.7146	0.0864	0.4633
S1.F8.N1.75to200ms.Lat.ms.	0.1768	0.1319	-0.0530	0.6538	0.2193	0.0605	0.0568	0.6310	-0.0204	0.8627	0.0075	0.9493
S1.C3.N1.100to150ms.Amp.mV.	0.1164	0.3199	0.1231	0.2926	0.0621	0.5964	0.0973	0.4062	-0.1980	0.0886	-0.1259	0.2812
S1.C3.N1.100to150ms.Lat.ms.	-0.1616	0.1661	0.0952	0.4167	-0.0289	0.8054	0.0559	0.6340	-0.0764	0.5150	-0.0675	0.5650
S1.C4.N1.100to150ms.Amp.mV.	0.1706	0.1434	0.1214	0.2994	0.1844	0.1132	0.1683	0.1489	-0.0894	0.4454	-0.0498	0.6710
S1.C4.N1.100to150ms.Lat.ms.	-0.1109	0.3436	0.0209	0.8586	0.0542	0.6443	0.0387	0.7418	-0.2116	0.0684	-0.1908	0.1011
S1.P3.N1.120to180ms.Amp.mV.	0.0533	0.6495	0.0417	0.7222	0.1026	0.3811	0.0760	0.5172	-0.2295	0.0476 *	-0.1516	0.1939
S1.P3.N1.120to180ms.Lat.ms.	-0.0940	0.4222	0.2515	0.0295 *	0.2424	0.0361 *	0.2779	0.0158 *	0.1178	0.3141	0.0717	0.5407
S1.P4.N1.120to180ms.Amp.mV.	0.0307	0.7950	0.0908	0.4415	-0.0127	0.9146	0.0387	0.7433	-0.1758	0.1340	-0.0819	0.4870
S1.P4.N1.120to180ms.Lat.ms.	-0.0530	0.6539	0.1334	0.2573	0.2077	0.0758	0.2083	0.0749	0.0108	0.9273	-0.0518	0.6614
S1.C3.P2.150to300ms.Amp.mV.	0.0429	0.7145	0.1020	0.3837	0.0357	0.7614	0.0768	0.5126	-0.0178	0.8793	0.0300	0.7980
S1.C3.P2.150to300ms.Lat.ms.	0.1001	0.3930	-0.1041	0.3739	0.0283	0.8094	-0.0293	0.8029	0.1051	0.3696	0.1013	0.3871
S1.C4.P2.150to300ms.Amp.mV.	0.1582	0.1753	0.2088	0.0722	0.1012	0.3875	0.1673	0.1513	0.1337	0.2529	0.1436	0.2187
S1.C4.P2.150to300ms.Lat.ms.	-0.0888	0.4486	-0.0933	0.4261	-0.1214	0.2997	-0.1420	0.2242	0.1140	0.3301	0.0946	0.4193
S1.FP1.P2.150to350ms.Amp.mV.	0.3332	0.0067 *	0.0737	0.5595	0.1493	0.2351	0.1413	0.2616	-0.0262	0.8358	-0.0167	0.8945
S1.FP1.P2.150to350ms.Lat.ms.	0.0831	0.5103	0.0654	0.6045	-0.0772	0.5410	0.0311	0.8054	0.0319	0.8011	-0.1493	0.2351
S1.FP2.P2.150to350ms.Amp.mV.	0.2901	0.0191 *	-0.0200	0.8745	0.0632	0.6171	0.0027	0.9828	-0.0686	0.5869	-0.0948	0.4518
S1.FP2.P2.150to350ms.Lat.ms.	0.0348	0.7831	-0.0264	0.8344	-0.0077	0.9517	0.0156	0.9021	0.1179	0.3497	0.0124	0.9221
S1.F3.P2.150to350ms.Amp.mV.	0.0374	0.7515	0.0949	0.4212	-0.0820	0.4871	-0.0108	0.9273	-0.2839	0.0143 *	-0.2148	0.0662
S1.F3.P2.150to350ms.Lat.ms.	-0.1309	0.2664	-0.0047	0.9683	-0.1495	0.2035	-0.0804	0.4960	-0.0881	0.4556	-0.0526	0.6565
S1.F4.P2.150to350ms.Amp.mV.	0.1589	0.1792	0.1204	0.3101	0.0076	0.9489	0.0843	0.4783	-0.0056	0.9623	0.0216	0.8556
S1.F4.P2.150to350ms.Lat.ms.	0.0535	0.6528	-0.1299	0.2735	-0.3470	0.0026 *	-0.2783	0.0171 *	-0.1081	0.3626	-0.0240	0.8401
S1.F7.P2.150to350ms.Amp.mV.	0.0980	0.4027	0.0786	0.5026	0.0800	0.4952	0.0678	0.5630	-0.0044	0.9703	-0.0418	0.7209
S1.F7.P2.150to350ms.Lat.ms.	0.0573	0.6254	-0.0814	0.4874	-0.0314	0.7888	-0.0278	0.8127	0.0842	0.4724	0.0842	0.4724
S1.F8.P2.150to350ms.Amp.mV.	-0.0647	0.5840	-0.0239	0.8397	-0.1616	0.1689	-0.0743	0.5293	0.0740	0.5312	-0.0112	0.9244
S1.F8.P2.150to350ms.Lat.ms.	0.1762	0.1332	0.0311	0.7925	-0.1689	0.1502	-0.0534	0.6515	0.0936	0.4277	0.0761	0.5194
S1.FP1.P2.150to400ms.Amp.mV.	0.3385	0.0058 *	0.0664	0.5995	0.1457	0.2469	0.1387	0.2707	-0.0414	0.7436	-0.0428	0.7345
S1.FP1.P2.150to400ms.Lat.ms.	0.0407	0.7476	0.0061	0.9617	-0.1350	0.2835	-0.0362	0.7747	-0.0472	0.7086	-0.1705	0.1746
S1.FP2.P2.150to400ms.Amp.mV.	0.2940	0.0175 *	-0.0073	0.9542	0.1028	0.4153	0.0287	0.8203	-0.0602	0.6339	-0.0807	0.5217
S1.FP2.P2.150to400ms.Lat.ms.	-0.0241	0.8488	-0.0277	0.8267	-0.0483	0.7025	-0.0169	0.8937	0.0854	0.4989	0.0379	0.7646
S1.F3.P2.150to400ms.Amp.mV.	0.0212	0.8577	0.1409	0.2312	-0.0127	0.9144	0.0526	0.6561	-0.2809	0.0154 *	-0.2115	0.0705

S1.F3.P2.150to400ms.Lat.ms.	-0.1351	0.2511	0.1434	0.2230	-0.0053	0.9640	0.0826	0.4841	-0.0182	0.8777	0.0067	0.9549
S1.F4.P2.150to400ms.Amp.mV.	0.1746	0.1395	0.1478	0.2122	0.0411	0.7297	0.1155	0.3306	0.0127	0.9151	0.0406	0.7327
S1.F4.P2.150to400ms.Lat.ms.	0.0906	0.4460	-0.0318	0.7892	-0.1995	0.0906	-0.1492	0.2078	-0.0759	0.5232	0.0384	0.7473
S1.F7.P2.150to400ms.Amp.mV.	0.1012	0.3878	0.1060	0.3652	0.1360	0.2446	0.1214	0.2995	0.0122	0.9169	-0.0354	0.7624
S1.F7.P2.150to400ms.Lat.ms.	0.0001	0.9993	-0.0783	0.5044	-0.0056	0.9621	-0.0105	0.9285	0.0705	0.5479	0.0022	0.9851
S1.F8.P2.150to400ms.Amp.mV.	-0.0430	0.7160	-0.0157	0.8947	-0.1555	0.1858	-0.0710	0.5476	0.0799	0.4986	0.0037	0.9748
S1.F8.P2.150to400ms.Lat.ms.	0.1451	0.2175	0.0038	0.9742	-0.1803	0.1242	-0.0879	0.4563	0.1246	0.2903	0.1322	0.2616
S1.P3.P2.150to250ms.Amp.mV.	0.0741	0.5275	0.0795	0.4978	0.0314	0.7891	0.0509	0.6644	-0.0198	0.8659	0.0623	0.5947
S1.P3.P2.150to250ms.Lat.ms.	0.0279	0.8119	-0.0262	0.8233	-0.0005	0.9965	-0.0173	0.8828	0.2078	0.0736	0.1405	0.2294
S1.P4.P2.150to250ms.Amp.mV.	0.1458	0.2152	0.2201	0.0596	0.1054	0.3716	0.1715	0.1440	0.0752	0.5242	0.1517	0.1966
S1.P4.P2.150to250ms.Lat.ms.	-0.0084	0.9434	-0.0848	0.4724	-0.0552	0.6401	-0.0891	0.4505	0.2065	0.0775	0.1731	0.1401
S1.P3.N2.200to350ms.Amp.mV.	-0.0007	0.9954	-0.0008	0.9945	-0.0127	0.9138	-0.0227	0.8470	-0.0285	0.8085	0.0428	0.7146
S1.P3.N2.200to350ms.Lat.ms.	0.0800	0.4949	-0.0848	0.4696	-0.0986	0.4000	-0.1074	0.3591	-0.1505	0.1976	-0.1343	0.2507
S1.P4.N2.200to350ms.Amp.mV.	-0.0026	0.9823	0.1322	0.2615	-0.0415	0.7254	0.0367	0.7562	0.0169	0.8861	0.0943	0.4234
S1.P4.N2.200to350ms.Lat.ms.	0.1432	0.2236	0.0029	0.9805	0.1802	0.1245	0.0797	0.4996	-0.2368	0.0423 *	-0.2069	0.0769
S1.C3.P3.300to550.ms.Amp.mV.	0.0175	0.8814	-0.0183	0.8759	0.0655	0.5763	0.0204	0.8623	0.1204	0.3036	0.1934	0.0964
S1.C3.P3.300to550.ms.Lat.ms.	-0.1027	0.3807	0.0109	0.9262	0.0439	0.7084	0.0312	0.7905	0.0977	0.4042	0.0785	0.5033
S1.C4.P3.300to550.ms.Amp.mV.	0.0294	0.8021	0.0732	0.5327	0.1013	0.3870	0.0757	0.5184	0.3201	0.0051 *	0.3403	0.0030 *
S1.C4.P3.300to550.ms.Lat.ms.	-0.0378	0.7476	0.0610	0.6032	0.1186	0.3110	0.0852	0.4673	-0.0085	0.9423	-0.0579	0.6216
S1.P3.P3.300to550ms.Amp.mV.	-0.0724	0.5368	0.0385	0.7430	0.1624	0.1639	0.1050	0.3701	0.1031	0.3786	0.1728	0.1381
S1.P3.P3.300to550ms.Lat.ms.	-0.0717	0.5408	-0.1094	0.3502	0.0695	0.5534	-0.0333	0.7764	0.2970	0.0097 *	0.1552	0.1837
S1.P4.P3.300to550ms.Amp.mV.	-0.0024	0.9835	0.1833	0.1180	0.1391	0.2371	0.1620	0.1679	0.2380	0.0412 *	0.2881	0.0131 *
S1.P4.P3.300to550ms.Lat.ms.	-0.0487	0.6800	-0.1010	0.3917	0.1567	0.1824	0.0276	0.8151	0.1645	0.1613	0.1449	0.2181

	Age on Day of Testing		Years at School		Years of Tertiary Education		Total Years of Education		Weight		BMI	
Measures	Spearma n's rho	p-values	Spearma n's rho	p-values	Spearma n's rho	p-values	Spearma n's rho	p-values	Spearma n's rho	p-values	Spearma n's rho	p-values
S2.C3.Nc.0to100ms.Amp.mV.	0.2513	0.0297 *	-0.3345	0.0034 *	-0.2277	0.0495 *	-0.3449	0.0024 *	-0.0584	0.6185	-0.1176	0.3143
S2.C3.Nc.0to100ms.Lat.ms.	-0.0085	0.9421	0.1469	0.2084	0.1878	0.1067	0.1828	0.1165	0.0069	0.9530	0.0775	0.5089
S2.C4.Nc.0to100ms.Amp.mV.	0.3103	0.0067 *	-0.2565	0.0263 *	-0.1010	0.3888	-0.2079	0.0734	-0.0889	0.4480	-0.1784	0.1256
S2.C4.Nc.0to100ms.Lat.ms.	-0.2203	0.0576	0.1612	0.1670	0.0861	0.4624	0.1376	0.2390	-0.0658	0.5749	-0.0006	0.9957
S2.FP1.P1.0to150ms.Amp.mV.	0.0606	0.6314	-0.0987	0.4340	-0.1613	0.1992	-0.1427	0.2567	-0.0172	0.8921	0.0121	0.9239
S2.FP1.P1.0to150ms.Lat.ms.	-0.1296	0.3035	0.0551	0.6630	-0.0436	0.7302	0.0342	0.7866	-0.1642	0.1913	-0.2641	0.0335 *
S2.FP2.P1.0to150ms.Amp.mV.	-0.0128	0.9195	-0.1050	0.4052	-0.1786	0.1546	-0.1722	0.1702	-0.0936	0.4581	-0.0596	0.6363
S2.FP2.P1.0to150ms.Lat.ms.	-0.0340	0.7881	0.1881	0.1335	0.0696	0.5820	0.1459	0.2463	-0.0047	0.9703	-0.0513	0.6848
S2.F3.P1.0to150ms.Amp.mV.	0.0868	0.4621	-0.1006	0.3939	-0.0213	0.8570	-0.0788	0.5044	0.0957	0.4171	-0.0225	0.8488
S2.F3.P1.0to150ms.Lat.ms.	-0.0577	0.6252	0.0001	0.9990	-0.0556	0.6381	-0.0499	0.6732	-0.0389	0.7421	-0.2050	0.0798
S2.F4.P1.0to150ms.Amp.mV.	0.1928	0.1021	-0.1413	0.2332	-0.1230	0.2998	-0.1652	0.1624	0.0715	0.5478	0.0105	0.9299
S2.F4.P1.0to150ms.Lat.ms.	0.1198	0.3128	-0.0772	0.5164	-0.1927	0.1023	-0.1655	0.1617	-0.0143	0.9045	-0.1789	0.1300
S2.F7.P1.0to150ms.Amp.mV.	-0.0435	0.7108	-0.1017	0.3851	-0.0864	0.4610	-0.1097	0.3486	-0.0167	0.8866	-0.0929	0.4273
S2.F7.P1.0to150ms.Lat.ms.	-0.0262	0.8232	-0.0920	0.4324	0.0699	0.5514	-0.0073	0.9502	0.0082	0.9445	-0.1376	0.2391
S2.F8.P1.0to150ms.Amp.mV.	0.0525	0.6566	-0.0582	0.6225	-0.0500	0.6722	-0.0855	0.4688	-0.0760	0.5196	-0.1183	0.3145
S2.F8.P1.0to150ms.Lat.ms.	-0.0013	0.9915	-0.1969	0.0926	-0.2340	0.0448 *	-0.2580	0.0265 *	0.0214	0.8562	-0.0231	0.8452
S2.P3.Nc.0to100ms.Amp.mV.	0.2810	0.0146 *	-0.2335	0.0438 *	-0.1642	0.1593	-0.2363	0.0413 *	0.0134	0.9089	-0.0890	0.4467
S2.P3.Nc.0to100ms.Lat.ms.	-0.0906	0.4393	0.1259	0.2816	0.1861	0.1099	0.1655	0.1558	-0.0017	0.9881	0.0695	0.5534
S2.P4.Nc.0to100ms.Amp.mV.	0.2109	0.0713	-0.2002	0.0872	-0.2160	0.0646	-0.2438	0.0364 *	-0.1594	0.1748	-0.1959	0.0943
S2.P4.Nc.0to100ms.Lat.ms.	-0.0524	0.6576	0.0705	0.5505	0.1639	0.1630	0.1233	0.2951	0.0935	0.4283	0.1475	0.2099
S2.FP1.N1.75to200ms.Amp.mV.	-0.0025	0.9845	-0.0992	0.4317	-0.0780	0.5370	-0.1033	0.4127	-0.0044	0.9722	0.0221	0.8612
S2.FP1.N1.75to200ms.Lat.ms.	0.1650	0.1890	0.0726	0.5656	0.2522	0.0427 *	0.2000	0.1102	0.2325	0.0624	0.3623	0.0030 *
S2.FP2.N1.75to200ms.Amp.mV.	-0.0310	0.8063	-0.0693	0.5831	-0.1374	0.2750	-0.1224	0.3315	-0.1702	0.1752	-0.1414	0.2605
S2.FP2.N1.75to200ms.Lat.ms.	0.0074	0.9535	0.0166	0.8958	0.0416	0.7422	0.0489	0.6991	0.1391	0.2690	0.0851	0.5002
S2.F3.N1.75to200ms.Amp.mV.	0.0126	0.9150	-0.1103	0.3495	-0.0890	0.4508	-0.1325	0.2603	-0.0374	0.7514	-0.2209	0.0587
S2.F3.N1.75to200ms.Lat.ms.	0.0435	0.7129	0.1505	0.2006	0.0893	0.4493	0.1716	0.1437	0.0927	0.4324	0.1607	0.1713
S2.F4.N1.75to200ms.Amp.mV.	0.1234	0.2984	-0.1848	0.1176	-0.1779	0.1320	-0.2256	0.0550	-0.0484	0.6846	-0.1703	0.1495
S2.F4.N1.75to200ms.Lat.ms.	-0.1531	0.1961	0.1855	0.1161	0.1764	0.1355	0.2211	0.0601	-0.0737	0.5353	0.0798	0.5021
S2.F7.N1.75to200ms.Amp.mV.	-0.0689	0.5569	-0.0846	0.4704	0.0713	0.5435	-0.0258	0.8259	-0.0495	0.6735	-0.1930	0.0971
S2.F7.N1.75to200ms.Lat.ms.	0.1503	0.1980	0.1570	0.1787	0.1713	0.1417	0.2107	0.0696	0.1366	0.2425	0.3028	0.0083 *
S2.F8.N1.75to200ms.Amp.mV.	-0.0045	0.9699	-0.0273	0.8171	-0.0052	0.9648	-0.0559	0.6361	-0.1667	0.1558	-0.2270	0.0519
S2.F8.N1.75to200ms.Lat.ms.	0.0334	0.7777	0.3114	0.0069 *	0.2855	0.0137 *	0.3622	0.0015 *	0.1012	0.3908	0.1563	0.1836
S2.C3.N2.100to250ms.Amp.mV.	0.2316	0.0456 *	-0.3393	0.0029 *	-0.1448	0.2153	-0.3235	0.0046 *	0.0959	0.4129	-0.0912	0.4359
S2.C3.N2.100to250ms.Lat.ms.	0.0576	0.6234	0.0820	0.4843	0.1670	0.1522	0.1799	0.1224	-0.0186	0.8739	0.0369	0.7533
S2.C4.N2.100to250ms.Amp.mV.	0.3162	0.0057 *	-0.2890	0.0119 *	-0.1062	0.3646	-0.2442	0.0347 *	0.0506	0.6662	-0.0942	0.4207
S2.C4.N2.100to250ms.Lat.ms.	0.0968	0.4085	0.1753	0.1325	0.1972	0.0899	0.2211	0.0566	-0.0794	0.4984	-0.0140	0.9052
S2.P3.N2.100to300ms.Amp.mV.	0.2631	0.0226 *	-0.2408	0.0374 *	-0.1606	0.1686	-0.2521	0.0291 *	0.0009	0.9938	-0.1417	0.2249
S2.P3.N2.100to300ms.Lat.ms.	0.0740	0.5282	0.0013	0.9915	0.0410	0.7270	0.0284	0.8088	0.0495	0.6731	0.0985	0.4005
S2.P4.N2.100to300ms.Amp.mV.	0.2335	0.0453 *	-0.2134	0.0680	-0.1556	0.1856	-0.2252	0.0537	-0.0547	0.6433	-0.1475	0.2092
S2.P4.N2.100to300ms.Lat.ms.	0.0731	0.5362	-0.0043	0.9707	0.0394	0.7386	0.0303	0.7975	-0.0471	0.6903	0.0048	0.9676
S2.FP1.P3.150to450ms.Amp.mV.	-0.1049	0.4058	-0.0156	0.9017	-0.2354	0.0591	-0.1416	0.2605	-0.0155	0.9022	-0.1014	0.4206
S2.FP1.P3.150to450ms.Lat.ms.	-0.0300	0.8124	-0.1033	0.4128	-0.0905	0.4734	-0.1005	0.4259	0.0385	0.7610	0.0481	0.7034
S2.FP2.P3.150to450ms.Amp.mV.	-0.1696	0.1768	-0.0705	0.5770	-0.2726	0.0280 *	-0.2025	0.1057	-0.2042	0.1028	-0.2043	0.1026
S2.FP2.P3.150to450ms.Lat.ms.	0.0188	0.8821	-0.1721	0.1705	-0.1809	0.1493	-0.1911	0.1272	0.0412	0.7445	0.0480	0.7043
S2.F3.P3.150to450ms.Amp.mV.	-0.1031	0.3820	0.0464	0.6945	-0.0517	0.6618	-0.0309	0.7939	0.0392	0.7402	-0.0731	0.5354
S2.F3.P3.150to450ms.Lat.ms.	0.1162	0.3240	-0.0122	0.9177	-0.0014	0.9902	0.0074	0.9503	-0.0068	0.9543	-0.0052	0.9646
S2.F4.P3.150to450ms.Amp.mV.	-0.0530	0.6561	-0.0313	0.7926	-0.0252	0.8321	-0.0722	0.5438	0.0488	0.6815	-0.0507	0.6697
S2.F4.P3.150to450ms.Lat.ms.	-0.0568	0.6331	0.0753	0.5265	0.0948	0.4251	0.0932	0.4328	-0.1779	0.1321	-0.1391	0.2404
S2.F7.P3.150to450ms.Amp.mV.	-0.0019	0.9874	0.0008	0.9945	0.0077	0.9476	-0.0227	0.8465	0.0368	0.7540	-0.0732	0.5316
S2.F7.P3.150to450ms.Lat.ms.	-0.0919	0.4330	0.1214	0.2993	0.1237	0.2903	0.1280	0.2737	-0.0148	0.9000	0.1130	0.3342
S2.F8.P3.150to450ms.Amp.mV.	-0.0092	0.9377	-0.0535	0.6505	-0.0758	0.5212	-0.1133	0.3366	0.0488	0.6797	-0.1312	0.2647
S2.F8.P3.150to450ms.Lat.ms.	0.1330	0.2586	0.0738	0.5321	0.1206	0.3059	0.0730	0.5364	0.0500	0.6725	-0.0784	0.5069
S2.C3.P3.250to500ms.Amp.mV.	-0.0280	0.8116	-0.0981	0.4023	-0.0937	0.4239	-0.1391	0.2340	-0.0489	0.6770	-0.1487	0.2025
S2.C3.P3.250to500ms.Lat.ms.	-0.0036	0.9755	-0.1211	0.3007	-0.0009	0.9939	-0.0656	0.5758	0.0127	0.9137	0.0286	0.8074
S2.C4.P3.250to500ms.Amp.mV.	-0.0560	0.6333	-0.0096	0.9346	-0.0436	0.7102	-0.0410	0.7267	0.0453	0.6996	-0.1312	0.2611
S2.C4.P3.250to500ms.Lat.ms.	-0.1201	0.3047	-0.2084	0.0728	0.0230	0.8447	-0.1213	0.2999	-0.0006	0.9957	-0.0340	0.7724
S2.P3.P3.250to500ms.Amp.mV.	-0.0652	0.5781	0.0155	0.8951	-0.1060	0.3653	-0.0737	0.5298	-0.0336	0.7746	-0.1367	0.2415
S2.P3.P3.250to500ms.Lat.ms.	0.1476	0.2063	-0.1851	0.1118	-0.1154	0.3241	-0.1543	0.1864	0.0235	0.8413	0.0824	0.4820
S2.P4.P3.250to500ms.Amp.mV.	-0.0705	0.5508	0.0338	0.7750	-0.0717	0.5440	-0.0244	0.8363	-0.0748	0.5267	-0.1488	0.2053
S2.P4.P3.250to500ms.Lat.ms.	0.1163	0.3240	-0.1061	0.3685	-0.0277	0.8148	-0.0832	0.4811	0.0910	0.4406	0.1177	0.3178

	Age on Day of Testing	Years at School	Years of Tertiary Education	Total Years of Education	Weight	BMI

Measures	Spearma n's rho	p-values	Spearma n's rho	p-values	Spearma n's rho	p-values	Spearma n's rho	p-values	Spearma n's rho	p-values	Spearma n's rho	p-values
S3.C3.Nc.0to100ms.Amp.mV.	0.0143	0.9031	-0.2506	0.0301 *	0.0328	0.7797	-0.1685	0.1484	0.1416	0.2257	0.0498	0.6708
S3.C3.Nc.0to100ms.Lat.ms.	0.0837	0.4753	0.2989	0.0092 *	0.0227	0.8466	0.1978	0.0889	0.0053	0.9643	0.0026	0.9826
S3.C4.Nc.0to100ms.Amp.mV.	0.1931	0.0970	-0.2656	0.0213 *	-0.0669	0.5685	-0.2281	0.0491 *	0.0717	0.5412	-0.0189	0.8720
S3.C4.Nc.0to100ms.Lat.ms.	-0.0376	0.7489	0.1955	0.0928	0.1341	0.2513	0.1881	0.1060	0.0854	0.4662	0.1613	0.1668
S3.P3.P50.0to60ms.Amp.mV.	0.1469	0.2086	-0.1846	0.1129	0.0126	0.9147	-0.1467	0.2091	0.2575	0.0257 *	0.2423	0.0364 *
S3.P3.P50.0to60ms.Lat.ms.	0.0769	0.5121	-0.2553	0.0270 *	-0.0506	0.6663	-0.1863	0.1094	0.1983	0.0882	0.2498	0.0306 *
S3.P4.P50.0to60ms.Amp.mV.	0.1195	0.3105	-0.2049	0.0799	0.0299	0.8005	-0.1322	0.2616	0.1729	0.1407	0.1630	0.1648
S3.P4.P50.0to60ms.Lat.ms.	0.0692	0.5583	-0.2585	0.0262 *	-0.1487	0.2061	-0.2510	0.0310 *	0.0988	0.4022	0.1061	0.3682
S3.FP1.P1.50to180ms.Amp.mV.	0.0034	0.9789	-0.1773	0.1576	-0.1163	0.3564	-0.1999	0.1104	-0.0494	0.6957	-0.1492	0.2349
S3.FP1.P1.50to180ms.Lat.ms.	0.0108	0.9318	-0.3934	0.0012 *	-0.0759	0.5478	-0.3029	0.0142 *	-0.0922	0.4652	-0.1052	0.4045
S3.FP2.P1.50to180ms.Amp.mV.	0.0091	0.9424	-0.2132	0.0882	-0.1779	0.1563	-0.2439	0.0502	-0.0779	0.5371	-0.0829	0.5107
S3.FP2.P1.50to180ms.Lat.ms.	0.0105	0.9340	-0.1323	0.2935	0.0905	0.4733	-0.0402	0.7504	0.0454	0.7195	0.0724	0.5665
S3.F3.P1.50to180ms.Amp.mV.	-0.0024	0.9835	-0.1387	0.2387	-0.0436	0.7123	-0.1133	0.3367	0.1001	0.3961	-0.0126	0.9150
S3.F3.P1.50to180ms.Lat.ms.	-0.1349	0.2764	-0.1151	0.3537	-0.1399	0.2587	-0.1742	0.1587	-0.0220	0.8600	-0.0920	0.4589
S3.F4.P1.50to180ms.Amp.mV.	0.0639	0.5910	-0.2031	0.0848	-0.0403	0.7348	-0.1385	0.2427	0.0782	0.5107	0.0415	0.7271
S3.F4.P1.50to180ms.Lat.ms.	-0.0996	0.4227	0.0178	0.8862	-0.0048	0.9693	-0.0310	0.8031	-0.0448	0.7187	-0.0656	0.5980
S3.F7.P1.50to180ms.Amp.mV.	0.1584	0.1748	-0.2273	0.0499 *	-0.1791	0.1243	-0.2485	0.0316 *	0.0927	0.4289	0.0771	0.5102
S3.F7.P1.50to180ms.Lat.ms.	0.0635	0.6015	-0.2734	0.0220 *	-0.0094	0.9387	-0.1736	0.1506	0.1756	0.1460	0.2183	0.0695
S3.F8.P1.50to180ms.Amp.mV.	0.2172	0.0631	-0.3853	0.0007 *	-0.2359	0.0430 *	-0.3723	0.0011 *	0.1067	0.3657	0.1006	0.3929
S3.F8.P1.50to180ms.Lat.ms.	-0.0128	0.9141	-0.1954	0.0953	-0.1041	0.3776	-0.2042	0.0809	-0.0150	0.8989	-0.0005	0.9969
S3.P3.N1.50to110ms.Amp.mV.	0.0408	0.7282	-0.2696	0.0193 *	-0.0775	0.5089	-0.2317	0.0455 *	0.1354	0.2468	0.1134	0.3321
S3.P3.N1.50to110ms.Lat.ms.	-0.1683	0.1490	-0.1209	0.3015	0.0357	0.7610	-0.0231	0.8439	0.1239	0.2897	0.1480	0.2049
S3.P4.N1.50to110ms.Amp.mV.	0.1296	0.2709	-0.2428	0.0371 *	-0.1118	0.3430	-0.2265	0.0523	-0.0303	0.7974	-0.0959	0.4156
S3.P4.N1.50to110ms.Lat.ms.	-0.0833	0.4807	-0.1575	0.1803	0.0344	0.7709	-0.0557	0.6376	0.2038	0.0815	0.2792	0.0160 *
S3.C3.P1.75to175ms.Amp.mV.	0.0584	0.6186	-0.1714	0.1415	0.0064	0.9566	-0.1286	0.2715	0.1046	0.3718	0.0069	0.9528
S3.C3.P1.75to175ms.Lat.ms.	-0.2425	0.0361 *	0.0546	0.6419	-0.1333	0.2541	-0.0205	0.8616	-0.1324	0.2574	-0.2329	0.0443 *
S3.C4.P1.75to175ms.Amp.mV.	0.1490	0.2020	-0.1185	0.3112	-0.0084	0.9428	-0.0919	0.4327	0.1533	0.1891	0.0750	0.5217
S3.C4.P1.75to175ms.Lat.ms.	-0.1875	0.1072	0.1397	0.2319	0.0775	0.5084	0.1239	0.2896	-0.0428	0.7153	-0.0961	0.4121
S3.P3.P2.100to180ms.Amp.mV.	0.0117	0.9204	-0.0793	0.4989	-0.0490	0.6764	-0.1158	0.3225	0.0760	0.5168	0.0178	0.8791
S3.P3.P2.100to180ms.Lat.ms.	0.0098	0.9336	0.1101	0.3469	0.2212	0.0566	0.1867	0.1087	0.1000	0.3935	0.0588	0.6161
S3.P4.P2.100to180ms.Amp.mV.	0.0745	0.5282	-0.0300	0.7999	0.0826	0.4844	0.0056	0.9620	0.1015	0.3896	0.0083	0.9438
S3.P4.P2.100to180ms.Lat.ms.	-0.1271	0.2804	0.1834	0.1177	0.1302	0.2688	0.1708	0.1458	-0.0324	0.7842	-0.0856	0.4686
S3.C3.N2.120to220ms.Amp.mV.	-0.0664	0.5712	-0.2570	0.0260 *	-0.0698	0.5518	-0.2060	0.0762	-0.0365	0.7557	-0.0798	0.4955
S3.C3.N2.120to220ms.Lat.ms.	0.0086	0.9417	0.1930	0.0971	0.2338	0.0435 *	0.2252	0.0521	0.1097	0.3487	0.1162	0.3207
S3.C4.N2.120to220ms.Amp.mV.	0.1435	0.2193	-0.1821	0.1179	-0.0180	0.8782	-0.1191	0.3086	0.0681	0.5613	-0.0071	0.9517
S3.C4.N2.120to220ms.Lat.ms.	0.0121	0.9179	0.2402	0.0379 *	0.2149	0.0641	0.2722	0.0181 *	0.1080	0.3566	0.0806	0.4919
S3.P3.N2.150to250ms.Amp.mV.	-0.0157	0.8933	-0.1862	0.1097	-0.0187	0.8736	-0.1383	0.2366	0.0308	0.7929	-0.0535	0.6479
S3.P3.N2.150to250ms.Lat.ms.	0.0277	0.8135	0.1424	0.2229	0.1225	0.2950	0.1401	0.2305	0.1367	0.2421	0.1789	0.1246
S3.P4.N2.150to250ms.Amp.mV.	0.0075	0.9494	-0.1656	0.1586	-0.0473	0.6889	-0.1251	0.2884	-0.0104	0.9302	-0.1069	0.3640
S3.P4.N2.150to250ms.Lat.ms.	-0.0729	0.5368	0.2057	0.0788	0.0827	0.4838	0.1829	0.1188	0.1268	0.2818	0.0776	0.5112
S3.C3.P3.200to650ms.Amp.mV.	0.0342	0.7707	-0.0290	0.8047	0.0910	0.4376	0.0282	0.8103	0.1131	0.3338	0.0185	0.8743
S3.C3.P3.200to650ms.Lat.ms.	0.1994	0.0863	0.1626	0.1633	0.0313	0.7895	0.1459	0.2117	0.2186	0.0595	0.2512	0.0297 *
S3.C4.P3.200to650ms.Amp.mV.	0.0205	0.8611	0.0476	0.6853	0.0089	0.9396	0.0262	0.8232	0.1322	0.2581	0.0658	0.5739
S3.C4.P3.200to650ms.Lat.ms.	0.0612	0.6022	0.2295	0.0476 *	0.0964	0.4106	0.1926	0.0979	0.1018	0.3849	0.0367	0.7544
S3.FP1.P3.200to350ms.Amp.mV.	-0.0770	0.5420	-0.1722	0.1700	-0.1840	0.1423	-0.2221	0.0754	-0.0708	0.5753	-0.1369	0.2760
S3.FP1.P3.200to350ms.Lat.ms.	-0.3036	0.0140 *	0.0475	0.7073	-0.0383	0.7617	-0.0048	0.9696	-0.0210	0.8678	0.0499	0.6932
S3.FP2.P3.200to350ms.Amp.mV.	-0.0543	0.6677	-0.1305	0.3003	-0.1793	0.1530	-0.2019	0.1067	-0.0679	0.5911	0.0143	0.9099
S3.FP2.P3.200to350ms.Lat.ms.	0.0891	0.4802	0.0858	0.4967	-0.0172	0.8920	0.0379	0.7645	0.0724	0.5665	0.1448	0.2497
S3.F3.P3.200to350ms.Amp.mV.	-0.2306	0.0481 *	-0.1903	0.1044	-0.1763	0.1329	-0.2294	0.0493 *	0.0012	0.9917	-0.0275	0.8159
S3.F3.P3.200to350ms.Lat.ms.	-0.1215	0.3024	0.0133	0.9107	0.0233	0.8435	0.0205	0.8625	-0.0705	0.5508	-0.0745	0.5283
S3.F4.P3.200to350ms.Amp.mV.	-0.1417	0.2318	-0.2716	0.0201 *	-0.1349	0.2551	-0.2405	0.0404 *	0.0929	0.4343	0.0881	0.4577
S3.F4.P3.200to350ms.Lat.ms.	-0.1368	0.2486	-0.0383	0.7474	-0.0049	0.9669	-0.0526	0.6585	-0.0059	0.9604	-0.0317	0.7899
S3.F7.P3.200to350ms.Amp.mV.	0.0323	0.7831	-0.3694	0.0011 *	-0.2677	0.0202 *	-0.3715	0.0010 *	-0.0072	0.9512	0.0422	0.7187
S3.F7.P3.200to350ms.Lat.ms.	0.1748	0.1336	-0.0400	0.7331	-0.0743	0.5262	-0.0636	0.5877	0.0171	0.8840	-0.0364	0.7565
S3.F8.P3.200to350ms.Amp.mV.	0.0235	0.8422	-0.3074	0.0077 *	-0.2235	0.0556	-0.3171	0.0059 *	0.0656	0.5788	0.2237	0.0556
S3.F8.P3.200to350ms.Lat.ms.	-0.0155	0.8954	0.0665	0.5733	0.0976	0.4083	0.0877	0.4576	0.0605	0.6085	0.0321	0.7863
S3.FP1.P3.200to400ms.Amp.mV.	-0.0636	0.6146	-0.1264	0.3156	-0.1935	0.1225	-0.1944	0.1208	-0.0968	0.4431	-0.1444	0.2503
S3.FP1.P3.200to400ms.Lat.ms.	-0.0354	0.7795	0.0147	0.9076	0.0211	0.8674	0.0165	0.8964	0.0673	0.5945	0.1362	0.2792
S3.FP2.P3.200to400ms.Amp.mV.	-0.0144	0.9093	-0.1517	0.2276	-0.1852	0.1397	-0.2167	0.0829	-0.0529	0.6755	0.0467	0.7113
S3.FP2.P3.200to400ms.Lat.ms.	0.0555	0.6604	0.0720	0.5688	0.0624	0.6214	0.0827	0.5126	0.0888	0.4818	0.1604	0.2018
S3.F3.P3.200to400ms.Amp.mV.	-0.2226	0.0566	-0.1855	0.1135	-0.1473	0.2103	-0.2058	0.0785	-0.0090	0.9391	-0.0430	0.7157
S3.F3.P3.200to400ms.Lat.ms.	-0.0884	0.4540	0.1686	0.1511	0.1908	0.1034	0.2303	0.0484 *	0.0002	0.9984	0.0262	0.8245
S3.F4.P3.200to400ms.Amp.mV.	-0.1597	0.1772	-0.2337	0.0466 *	-0.1167	0.3254	-0.2058	0.0807	0.0377	0.7516	0.0589	0.6197
S3.F4.P3.200to400ms.Lat.ms.	-0.0200	0.8669	0.1651	0.1629	0.2398	0.0410 *	0.2417	0.0393 *	0.0629	0.5969	0.0841	0.4795
S3.F7.P3.200to400ms.Amp.mV.	0.0688	0.5573	-0.3673	0.0012 *	-0.2810	0.0146 *	-0.3823	0.0007 *	-0.0215	0.8550	0.0154	0.8954
S3.F7.P3.200to400ms.Lat.ms.	0.1592	0.1724	0.1019	0.3842	-0.0818	0.4854	0.0040	0.9728	-0.0511	0.6633	-0.0636	0.5879
S3.F8.P3.200to400ms.Amp.mV.	0.0141	0.9050	-0.2927	0.0114 *	-0.2290	0.0497 *	-0.3118	0.0068 *	0.0476	0.6870	0.2120	0.0699
S3.F8.P3.200to400ms.Lat.ms.	0.0479	0.6853	0.1001	0.3959	0.1455	0.2161	0.1416	0.2288	0.1646	0.1612	0.1774	0.1306
S3.FP1.Wide.200to800ms.Amp.mV	-0.0235	0.8525	0.0881	0.4853	0.0734	0.5610	0.0890	0.4810	-0.1530	0.2237	-0.1003	0.4259
S3.FP1.Wide.200to800ms.Lat.ms.	-0.0212	0.8672	0.1892	0.1311	0.1971	0.1155	0.2078	0.0968	0.0681	0.5901	0.0440	0.7278
S3.FP2.Wide.200to800ms.Amp.mV	-0.0017	0.9895	0.0521	0.6801	0.1005	0.4255	0.0651	0.6065	-0.0798	0.5273	0.0389	0.7576
S3.FP2.Wide.200to800ms.Lat.ms.	-0.0993	0.4312	0.1131	0.3696	0.1376	0.2745	0.1057	0.4022	-0.1570	0.2117	-0.0803	0.5251
S3.F3.Wide.200to800ms.Amp.mV.	0.0608	0.6071	0.0559	0.6362	0.0946	0.4229	0.0798	0.4993	0.0727	0.5380	0.0462	0.6955
S3.F3.Wide.200to800ms.Lat.ms.	0.0490	0.6785	0.1161	0.3244	0.0187	0.8746	0.0852	0.4706	0.1658	0.1580	0.1576	0.1800
S3.F4.Wide.200to800ms.Amp.mV.	0.0420	0.7240	0.0696	0.5585	0.1594	0.1778	0.1342	0.2578	0.0854	0.4723	0.0544	0.6471
S3.F4.Wide.200to800ms.Lat.ms.	-0.0579	0.6267	0.2056	0.0810	0.1392	0.2403	0.1656	0.1614	0.0708	0.5517	0.0051	0.9658
S3.F7.Wide.200to800ms.Amp.mV.	0.2069	0.0749	-0.0544	0.6431	-0.0204	0.8624	-0.0430	0.7144	-0.0253	0.8291	-0.0619	0.5970
S3.F7.Wide.200to800ms.Lat.ms.	0.0557	0.6349	0.2441	0.0348 *	0.3034	0.0081 *	0.3219	0.0049 *	0.1077	0.3576	0.0148	0.8995
S3.F8.Wide.200to800ms.Amp.mV.	0.1513	0.1981	-0.0522	0.6588	-0.0724	0.5401	-0.0703	0.5518	0.0648	0.5831	0.0931	0.4293
S3.F8.Wide.200to800ms.Lat.ms.	0.0025	0.9830	0.2514	0.0307 *	0.0732	0.5355	0.2074	0.0762	0.0143	0.9036	-0.0674	0.5683
S3.P3.P3.200to650ms.Amp.mV.	0.0284	0.8089	-0.0876	0.4548	-0.0413	0.7248	-0.0940	0.4224	0.1086	0.3537	0.0699	0.5504
S3.P3.P3.200to650ms.Lat.ms.	0.0202	0.8631	0.1107	0.3445	0.0062	0.9582	0.0759	0.5178	0.1307	0.2637	0.1887	0.1050
S3.P4.P3.200to650ms.Amp.mV.	-0.0674	0.5682	-0.1206	0.3062	0.0290	0.8060	-0.0692	0.5582	0.2064	0.0776	0.1323	0.2607
S3.P4.P3.200to650ms.Lat.ms.	-0.2318	0.0469 *	0.1007	0.3932	-0.0328	0.7813	0.0379	0.7488	0.0662	0.5750	0.1170	0.3207
S3.FP1.LPP.400to800ms.Amp.mV.	-0.0096	0.9395	0.1342	0.2864	0.1270	0.3134	0.1415	0.2608	-0.1478	0.2400	-0.0865	0.4924
S3.FP1.LPP.400to800ms.Lat.ms.	-0.0683	0.5889	0.2135	0.0877	0.2719	0.0285 *	0.2615	0.0353 *	0.0384	0.7611	-0.0492	0.6973
S3.FP2.LPP.400to800ms.Amp.mV.	0.0080	0.9493	0.0422	0.7386	0.1138	0.3665	0.0575	0.6494	-0.0849	0.5013	0.0554	0.6603

S3.FP2.LPP.400to800ms.Lat.ms.	-0.2407	0.0534	0.2637	0.0338 *	0.1637	0.1926	0.2186	0.0802	-0.1413	0.2614	-0.1639	0.1920
S3.F3.LPP.400to800ms.Amp.mV.	0.0537	0.6495	0.0698	0.5548	0.0932	0.4297	0.0891	0.4502	0.0612	0.6045	0.0430	0.7157
S3.F3.LPP.400to800ms.Lat.ms.	-0.0825	0.4846	0.0787	0.5049	0.0833	0.4803	0.0758	0.5210	0.2022	0.0841	0.1520	0.1959
S3.F4.LPP.400to800ms.Amp.mV.	0.0112	0.9250	0.1076	0.3648	0.1774	0.1333	0.1676	0.1564	0.0852	0.4736	0.0726	0.5408
S3.F4.LPP.400to800ms.Lat.ms.	-0.2063	0.0800	0.0620	0.6023	0.0369	0.7566	0.0210	0.8598	0.0501	0.6735	-0.0299	0.8019
S3.F7.LPP.400to800ms.Amp.mV.	0.2153	0.0636	0.0140	0.9048	0.0214	0.8553	0.0198	0.8658	-0.0399	0.7342	-0.0978	0.4030
S3.F7.LPP.400to800ms.Lat.ms.	-0.0658	0.5748	0.1623	0.1642	0.2912	0.0112 *	0.2571	0.0260 *	0.1028	0.3799	0.0581	0.6205
S3.F8.LPP.400to800ms.Amp.mV.	0.0904	0.4438	0.0020	0.9862	-0.0726	0.5385	-0.0296	0.8023	0.0538	0.6490	0.0834	0.4793
S3.F8.LPP.400to800ms.Lat.ms.	-0.0113	0.9241	0.1679	0.1527	0.2325	0.0462 *	0.2356	0.0433 *	0.2667	0.0216 *	0.1577	0.1798

	Age on Day of Testing		Years at School		Years of Tertiary Education		Total Years of Education		Weight		BMI	
Measures	Spearma n's rho	p-values	Spearma n's rho	p-values	Spearma n's rho	p-values	Spearma n's rho	p-values	Spearma n's rho	p-values	Spearma n's rho	p-values
TrickS.C3.P1.50to150ms.Amp.mV.	0.0818	0.4855	0.2347	0.0427 *	0.0967	0.4092	0.1766	0.1296	-0.0627	0.5932	-0.0815	0.4864
TrickS.C3.P1.50to150ms.Lat.ms.	-0.0545	0.6422	0.1299	0.2666	-0.1360	0.2445	0.0217	0.8533	-0.1655	0.1558	-0.1630	0.1623
TrickS.C4.P1.50to150ms.Amp.mV.	0.2199	0.0580	0.2646	0.0218 *	0.1561	0.1812	0.2366	0.0410 *	0.1442	0.2172	0.1076	0.3574
TrickS.C4.P1.50to150ms.Lat.ms.	-0.0319	0.7859	0.0169	0.8856	0.1435	0.2193	0.0992	0.3971	-0.1019	0.3844	-0.1023	0.3823
TrickS.P3.N1.50to150ms.Amp.mV.	0.0102	0.9306	-0.0195	0.8679	-0.0354	0.7633	-0.0052	0.9644	-0.1073	0.3597	-0.1407	0.2281
TrickS.P3.N1.50to150ms.Lat.ms.	-0.0142	0.9038	-0.0093	0.9369	-0.0162	0.8902	-0.0184	0.8754	-0.0056	0.9619	0.0440	0.7080
TrickS.P4.N1.50to150ms.Amp.mV.	-0.0653	0.5777	0.0154	0.8955	0.0551	0.6388	0.0489	0.6770	-0.0895	0.4453	-0.1556	0.1822
TrickS.P4.N1.50to150ms.Lat.ms.	0.1234	0.2915	0.0124	0.9161	0.0570	0.6270	0.0553	0.6376	0.1629	0.1626	0.1944	0.0946
TrickS.FP1.P1.75to150ms.Amp.mV	0.0797	0.5027	0.1485	0.2098	0.0269	0.8212	0.0965	0.4166	-0.0264	0.8248	-0.0566	0.6334
TrickS.FP1.P1.75to150ms.Lat.ms.	-0.2386	0.0421 *	-0.0525	0.6590	-0.0641	0.5900	-0.0782	0.5105	-0.0404	0.7343	0.0163	0.8909
TrickS.FP2.P1.75to150ms.Amp.mV	0.1429	0.2279	0.1867	0.1138	0.1325	0.2640	0.1745	0.1398	0.2119	0.0719	0.1803	0.1267
TrickS.FP2.P1.75to150ms.Lat.ms.	-0.1683	0.1547	0.0247	0.8355	0.0158	0.8942	-0.0125	0.9165	0.1304	0.2716	0.2159	0.0666
TrickS.F3.P1.75to150ms.Amp.mV.	0.1058	0.3695	0.2850	0.0138 *	0.1704	0.1466	0.2450	0.0354 *	0.0936	0.4274	0.1226	0.2973
TrickS.F3.P1.75to150ms.Lat.ms.	-0.0172	0.8842	-0.0818	0.4885	-0.0594	0.6150	-0.0718	0.5430	0.0101	0.9319	0.0644	0.5854
TrickS.F4.P1.75to150ms.Amp.mV.	0.1899	0.1052	0.2632	0.0234 *	0.2635	0.0233 *	0.2880	0.0128 *	0.0799	0.4988	0.0736	0.5324
TrickS.F4.P1.75to150ms.Lat.ms.	0.0313	0.7912	-0.1464	0.2134	-0.0567	0.6314	-0.1321	0.2617	-0.0231	0.8454	0.0410	0.7287
TrickS.F7.P1.75to150ms.Amp.mV.	0.2332	0.0456 *	0.1655	0.1587	0.0857	0.4676	0.1518	0.1967	0.0927	0.4320	0.0299	0.8000
TrickS.F7.P1.75to150ms.Lat.ms.	-0.0063	0.9572	0.0288	0.8076	-0.0925	0.4331	-0.0476	0.6874	0.0724	0.5398	0.0315	0.7902
TrickS.F8.P1.75to150ms.Amp.mV.	0.0635	0.5912	0.0814	0.4903	0.0430	0.7160	0.0921	0.4349	0.1168	0.3217	0.0609	0.6053
TrickS.F8.P1.75to150ms.Lat.ms.	0.1206	0.3061	-0.1094	0.3535	-0.1237	0.2939	-0.1463	0.2136	-0.0583	0.6215	-0.0683	0.5630
TrickS.FP1.N1.100to200ms.Amp.m'	0.0381	0.7487	0.2209	0.0604	0.1314	0.2678	0.2103	0.0741	-0.0511	0.6678	-0.1366	0.2484
TrickS.FP1.N1.100to200ms.Lat.ms.	0.1326	0.2633	0.2068	0.0792	0.1057	0.3737	0.1659	0.1607	0.0717	0.5465	0.0953	0.4227
TrickS.FP2.N1.100to200ms.Amp.m'	0.0913	0.4422	0.2846	0.0147 *	0.2546	0.0297 *	0.3148	0.0067 *	0.2026	0.0856	0.1468	0.2148
TrickS.FP2.N1.100to200ms.Lat.ms.	0.0190	0.8732	-0.0584	0.6236	0.0151	0.8993	-0.0238	0.8417	0.1134	0.3395	0.1558	0.1882
TrickS.F3.N1.100to200ms.Amp.mV.	0.0702	0.5521	0.1136	0.3353	0.1171	0.3206	0.1333	0.2575	0.0000	0.9997	0.0065	0.9561
TrickS.F3.N1.100to200ms.Lat.ms.	0.0561	0.6350	-0.1024	0.3851	-0.0669	0.5715	-0.0616	0.6024	-0.0816	0.4894	-0.1032	0.3816
TrickS.F4.N1.100to200ms.Amp.mV.	0.1378	0.2417	0.0826	0.4841	0.2319	0.0468 *	0.1619	0.1683	0.0327	0.7822	0.0360	0.7605
TrickS.F4.N1.100to200ms.Lat.ms.	-0.0407	0.7308	0.0831	0.4817	0.1240	0.2926	0.1249	0.2890	-0.0162	0.8910	0.0161	0.8918
TrickS.F7.N1.100to200ms.Amp.mV.	0.1990	0.0892	0.1052	0.3723	0.0516	0.6623	0.1020	0.3871	-0.0766	0.5163	-0.1497	0.2024
TrickS.F7.N1.100to200ms.Lat.ms.	-0.2123	0.0694	-0.0971	0.4105	0.0384	0.7454	-0.0075	0.9494	0.0080	0.9458	0.0676	0.5674
TrickS.F8.N1.100to200ms.Amp.mV.	-0.0592	0.6165	0.0809	0.4930	0.1638	0.1632	0.1333	0.2575	0.0683	0.5631	-0.0096	0.9356
TrickS.F8.N1.100to200ms.Lat.ms.	0.0217	0.8546	0.0601	0.6107	0.0444	0.7075	0.0605	0.6084	0.0712	0.5469	0.1067	0.3657
TrickS.P3.P1.100to200ms.Amp.mV.	0.0012	0.9922	0.1404	0.2295	0.0215	0.8547	0.0960	0.4125	-0.0793	0.4991	-0.0335	0.7749
TrickS.P3.P1.100to200ms.Lat.ms.	-0.1653	0.1564	0.0694	0.5541	0.1491	0.2017	0.1334	0.2540	-0.1216	0.2988	0.0423	0.7189
TrickS.P4.P1.100to200ms.Amp.mV.	-0.0284	0.8086	0.1344	0.2502	0.0566	0.6296	0.1027	0.3805	0.0706	0.5473	0.0550	0.6385
TrickS.P4.P1.100to200ms.Lat.ms.	-0.1397	0.2319	0.0806	0.4919	-0.1195	0.3073	-0.0038	0.9739	-0.3535	0.0019 *	-0.2225	0.0551
TrickS.P3.N2.150to250ms.Amp.mV	-0.0322	0.7838	0.0464	0.6925	-0.0120	0.9183	0.0330	0.7789	-0.0496	0.6723	-0.0919	0.4323
TrickS.P3.N2.150to250ms.Lat.ms.	0.0727	0.5354	0.0515	0.6606	0.0295	0.8015	0.0625	0.5942	0.1532	0.1893	0.0713	0.5435
TrickS.P4.N2.150to250ms.Amp.mV	-0.1795	0.1233	0.1412	0.2269	-0.0212	0.8570	0.0699	0.5512	-0.0960	0.4128	-0.1299	0.2659
TrickS.P4.N2.150to250ms.Lat.ms.	0.1774	0.1279	-0.0681	0.5613	-0.0371	0.7517	-0.0531	0.6511	0.1097	0.3487	-0.0087	0.9413
TrickS.C3.P2.175to300ms.Amp.mV.	0.0117	0.9209	0.1032	0.3781	0.0077	0.9476	0.0636	0.5880	-0.0804	0.4931	-0.0206	0.8605
TrickS.C3.P2.175to300ms.Lat.ms.	0.1533	0.1891	-0.2057	0.0766	0.0284	0.8087	-0.1458	0.2118	0.0120	0.9185	0.1209	0.3014
TrickS.C4.P2.175to300ms.Amp.mV	0.0898	0.4436	0.1295	0.2682	0.1600	0.1702	0.1475	0.2065	0.1463	0.2104	0.1412	0.2265
TrickS.C4.P2.175to300ms.Lat.ms.	-0.0518	0.6588	-0.1913	0.1001	-0.0275	0.8147	-0.1665	0.1534	0.0205	0.8612	0.0733	0.5317
TrickS.FP1.P3.200to450ms.Amp.m'	-0.0138	0.9076	0.1022	0.3897	0.0597	0.6160	0.1138	0.3379	-0.1232	0.2989	-0.1299	0.2729
TrickS.FP1.P3.200to450ms.Lat.ms.	0.2000	0.0898	0.0174	0.8840	-0.0231	0.8460	0.0319	0.7891	-0.0972	0.4134	-0.1211	0.3076
TrickS.FP2.P3.200to450ms.Amp.m'	0.0181	0.8792	0.1798	0.1280	0.1141	0.3367	0.1656	0.1615	0.0945	0.4266	0.0867	0.4650
TrickS.FP2.P3.200to450ms.Lat.ms.	0.0707	0.5523	-0.1171	0.3237	-0.1838	0.1196	-0.1416	0.2320	-0.0503	0.6729	-0.0750	0.5281
TrickS.F3.P3.200to450ms.Amp.mV.	-0.1448	0.2184	0.2332	0.0456 *	0.0372	0.7533	0.1495	0.2038	-0.0482	0.6837	-0.0177	0.8810
TrickS.F3.P3.200to450ms.Lat.ms.	0.0689	0.5597	-0.1589	0.1763	-0.2505	0.0313 *	-0.2263	0.0526	-0.0013	0.9916	0.0011	0.9929
TrickS.F4.P3.200to450ms.Amp.mV.	-0.0373	0.7525	0.1807	0.1234	0.0487	0.6800	0.1229	0.2969	-0.0182	0.8774	0.0402	0.7332
TrickS.F4.P3.200to450ms.Lat.ms.	0.1478	0.2089	-0.1718	0.1434	-0.3140	0.0064 *	-0.2578	0.0266 *	-0.0208	0.8605	0.0007	0.9954
TrickS.F7.P3.200to450ms.Amp.mV.	0.0354	0.7649	0.1075	0.3618	-0.0286	0.8088	0.0420	0.7223	-0.0808	0.4937	-0.0917	0.4365
TrickS.F7.P3.200to450ms.Lat.ms.	0.0247	0.8345	0.0305	0.7966	0.0666	0.5728	0.0186	0.8748	0.0790	0.5032	0.0012	0.9921
TrickS.F8.P3.200to450ms.Amp.mV.	-0.0416	0.7250	0.1094	0.3534	-0.0003	0.9982	0.0807	0.4944	0.0013	0.9915	-0.0805	0.4948
TrickS.F8.P3.200to450ms.Lat.ms.	-0.0488	0.6795	-0.0382	0.7467	-0.1555	0.1858	-0.1355	0.2496	-0.0447	0.7055	0.0129	0.9132
TrickS.P3.P2.200to300ms.Amp.mV.	0.0711	0.5447	0.1034	0.3773	0.0045	0.9693	0.0645	0.5827	-0.0244	0.8357	0.0061	0.9587
TrickS.P3.P2.200to300ms.Lat.ms.	0.0212	0.8565	-0.1232	0.2923	0.0249	0.8322	-0.0910	0.4373	0.1615	0.1662	0.0229	0.8454
TrickS.P4.P2.200to300ms.Amp.mV.	-0.0370	0.7529	0.1079	0.3570	-0.0057	0.9613	0.0613	0.6012	0.0476	0.6851	0.0977	0.4035
TrickS.P4.P2.200to300ms.Lat.ms.	0.0285	0.8082	-0.2268	0.0504	-0.1176	0.3149	-0.1872	0.1077	0.1152	0.3250	0.0963	0.4109
TrickS.P3.N3.250to375ms.Amp.mV.	0.0449	0.7020	-0.0091	0.9384	-0.0177	0.8803	-0.0336	0.7750	0.0451	0.7007	0.0548	0.6399
TrickS.P3.N3.250to375ms.Lat.ms.	0.2516	0.0294 *	-0.1388	0.2350	-0.1960	0.0920	-0.2089	0.0720	0.0013	0.9909	-0.0928	0.4283
TrickS.P4.N3.250to375ms.Amp.mV	-0.0993	0.3968	-0.0486	0.6790	-0.0589	0.6159	-0.0766	0.5136	0.0123	0.9168	0.0700	0.5498
TrickS.P4.N3.250to375ms.Lat.ms.	0.1232	0.2923	-0.1266	0.2790	-0.0567	0.6288	-0.0915	0.4351	-0.0117	0.9207	-0.0577	0.6229
TrickS.C3.P3.300to600ms.Amp.mV	-0.0614	0.6011	-0.0268	0.8194	-0.1208	0.3019	-0.0788	0.5017	-0.0271	0.8175	0.0666	0.5696
TrickS.C3.P3.300to600ms.Lat.ms.	-0.1072	0.3601	0.0091	0.9380	-0.0655	0.5766	-0.0063	0.9574	0.0587	0.6172	0.0216	0.8541
TrickS.C4.P3.300to600ms.Amp.mV	-0.0181	0.8777	0.0429	0.7148	0.0343	0.7699	0.0185	0.8748	0.1621	0.1646	0.2000	0.0854
TrickS.C4.P3.300to600ms.Lat.ms.	-0.0479	0.6834	0.0913	0.4360	-0.0786	0.5024	0.0026	0.9823	0.1795	0.1232	0.1319	0.2593
TrickS.P3.P3.300to650ms.Amp.mV.	-0.1247	0.2866	-0.0082	0.9445	-0.0414	0.7241	-0.0225	0.8479	0.0751	0.5217	0.1159	0.3213
TrickS.P3.P3.300to650ms.Lat.ms.	-0.1530	0.1900	-0.1590	0.1730	-0.1557	0.1823	-0.1662	0.1542	0.0637	0.5872	-0.0205	0.8615
TrickS.P4.P3.300to650ms.Amp.mV.	-0.1096	0.3490	-0.0017	0.9886	-0.0632	0.5904	-0.0537	0.6471	0.1276	0.2753	0.1523	0.1916
TrickS.P4.P3.300to650ms.Lat.ms.	-0.1262	0.2807	-0.0634	0.5889	-0.2046	0.0783	-0.1559	0.1817	0.0618	0.5987	0.0258	0.8260

	B9 ASSIST		B9 ASSIST		B7 ASRS PartB		B9 ASSIST		B9 ASSIST		B9 ASSIST Total	
Measures	Spearma n's rho	p-values	Spearma n's rho	p-values	Spearma n's rho	p-values	Spearma n's rho	p-values	Spearma n's rho	p-values	Spearma n's rho	p-values
S3.RT	0.0941	0.4096	0.0506	0.6581	0.1530	0.1782	0.1440	0.2054	0.0847	0.4577	0.0501	0.6611

S3.Response	-0.0876	0.4427		-0.1711	0.1316		-0.1092	0.3379		-0.1116	0.3275		-0.2693	0.0164	*	-0.0737	0.5186	
S3.Omit	0.0876	0.4427		0.1711	0.1316		0.1092	0.3379		0.1116	0.3275		0.2693	0.0164	*	0.0737	0.5186	
NonT.Response	0.0651	0.5689		0.2094	0.0640		0.0883	0.4389		0.1430	0.2086		0.2534	0.0242	*	0.0655	0.5663	
TrickS.Response	0.0072	0.9497		-0.0678	0.5529		-0.0858	0.4520		0.0057	0.9603		-0.0198	0.8626		-0.1185	0.2985	
S1.Response	0.0647	0.5710		-0.0037	0.9743		-0.0336	0.7687		0.0749	0.5120		0.0803	0.4816		0.0149	0.8960	
S2.Response	0.1611	0.1562		0.1966	0.0824		-0.1539	0.1756		0.1058	0.3535		0.2573	0.0221	*	0.0901	0.4297	
A.Total.Correct	-0.0880	0.4494		-0.2082	0.0712		-0.1464	0.2039		-0.1960	0.0896		-0.2767	0.0155	*	-0.1106	0.3414	
A.S3.Delayed.Response	-0.0135	0.9079		0.1971	0.0880		0.2347	0.0399	*	0.1479	0.2023		0.1808	0.1181		0.0898	0.4405	
A.S3.Delayed.RT	0.0118	0.9194		0.1478	0.2027		0.2118	0.0645		0.1084	0.3513		0.2410	0.0360	*	0.0854	0.4633	
A.S2.Responses	0.2162	0.0607		0.2563	0.0254	*	-0.1237	0.2839		0.1613	0.1638		0.2784	0.0149	*	0.1259	0.2787	
A.Omissions	0.0177	0.8796		0.0163	0.8891		0.1198	0.2992		0.0861	0.4594		0.1300	0.2631		-0.0641	0.5822	
A.TrickS.Responses	0.2002	0.0829		0.1107	0.3413		-0.1393	0.2269		0.1386	0.2326		0.2761	0.0158	*	0.0299	0.7978	
A.S3.RT	0.0245	0.8300		0.0980	0.3901		0.2513	0.0255	*	0.0780	0.4943		0.1432	0.2080		0.0781	0.4939	
S1.FP1.P50.0to100ms.Amp.mV.	0.0727	0.5712		0.0260	0.8394		0.0453	0.7220		0.0838	0.5137		0.0589	0.6464		0.0737	0.5661	
S1.FP1.P50.0to100ms.Lat.ms.	0.1154	0.3677		-0.0600	0.6407		-0.1047	0.4102		0.0161	0.9002		0.2236	0.0782		0.0559	0.6637	
S1.FP2.P50.0to100ms.Amp.mV.	-0.0658	0.6082		-0.1053	0.4113		-0.0450	0.7243		0.0612	0.6338		-0.1291	0.3131		-0.0657	0.6088	
S1.FP2.P50.0to100ms.Lat.ms.	0.1613	0.2104		-0.1201	0.3526		-0.1652	0.1956		-0.0085	0.9475		0.0797	0.5380		-0.0302	0.8157	
S1.F3.P50.0to100ms.Amp.mV.	0.0267	0.8237		-0.1060	0.3753		0.0099	0.9337		0.0257	0.8303		-0.1309	0.2730		-0.0899	0.4527	
S1.F3.P50.0to100ms.Lat.ms.	-0.0224	0.8517		-0.0435	0.7170		0.0014	0.9907		0.1053	0.3786		-0.0427	0.7219		-0.0199	0.8680	
S1.F4.P50.0to100ms.Amp.mV.	0.0164	0.8919		-0.0116	0.9235		-0.0586	0.6247		0.0876	0.4678		-0.0509	0.6733		-0.0650	0.5900	
S1.F4.P50.0to100ms.Lat.ms.	0.0206	0.8648		0.0265	0.8264		-0.0221	0.8536		-0.0004	0.9976		0.1276	0.2889		-0.0909	0.4509	
S1.F7.P50.0to100ms.Amp.mV.	0.0436	0.7140		-0.1842	0.1187		-0.1049	0.3739		-0.0249	0.8341		0.1063	0.3708		-0.0827	0.4868	
S1.F7.P50.0to100ms.Lat.ms.	-0.0597	0.6156		0.0922	0.4380		-0.0869	0.4615		0.1364	0.2500		0.1291	0.2762		0.0278	0.8156	
S1.F8.P50.0to100ms.Amp.mV.	0.0644	0.5909		0.1600	0.1793		-0.0042	0.9720		0.1584	0.1840		0.1162	0.3309		0.0864	0.4707	
S1.F8.P50.0to100ms.Lat.ms.	-0.0047	0.9687		0.2486	0.0353	*	-0.0828	0.4860		-0.0935	0.4347		0.2183	0.0654		0.0373	0.7555	
S1.P3.Nc.0to100ms.Amp.mV.	0.0362	0.7610		0.0861	0.4688		0.0249	0.8331		0.0130	0.9128		0.1059	0.3727		0.0743	0.5322	
S1.P3.Nc.0to100ms.Lat.ms.	-0.0418	0.7252		-0.0660	0.5791		-0.0859	0.4666		-0.0710	0.5503		0.0362	0.7611		0.0578	0.6270	
S1.P4.Nc.0to100ms.Amp.mV.	-0.0321	0.7890		0.0530	0.6584		0.1113	0.3486		0.0076	0.9498		-0.0342	0.7757		0.0056	0.9628	
S1.P4.Nc.0to100ms.Lat.ms.	0.1171	0.3272		-0.0691	0.5643		-0.1337	0.2596		0.0250	0.8351		0.1251	0.2952		0.2091	0.0780	
S1.C3.P1.50to140ms.Amp.mV.	0.0775	0.5148		0.0788	0.5078		0.0498	0.6734		0.1797	0.1281		0.0317	0.7898		0.1125	0.3431	
S1.C3.P1.50to140ms.Lat.ms.	0.4053	0.0004	*	0.2885	0.0133	*	0.0432	0.7148		0.1861	0.1148		0.2271	0.0533		0.3940	0.0006	*
S1.C4.P1.50to140ms.Amp.mV.	-0.0343	0.7735		0.1065	0.3698		0.0010	0.9930		0.0519	0.6628		-0.0086	0.9423		-0.0231	0.8465	
S1.C4.P1.50to140ms.Lat.ms.	0.0750	0.5285		0.2613	0.0256	*	-0.0722	0.5411		0.0009	0.9941		0.1361	0.2509		0.2208	0.0605	
S1.P3.P1.50to150ms.Amp.mV.	0.0915	0.4412		0.0021	0.9858		0.0134	0.9097		-0.0706	0.5528		-0.0287	0.8096		0.0579	0.6264	
S1.P3.P1.50to150ms.Lat.ms.	0.0319	0.7885		0.2823	0.0155	*	0.0730	0.5365		0.1251	0.2918		0.2575	0.0278	*	0.2668	0.0225	*
S1.P4.P1.50to150ms.Amp.mV.	-0.0278	0.8167		-0.0218	0.8561		0.0557	0.6399		-0.0850	0.4778		-0.1328	0.2660		-0.0193	0.8721	
S1.P4.P1.50to150ms.Lat.ms.	0.2089	0.0783		0.2992	0.0107	*	0.0795	0.5038		0.1413	0.2365		0.1422	0.2333		0.3387	0.0036	*
S1.Fp1.N1.75to200ms.Amp.mV.	0.0460	0.7179		-0.1273	0.3160		-0.0359	0.7763		-0.0421	0.7414		0.1570	0.2154		-0.0360	0.7774	
S1.Fp1.N1.75to200ms.Lat.ms.	0.0318	0.8028		0.1964	0.1199		0.1270	0.3134		0.2841	0.0229	*	0.1203	0.3436		0.0573	0.6528	
S1.Fp2.N1.75to200ms.Amp.mV.	0.0172	0.8926		-0.1310	0.3020		-0.0929	0.4618		0.0126	0.9214		-0.0046	0.9711		-0.1091	0.3908	
S1.Fp2.N1.75to200ms.Lat.ms.	-0.0650	0.6101		0.1221	0.3364		0.2300	0.0653		0.1530	0.2275		-0.0193	0.8796		0.0891	0.4838	
S1.F3.N1.75to200ms.Amp.mV.	0.0820	0.4937		0.0155	0.8969		-0.0265	0.8237		0.1288	0.2809		0.0208	0.8625		0.0301	0.8018	
S1.F3.N1.75to200ms.Lat.ms.	-0.1104	0.3560		-0.1455	0.2227		0.3481	0.0025	*	-0.1400	0.2408		-0.1024	0.3920		-0.1250	0.2954	
S1.F4.N1.75to200ms.Amp.mV.	0.0157	0.8967		-0.0014	0.9907		-0.2259	0.0564		-0.0180	0.8819		0.1378	0.2519		-0.1486	0.2161	
S1.F4.N1.75to200ms.Lat.ms.	0.0553	0.6467		0.0837	0.4876		0.2742	0.0198	*	0.1873	0.1178		-0.0761	0.5280		0.1034	0.3908	
S1.F7.N1.75to200ms.Amp.mV.	0.1193	0.3146		-0.0856	0.4712		-0.1734	0.1397		-0.0497	0.6765		0.2748	0.0186	*	-0.0341	0.7745	
S1.F7.N1.75to200ms.Lat.ms.	-0.0644	0.5882		-0.0147	0.9016		0.1853	0.1141		0.1237	0.2973		0.0322	0.7870		-0.0724	0.5426	
S1.F8.N1.75to200ms.Amp.mV.	0.0710	0.5532		0.2221	0.0607		-0.1558	0.1880		0.0349	0.7709		0.2532	0.0319	*	0.1068	0.3717	
S1.F8.N1.75to200ms.Lat.ms.	-0.0734	0.5399		-0.0544	0.6498		0.2420	0.0392	*	0.0360	0.7639		-0.0375	0.7546		-0.0260	0.8283	
S1.C3.N1.100to150ms.Amp.mV.	0.0643	0.5891		0.1544	0.1922		0.0477	0.6864		0.1097	0.3554		0.0851	0.4743		0.1158	0.3291	
S1.C3.N1.100to150ms.Lat.ms.	-0.1256	0.2895		-0.1468	0.2151		-0.0241	0.8386		-0.1138	0.3378		-0.1603	0.1754		-0.2018	0.0869	
S1.C4.N1.100to150ms.Amp.mV.	-0.0358	0.7635		0.1339	0.2586		0.1198	0.3092		0.0632	0.5955		0.0233	0.8451		0.0611	0.6078	
S1.C4.N1.100to150ms.Lat.ms.	-0.0776	0.5139		0.0391	0.7428		-0.1035	0.3802		-0.2100	0.0745		-0.1483	0.2104		-0.0295	0.8046	
S1.P3.N1.120to180ms.Amp.mV.	0.1461	0.2175		0.1999	0.0900		0.0873	0.4597		0.0114	0.9239		0.0753	0.5264		0.1366	0.2490	
S1.P3.N1.120to180ms.Lat.ms.	-0.1044	0.3796		-0.0853	0.4729		0.0477	0.6863		-0.2479	0.0345	*	-0.2661	0.0229	*	-0.1153	0.3314	
S1.P4.N1.120to180ms.Amp.mV.	0.0037	0.9756		0.1361	0.2545		0.0690	0.5619		0.0278	0.8164		0.0049	0.9674		-0.0175	0.8843	
S1.P4.N1.120to180ms.Lat.ms.	0.0857	0.4740		0.0864	0.4706		-0.0148	0.9008		0.0576	0.6310		-0.0858	0.4735		0.1644	0.1675	
S1.C3.P2.150to300ms.Amp.mV.	0.0517	0.6643		0.0448	0.7065		-0.0543	0.6456		0.0878	0.4602		0.0830	0.4853		0.0612	0.6069	
S1.C3.P2.150to300ms.Lat.ms.	-0.1196	0.3137		0.0867	0.4659		0.1500	0.2021		-0.0408	0.7315		0.0717	0.5467		-0.0251	0.8331	
S1.C4.P2.150to300ms.Amp.mV.	0.0094	0.9374		0.0141	0.9061		0.0021	0.9862		0.0014	0.9907		0.0970	0.4145		-0.0560	0.6377	
S1.C4.P2.150to300ms.Lat.ms.	0.0039	0.9738		-0.0499	0.6750		0.0095	0.9357		0.0189	0.8741		0.1124	0.3438		-0.0686	0.5642	
S1.FP1.P2.150to350ms.Amp.mV.	-0.0999	0.4359		-0.1732	0.1745		-0.0606	0.6343		-0.1450	0.2569		-0.0728	0.5706		-0.1110	0.3865	
S1.FP1.P2.150to350ms.Lat.ms.	-0.1180	0.3569		-0.0513	0.6898		0.0992	0.4354		-0.1321	0.3021		-0.2644	0.0362	*	-0.1480	0.2471	
S1.FP2.P2.150to350ms.Amp.mV.	0.0269	0.8340		-0.0934	0.4666		-0.1219	0.3374		-0.0313	0.8077		-0.1198	0.3496		-0.0851	0.5075	
S1.FP2.P2.150to350ms.Lat.ms.	0.1228	0.3375		0.1449	0.2572		0.2241	0.0751		-0.0343	0.7894		0.0218	0.8656		0.2382	0.0601	
S1.F3.P2.150to350ms.Amp.mV.	-0.0494	0.6806		-0.0561	0.6399		-0.0985	0.4073		0.0033	0.9783		-0.0007	0.9952		-0.0329	0.7837	
S1.F3.P2.150to350ms.Lat.ms.	-0.0669	0.5764		-0.0621	0.6042		0.1419	0.2312		-0.0308	0.7972		-0.0136	0.9095		-0.1296	0.2779	
S1.F4.P2.150to350ms.Amp.mV.	-0.1765	0.1408		-0.1599	0.1830		-0.1460	0.2209		-0.2563	0.0309	*	-0.0129	0.9150		-0.2553	0.0316	*
S1.F4.P2.150to350ms.Lat.ms.	0.0243	0.8405		0.0672	0.5778		0.1437	0.2283		-0.0520	0.6666		0.0831	0.4907		-0.0332	0.7833	
S1.F7.P2.150to350ms.Amp.mV.	0.0355	0.7653		-0.1430	0.2276		-0.0710	0.5475		-0.1326	0.2635		0.0362	0.7613		-0.0869	0.4648	
S1.F7.P2.150to350ms.Lat.ms.	-0.1947	0.0988		-0.0088	0.9409		0.1265	0.2829		-0.1311	0.2690		-0.0693	0.5600		-0.2097	0.0750	
S1.F8.P2.150to350ms.Amp.mV.	0.0800	0.5039		0.1292	0.2793		-0.0391	0.7428		0.0718	0.5489		0.0541	0.6518		0.0966	0.4196	
S1.F8.P2.150to350ms.Lat.ms.	-0.0096	0.9365		-0.0820	0.4932		-0.0887	0.4557		-0.0825	0.4906		0.0333	0.7813		-0.1179	0.3239	
S1.FP1.P2.150to400ms.Amp.mV.	-0.0965	0.4518		-0.1618	0.2053		-0.0879	0.4899		-0.1682	0.1875		-0.0912	0.4769		-0.1064	0.4066	
S1.FP1.P2.150to400ms.Lat.ms.	-0.0822	0.5218		-0.0779	0.5441		0.1205	0.3429		-0.2074	0.1029		-0.1910	0.1337		-0.0794	0.5362	
S1.FP2.P2.150to400ms.Amp.mV.	0.0221	0.8637		-0.1141	0.3734		-0.1301	0.3056		-0.0681	0.5958		-0.1504	0.2395		-0.1072	0.4031	
S1.FP2.P2.150to400ms.Lat.ms.	0.0872	0.4970		0.0513	0.6896		0.2363	0.0602		-0.0172	0.8933		-0.0384	0.7650		0.1374	0.2829	
S1.F3.P2.150to400ms.Amp.mV.	-0.0580	0.6284		-0.0553	0.6447		-0.0853	0.4733		-0.0212	0.8600		-0.0285	0.8121		-0.0331	0.7828	
S1.F3.P2.150to400ms.Lat.ms.	-0.1079	0.3671		-0.1733	0.1455		0.0995	0.4025		-0.2205	0.0627		-0.0383	0.7495		-0.2459	0.0373	*
S1.F4.P2.150to400ms.Amp.mV.	-0.1778	0.1379		-0.1867	0.1191		-0.1489	0.2118		-0.2714	0.0221	*	-0.0252	0.8346		-0.2807	0.0177	*
S1.F4.P2.150to400ms.Lat.ms.	-0.0287	0.8120		-0.0279	0.8175		0.1134	0.3429		-0.1345	0.2635		0.0150	0.9010		-0.1092	0.3647	
S1.F7.P2.150to400ms.Amp.mV.	0.0279	0.8145		-0.1672	0.1575		-0.0851	0.4708		-0.1872	0.1128		0.0033	0.9780		-0.1128	0.3418	
S1.F7.P2.150to400ms.Lat.ms.	-0.1464	0.2164		-0.0580	0.6258		0.0070	0.9526		-0.1766	0.1350		-0.0699	0.5570		-0.2041	0.0833	
S1.F8.P2.150to400ms.Amp.mV.	0.0613	0.6092		0.1193	0.3180		-0.0796	0.5035		0.0451	0.7068		0.0366	0.7603		0.0615	0.6080	
S1.F8.P2.150to400ms.Lat.ms.	-0.0591	0.6220		-0.1317	0.2703		-0.1860	0.1151		-0.0887	0.4590		-0.0293	0.8070		-0.2159	0.0685	
S1.P3.P2.150to250ms.Amp.mV.	0.0580	0.6261		0.0885	0.4565		0.1092	0.3544		0.1433	0.2263		0.0913	0.4425		0.0861	0.4686	
S1.P3.P2.150to250ms.Lat.ms.	-0.0154	0.8971		0.1238	0.2965		0.0627	0.5954		0.0972	0.4132		0.1788	0.1302		0.0877	0.4607	
S1.P4.P2.150to250ms.Amp.mV.	0.0378	0.7527		0.0872	0.4662		0.0601	0.6133		0.0050	0.9667		0.0345	0.7734		-0.0240	0.8416	
S1.P4.P2.150to250ms.Lat.ms.	-0.0285	0.8119		0.0167	0.8891		-0.1037	0.3826		0.1220	0.3073		0.1927	0.1049		-0.0313	0.7942	

S1.P3.N2.200to350ms.Amp.mV.	0.0707	0.5520	0.1720	0.1456	-0.0345	0.7701	-0.0242	0.8392	0.1683	0.1547	0.0567	0.6338
S1.P3.N2.200to350ms.Lat.ms.	0.1345	0.2566	0.0880	0.4591	0.0335	0.7772	0.1016	0.3924	0.1366	0.2492	0.0762	0.5215
S1.P4.N2.200to350ms.Amp.mV.	0.0383	0.7495	0.1311	0.2722	-0.1020	0.3905	-0.0288	0.8102	0.1414	0.2362	-0.0406	0.7347
S1.P4.N2.200to350ms.Lat.ms.	-0.0270	0.8218	0.0522	0.6634	0.1829	0.1213	0.0496	0.6792	-0.0031	0.9793	0.0033	0.9784
S1.C3.P3.300to550.ms.Amp.mV.	-0.0982	0.4087	-0.0032	0.9785	-0.0537	0.6495	0.0919	0.4394	0.0344	0.7728	-0.0090	0.9396
S1.C3.P3.300to550.ms.Lat.ms.	-0.1325	0.2637	0.0327	0.7837	-0.0303	0.7978	0.0961	0.4188	-0.0445	0.7087	0.0990	0.4045
S1.C4.P3.300to550.ms.Amp.mV.	-0.0862	0.4684	-0.0886	0.4562	0.0660	0.5763	-0.0361	0.7620	0.0164	0.8905	-0.0932	0.4329
S1.C4.P3.300to550.ms.Lat.ms.	-0.0255	0.8306	0.0615	0.6051	0.1056	0.3708	0.0938	0.4300	-0.0795	0.5040	0.1061	0.3718
S1.P3.P3.300to550ms.Amp.mV.	-0.0398	0.7379	-0.0207	0.8621	0.0533	0.6521	0.0540	0.6498	-0.0185	0.8768	0.0004	0.9974
S1.P3.P3.300to550ms.Lat.ms.	-0.0320	0.7879	0.0504	0.6718	0.0713	0.5462	0.1390	0.2407	-0.0145	0.9032	-0.0309	0.7951
S1.P4.P3.300to550ms.Amp.mV.	-0.0394	0.7428	-0.0048	0.9678	0.0034	0.9773	0.0440	0.7137	-0.0099	0.9344	0.0244	0.8386
S1.P4.P3.300to550ms.Lat.ms.	-0.1315	0.2709	0.0271	0.8209	0.3343	0.0038 *	0.0975	0.4151	-0.0762	0.5244	0.0503	0.6746
	B9 ASSIST		**B9 ASSIST**		**B7 ASRS PartB**		**B9 ASSIST**		**B9 ASSIST**		**B9 ASSIST Total**	
	Spearma		**Spearma**		**Spearma**		**Spearma**		**Spearma**		**Spearma**	
Measures	**n's rho**	**p-values**	**n's rho**	**p-values**	**n's rho**	**p-values**	**n's rho**	**p-values**	**n's rho**	**p-values**	**n's rho**	**p-values**
S2.C3.Nc.0to100ms.Amp.mV.	0.0468	0.6943	0.2365	0.0440 *	0.2673	0.0213 *	0.3135	0.0069 *	0.1013	0.3939	0.1606	0.1747
S2.C3.Nc.0to100ms.Lat.ms.	0.1793	0.1291	-0.0128	0.9146	-0.2495	0.0321 *	-0.0007	0.9954	0.1543	0.1924	-0.0298	0.8024
S2.C4.Nc.0to100ms.Amp.mV.	-0.0543	0.6482	0.1759	0.1367	0.2776	0.0167 *	0.2269	0.0536	0.0352	0.7676	0.1185	0.3179
S2.C4.Nc.0to100ms.Lat.ms.	0.2098	0.0749	0.0526	0.6584	-0.1558	0.1850	0.0745	0.5309	0.0490	0.6803	0.1403	0.2363
S2.FP1.P1.0to150ms.Amp.mV.	-0.1881	0.1400	0.0661	0.6066	0.1115	0.3804	0.1295	0.3116	0.0204	0.8736	0.0808	0.5289
S2.FP1.P1.0to150ms.Lat.ms.	-0.1072	0.4030	0.1446	0.2581	0.0082	0.9485	0.1140	0.3735	0.0872	0.4969	0.1049	0.4132
S2.FP2.P1.0to150ms.Amp.mV.	-0.0971	0.4490	0.1535	0.2297	0.1533	0.2265	0.1347	0.2924	0.0139	0.9142	0.0415	0.7469
S2.FP2.P1.0to150ms.Lat.ms.	-0.0091	0.9434	0.0917	0.4747	0.1546	0.2225	0.0018	0.9887	-0.0581	0.6510	0.1077	0.4007
S2.F3.P1.0to150ms.Amp.mV.	-0.1238	0.3000	0.1676	0.1595	0.2966	0.0108 *	0.2206	0.0626	0.0935	0.4348	0.1056	0.3772
S2.F3.P1.0to150ms.Lat.ms.	-0.1307	0.2737	-0.0094	0.9374	-0.0173	0.8844	0.0710	0.5536	-0.1146	0.3377	0.0085	0.9436
S2.F4.P1.0to150ms.Amp.mV.	-0.1883	0.1158	0.2259	0.0582	0.2250	0.0575	0.2971	0.0119 *	0.0798	0.5080	0.0629	0.6024
S2.F4.P1.0to150ms.Lat.ms.	-0.1307	0.2774	-0.0167	0.8900	0.1067	0.3725	0.1159	0.3359	-0.1523	0.2048	-0.0416	0.7305
S2.F7.P1.0to150ms.Amp.mV.	-0.1153	0.3314	-0.0496	0.6769	0.1440	0.2209	0.1524	0.1979	-0.0668	0.5743	0.0896	0.4509
S2.F7.P1.0to150ms.Lat.ms.	-0.1308	0.2701	-0.1087	0.3599	0.2310	0.0477 *	0.1296	0.2746	-0.1089	0.3593	-0.0021	0.9858
S2.F8.P1.0to150ms.Amp.mV.	-0.1470	0.2178	-0.0170	0.8871	0.0395	0.7401	0.0270	0.8219	-0.1265	0.2897	0.0139	0.9074
S2.F8.P1.0to150ms.Lat.ms.	0.0769	0.5211	0.0145	0.9039	-0.0093	0.9377	0.0276	0.8179	0.0615	0.6077	0.0498	0.6781
S2.P3.Nc.0to100ms.Amp.mV.	0.0539	0.6508	0.2439	0.0376 *	0.1299	0.2699	0.0936	0.4309	0.1304	0.2715	0.1375	0.2460
S2.P3.Nc.0to100ms.Lat.ms.	0.1978	0.0934	-0.0060	0.9601	-0.2106	0.0717	0.0625	0.5994	0.1285	0.2787	0.0542	0.6485
S2.P4.Nc.0to100ms.Amp.mV.	0.0025	0.9836	0.1726	0.1471	0.2329	0.0474 *	0.0688	0.5659	-0.0311	0.7952	0.0586	0.6248
S2.P4.Nc.0to100ms.Lat.ms.	0.0795	0.5069	0.0576	0.6308	0.0166	0.8892	-0.0354	0.7681	0.0958	0.4235	0.1728	0.1467
S2.FP1.N1.75to200ms.Amp.mV.	-0.0964	0.4525	0.0876	0.4950	0.0794	0.5330	0.1853	0.1461	-0.0040	0.9750	0.1266	0.3228
S2.FP1.N1.75to200ms.Lat.ms.	-0.0747	0.5604	-0.0412	0.7486	0.0745	0.5587	-0.0169	0.8951	-0.0472	0.7134	-0.1258	0.3258
S2.FP2.N1.75to200ms.Amp.mV.	-0.0770	0.5485	0.1073	0.4027	0.1044	0.4115	0.0602	0.6391	0.0226	0.8604	0.0441	0.7316
S2.FP2.N1.75to200ms.Lat.ms.	-0.0244	0.8496	-0.0151	0.9065	-0.0260	0.8385	-0.0933	0.4670	-0.0235	0.8546	-0.0939	0.4642
S2.F3.N1.75to200ms.Amp.mV.	-0.0130	0.9136	0.0965	0.4199	0.1856	0.1160	0.2243	0.0582	0.1033	0.3879	0.1530	0.1996
S2.F3.N1.75to200ms.Lat.ms.	-0.0406	0.7346	-0.0636	0.5956	0.0167	0.8884	-0.1754	0.1405	-0.0715	0.5503	-0.0797	0.5060
S2.F4.N1.75to200ms.Amp.mV.	-0.1093	0.3640	0.0663	0.5831	0.1374	0.2496	0.2473	0.0376 *	0.0303	0.8020	-0.0062	0.9591
S2.F4.N1.75to200ms.Lat.ms.	-0.0359	0.7661	0.0269	0.8236	-0.1682	0.1579	-0.0957	0.4273	-0.0284	0.8143	0.0177	0.8837
S2.F7.N1.75to200ms.Amp.mV.	-0.0798	0.5023	-0.0276	0.8168	0.0985	0.4036	0.1233	0.2989	-0.0189	0.8740	0.1286	0.2782
S2.F7.N1.75to200ms.Lat.ms.	-0.0082	0.9449	0.0068	0.9545	-0.0079	0.9468	-0.0286	0.8103	0.0929	0.4342	-0.0979	0.4098
S2.F8.N1.75to200ms.Amp.mV.	-0.1478	0.2154	-0.0844	0.4809	-0.0395	0.7398	-0.0441	0.7131	-0.1513	0.2047	-0.0814	0.4969
S2.F8.N1.75to200ms.Lat.ms.	-0.0065	0.9568	0.1401	0.2404	-0.1154	0.3309	-0.0586	0.6249	0.0908	0.4481	0.0548	0.6474
S2.C3.N2.100to250ms.Amp.mV.	-0.0487	0.6822	0.1601	0.1761	0.4335	0.0001 *	0.2980	0.0105 *	-0.0019	0.9875	0.1232	0.2992
S2.C3.N2.100to250ms.Lat.ms.	0.2712	0.0203 *	0.0328	0.7827	-0.1396	0.2355	-0.0024	0.9838	0.1388	0.2415	0.0994	0.4026
S2.C4.N2.100to250ms.Amp.mV.	-0.1095	0.3565	0.1820	0.1234	0.3437	0.0027 *	0.2312	0.0490 *	0.0230	0.8466	0.0682	0.5664
S2.C4.N2.100to250ms.Lat.ms.	0.2788	0.0169 *	-0.0418	0.7258	-0.0193	0.8704	0.0026	0.9828	-0.0054	0.9640	0.1576	0.1830
S2.P3.N2.100to300ms.Amp.mV.	-0.1063	0.3708	0.1358	0.2520	0.2639	0.0231 *	0.1640	0.1655	-0.1156	0.3303	0.0413	0.7284
S2.P3.N2.100to300ms.Lat.ms.	-0.0800	0.5011	-0.1480	0.2115	0.0234	0.8431	-0.0217	0.8557	0.0894	0.4517	-0.0668	0.5745
S2.P4.N2.100to300ms.Amp.mV.	-0.1060	0.3756	0.0889	0.4578	0.2001	0.0896	0.0914	0.4449	-0.0994	0.4063	-0.0708	0.5544
S2.P4.N2.100to300ms.Lat.ms.	0.2103	0.0762	-0.0916	0.4440	-0.0617	0.6039	-0.0654	0.5851	0.0626	0.6014	0.1412	0.2367
S2.FP1.P3.150to450ms.Amp.mV.	-0.1808	0.1561	0.0495	0.7003	0.0946	0.4570	0.0219	0.8650	-0.0874	0.4959	0.0425	0.7409
S2.FP1.P3.150to450ms.Lat.ms.	-0.1068	0.4049	-0.0227	0.8600	0.2579	0.0397 *	-0.0230	0.8581	0.0579	0.6520	0.0403	0.7538
S2.FP2.P3.150to450ms.Amp.mV.	-0.0806	0.5299	0.2155	0.0898	0.1878	0.1373	0.0967	0.4510	-0.0883	0.4914	0.1105	0.3885
S2.FP2.P3.150to450ms.Lat.ms.	0.0324	0.8007	0.1430	0.2636	0.0847	0.5060	0.0725	0.5722	0.0844	0.5106	0.1653	0.1953
S2.F3.P3.150to450ms.Amp.mV.	-0.1658	0.1641	-0.0352	0.7693	0.2708	0.0205 *	0.0110	0.9271	-0.1421	0.2338	0.0200	0.8673
S2.F3.P3.150to450ms.Lat.ms.	-0.0881	0.4619	-0.0371	0.7570	0.3015	0.0095 *	-0.0798	0.5050	-0.1103	0.3564	-0.1200	0.3155
S2.F4.P3.150to450ms.Amp.mV.	-0.2514	0.0345 *	-0.0194	0.8727	0.2266	0.0556	0.1598	0.1832	-0.1951	0.1029	-0.0299	0.8046
S2.F4.P3.150to450ms.Lat.ms.	0.0578	0.6320	0.0169	0.8890	0.0971	0.4172	0.1770	0.1398	0.0579	0.6318	0.0302	0.8025
S2.F7.P3.150to450ms.Amp.mV.	-0.0581	0.6252	0.0348	0.7702	0.3038	0.0085 *	0.1340	0.2583	-0.0843	0.4781	0.1848	0.1176
S2.F7.P3.150to450ms.Lat.ms.	-0.0949	0.4244	0.0585	0.6227	-0.0117	0.9213	-0.0280	0.8141	0.0026	0.9823	-0.1078	0.3638
S2.F8.P3.150to450ms.Amp.mV.	-0.0770	0.5203	-0.0746	0.5332	0.1525	0.1977	0.0516	0.6666	-0.2494	0.0346 *	0.0024	0.9841
S2.F8.P3.150to450ms.Lat.ms.	0.0426	0.7224	-0.0070	0.9535	0.2441	0.0374 *	0.0874	0.4655	-0.1061	0.3750	0.0101	0.9329
S2.C3.P3.250to500ms.Amp.mV.	-0.1187	0.3173	0.0173	0.8842	0.2603	0.0251 *	0.0714	0.5480	-0.1781	0.1317	-0.1147	0.3340
S2.C3.P3.250to500ms.Lat.ms.	0.0405	0.7338	-0.0954	0.4220	0.0673	0.5689	-0.1141	0.3366	-0.0140	0.9061	-0.1111	0.3494
S2.C4.P3.250to500ms.Amp.mV.	-0.1250	0.2922	0.0401	0.7361	0.1713	0.1446	0.0214	0.8577	-0.1613	0.1727	-0.1020	0.3907
S2.C4.P3.250to500ms.Lat.ms.	0.1956	0.0973	-0.0617	0.6039	-0.0523	0.6583	-0.0909	0.4446	0.0331	0.7812	0.0062	0.9583
S2.P3.P3.250to500ms.Amp.mV.	-0.0931	0.4334	0.0108	0.9275	0.1529	0.1935	-0.0284	0.8114	-0.2644	0.0238 *	-0.1653	0.1621
S2.P3.P3.250to500ms.Lat.ms.	-0.0439	0.7126	-0.2347	0.0456 *	0.0532	0.6527	-0.2401	0.0407 *	-0.1749	0.1389	-0.2724	0.0197 *
S2.P4.P3.250to500ms.Amp.mV.	-0.1295	0.2783	-0.0471	0.6945	0.0923	0.4374	-0.0509	0.6708	-0.2701	0.0218 *	-0.1722	0.1481
S2.P4.P3.250to500ms.Lat.ms.	0.0950	0.4274	-0.1512	0.2048	-0.0772	0.5162	-0.1515	0.2041	0.1385	0.2460	0.0634	0.5969
	B9 ASSIST		**B9 ASSIST**		**B7 ASRS PartB**		**B9 ASSIST**		**B9 ASSIST**		**B9 ASSIST Total**	
	Spearma		**Spearma**		**Spearma**		**Spearma**		**Spearma**		**Spearma**	
Measures	**n's rho**	**p-values**	**n's rho**	**p-values**	**n's rho**	**p-values**	**n's rho**	**p-values**	**n's rho**	**p-values**	**n's rho**	**p-values**
S3.C3.Nc.0to100ms.Amp.mV.	-0.0602	0.6130	-0.0243	0.8384	0.1396	0.2355	-0.0509	0.6691	0.0236	0.8430	-0.0640	0.5909
S3.C3.Nc.0to100ms.Lat.ms.	0.1304	0.2713	-0.0146	0.9026	-0.0234	0.8432	-0.1078	0.3642	0.1202	0.3112	0.0373	0.7541
S3.C4.Nc.0to100ms.Amp.mV.	-0.0860	0.4693	-0.0177	0.8816	0.1368	0.2453	-0.0434	0.7155	-0.0805	0.4985	-0.0651	0.5843
S3.C4.Nc.0to100ms.Lat.ms.	-0.0544	0.6476	-0.0579	0.6266	-0.0156	0.8950	-0.2346	0.0457 *	0.0630	0.5962	-0.0028	0.9809
S3.P3.P50.0to60ms.Amp.mV.	-0.1215	0.3057	-0.0463	0.6974	0.2366	0.0424 *	-0.0497	0.6761	-0.0823	0.4889	-0.1896	0.1081
S3.P3.P50.0to60ms.Lat.ms.	0.0139	0.9068	0.0741	0.5332	0.0406	0.7314	0.0845	0.4773	0.0243	0.8382	0.0448	0.7066
S3.P4.P50.0to60ms.Amp.mV.	-0.0645	0.5903	0.0102	0.9324	0.1929	0.1021	-0.0757	0.5273	-0.0506	0.6732	-0.0579	0.6292
S3.P4.P50.0to60ms.Lat.ms.	-0.0897	0.4538	-0.0012	0.9921	0.0301	0.8006	0.0984	0.4110	0.0525	0.6617	0.0868	0.4683
S3.FP1.P1.50to180ms.Amp.mV.	0.0552	0.6674	0.0574	0.6551	-0.0333	0.7939	0.2219	0.0805	-0.0081	0.9496	0.0960	0.4541
S3.FP1.P1.50to180ms.Lat.ms.	-0.1255	0.3272	0.0816	0.5251	-0.1397	0.2708	0.2069	0.1037	-0.0222	0.8631	0.0290	0.8217
S3.FP2.P1.50to180ms.Amp.mV.	-0.0862	0.5018	-0.0795	0.5356	-0.0632	0.6200	0.1120	0.3822	0.0399	0.7562	-0.0085	0.9471

S3.FP2.P1.50to180ms.Lat.ms.	-0.1655	0.1950	-0.0763	0.5523	-0.1142	0.3688	0.0586	0.6483	0.1041	0.4168	-0.0885	0.4906
S3.F3.P1.50to180ms.Amp.mV.	-0.0436	0.7160	-0.1513	0.2045	-0.0784	0.5097	-0.0803	0.5025	-0.0572	0.6332	-0.1399	0.2413
S3.F3.P1.50to180ms.Lat.ms.	0.1648	0.1895	0.1402	0.2653	-0.2516	0.0416 *	0.1967	0.1163	0.0510	0.6867	0.1051	0.4049
S3.F4.P1.50to180ms.Amp.mV.	-0.1133	0.3470	-0.0566	0.6392	0.0070	0.9533	-0.1673	0.1631	-0.1141	0.3434	-0.0880	0.4656
S3.F4.P1.50to180ms.Lat.ms.	-0.1128	0.3708	0.0040	0.9745	-0.0560	0.6551	0.0376	0.7663	-0.1186	0.3467	-0.1064	0.3988
S3.F7.P1.50to180ms.Amp.mV.	-0.1274	0.2829	-0.1202	0.3109	-0.0229	0.8467	0.0807	0.4972	-0.0405	0.7336	-0.1588	0.1795
S3.F7.P1.50to180ms.Lat.ms.	-0.0813	0.5096	0.1058	0.3906	0.0018	0.9885	0.0936	0.4479	0.1161	0.3457	-0.0527	0.6693
S3.F8.P1.50to180ms.Amp.mV.	0.0545	0.6492	0.1447	0.2254	0.1315	0.2673	0.1766	0.1379	0.0329	0.7840	0.1630	0.1713
S3.F8.P1.50to180ms.Lat.ms.	0.0687	0.5663	0.2339	0.0480 *	-0.0296	0.8038	0.3307	0.0045 *	0.1232	0.3025	0.1567	0.1888
S3.P3.N1.50to110ms.Amp.mV.	-0.1099	0.3548	0.0039	0.9741	0.1120	0.3420	-0.0164	0.8905	-0.0617	0.6039	-0.1648	0.1635
S3.P3.N1.50to110ms.Lat.ms.	0.0569	0.6327	-0.0438	0.7127	-0.0206	0.8616	-0.1081	0.3625	0.0309	0.7950	0.0391	0.7426
S3.P4.N1.50to110ms.Amp.mV.	-0.0870	0.4676	0.0642	0.5918	0.1357	0.2525	-0.0792	0.5086	-0.1074	0.3690	-0.0996	0.4050
S3.P4.N1.50to110ms.Lat.ms.	-0.0132	0.9121	0.0081	0.9465	0.0891	0.4534	0.1122	0.3481	0.1074	0.3691	0.2055	0.0833
S3.C3.P1.75to175ms.Amp.mV.	0.0466	0.6955	0.1128	0.3418	0.1305	0.2678	0.0498	0.6755	-0.0107	0.9286	0.0101	0.9325
S3.C3.P1.75to175ms.Lat.ms.	0.0677	0.5691	-0.0704	0.5538	-0.2732	0.0185 *	-0.0838	0.4807	-0.0816	0.4927	0.0542	0.6487
S3.C4.P1.75to175ms.Amp.mV.	-0.1506	0.2036	-0.0835	0.4827	0.1174	0.3191	-0.1272	0.2834	-0.1655	0.1618	-0.1292	0.2758
S3.C4.P1.75to175ms.Lat.ms.	-0.1716	0.1465	0.0110	0.9261	-0.0876	0.4581	0.1432	0.2269	0.0062	0.9584	-0.0202	0.8651
S3.P3.P2.100to180ms.Amp.mV.	-0.1042	0.3804	-0.1202	0.3111	0.1130	0.3378	-0.0548	0.6451	-0.2095	0.0753	-0.2165	0.0658
S3.P3.P2.100to180ms.Lat.ms.	-0.0730	0.5393	-0.0237	0.8422	-0.0575	0.6264	0.0453	0.7035	0.0094	0.9369	-0.0622	0.6011
S3.P4.P2.100to180ms.Amp.mV.	-0.1291	0.2796	-0.0850	0.4778	0.1775	0.1331	-0.1228	0.3040	-0.2877	0.0143 *	-0.1253	0.2943
S3.P4.P2.100to180ms.Lat.ms.	0.0632	0.5980	-0.0420	0.7262	0.0863	0.4678	0.1267	0.2887	-0.1240	0.2992	0.0730	0.5422
S3.C3.N2.120to220ms.Amp.mV.	0.0476	0.6893	0.1274	0.2828	0.0809	0.4930	0.0660	0.5791	0.0259	0.8279	0.0627	0.5982
S3.C3.N2.120to220ms.Lat.ms.	0.0212	0.8588	0.0261	0.8267	0.0538	0.6488	-0.0553	0.6419	0.0809	0.4962	0.0358	0.7638
S3.C4.N2.120to220ms.Amp.mV.	-0.0377	0.7513	0.0348	0.7698	0.0688	0.5603	0.0233	0.8448	-0.0823	0.4887	0.0139	0.9069
S3.C4.N2.120to220ms.Lat.ms.	0.1072	0.3665	-0.0413	0.7287	0.0137	0.9080	-0.1799	0.1277	0.0548	0.6451	0.0060	0.9598
S3.P3.N2.150to250ms.Amp.mV.	-0.0481	0.6863	0.0208	0.8614	0.0835	0.4795	0.0453	0.7035	-0.1066	0.3695	-0.0570	0.6320
S3.P3.N2.150to250ms.Lat.ms.	-0.1442	0.2234	-0.1183	0.3189	0.0291	0.8054	-0.0910	0.4438	0.0353	0.7669	-0.2074	0.0783
S3.P4.N2.150to250ms.Amp.mV.	-0.0536	0.6548	0.0464	0.6985	0.0806	0.4978	-0.0064	0.9575	-0.1497	0.2096	-0.0373	0.7555
S3.P4.N2.150to250ms.Lat.ms.	-0.0741	0.5360	-0.1810	0.1282	-0.0290	0.8073	-0.3353	0.0040 *	-0.1300	0.2765	-0.1580	0.1851
S3.C3.P3.200to650ms.Amp.mV.	-0.0018	0.9880	-0.0564	0.6358	-0.0462	0.6956	-0.1839	0.1193	-0.2244	0.0563	-0.0651	0.5845
S3.C3.P3.200to650ms.Lat.ms.	-0.0702	0.5552	-0.0391	0.7425	-0.1142	0.3326	-0.2065	0.0796	-0.1026	0.3878	-0.1831	0.1210
S3.C4.P3.200to650ms.Amp.mV.	-0.1023	0.3891	-0.1332	0.2611	-0.0805	0.4953	-0.1485	0.2099	-0.2062	0.0801	-0.1500	0.2054
S3.C4.P3.200to650ms.Lat.ms.	-0.1078	0.3639	-0.0787	0.5080	-0.0326	0.7826	-0.1389	0.2412	-0.0561	0.6374	-0.1030	0.3860
S3.FP1.P3.200to350ms.Amp.mV.	0.0095	0.9408	0.0078	0.9516	-0.1166	0.3589	0.1256	0.3267	-0.0429	0.7383	0.0029	0.9820
S3.FP1.P3.200to350ms.Lat.ms.	0.0580	0.6514	0.0445	0.7290	-0.2215	0.0785	-0.1317	0.3035	0.0462	0.7190	0.0335	0.7942
S3.FP2.P3.200to350ms.Amp.mV.	-0.0795	0.5355	-0.0639	0.6186	-0.1953	0.1220	0.0188	0.8840	0.0185	0.8853	-0.0919	0.4736
S3.FP2.P3.200to350ms.Lat.ms.	-0.0380	0.7672	0.0138	0.9147	-0.0930	0.4646	-0.1638	0.1994	0.0715	0.5776	-0.0567	0.6592
S3.F3.P3.200to350ms.Amp.mV.	-0.0311	0.7956	-0.0919	0.4427	-0.2348	0.0456 *	-0.1004	0.4016	-0.1112	0.3524	-0.1343	0.2605
S3.F3.P3.200to350ms.Lat.ms.	-0.0154	0.8976	-0.0347	0.7724	-0.2177	0.0643	-0.1093	0.3609	-0.0142	0.9059	-0.0531	0.6575
S3.F4.P3.200to350ms.Amp.mV.	-0.1447	0.2287	-0.0092	0.9392	-0.1675	0.1596	-0.0987	0.4130	-0.0927	0.4421	-0.1300	0.2797
S3.F4.P3.200to350ms.Lat.ms.	0.0184	0.8792	-0.0248	0.8371	-0.0205	0.8643	-0.1109	0.3573	0.0660	0.5846	0.0179	0.8822
S3.F7.P3.200to350ms.Amp.mV.	-0.0537	0.6518	-0.0293	0.8058	-0.1078	0.3606	0.0674	0.5708	-0.0381	0.7488	-0.0882	0.4580
S3.F7.P3.200to350ms.Lat.ms.	-0.1520	0.1993	-0.0381	0.7491	0.1429	0.2246	-0.1297	0.2743	-0.0693	0.5599	-0.0561	0.6371
S3.F8.P3.200to350ms.Amp.mV.	0.0171	0.8864	0.0558	0.6417	0.0261	0.8265	0.1323	0.2681	-0.0276	0.8182	0.0644	0.5907
S3.F8.P3.200to350ms.Lat.ms.	-0.1822	0.1256	-0.0931	0.4366	0.0723	0.5432	-0.0848	0.4787	-0.0707	0.5550	-0.0401	0.7379
S3.FP1.P3.200to400ms.Amp.mV.	-0.0348	0.7866	-0.0079	0.9509	-0.1487	0.2410	0.0532	0.6787	-0.0554	0.6664	-0.0606	0.6371
S3.FP1.P3.200to400ms.Lat.ms.	-0.0787	0.5397	0.0728	0.5709	-0.0608	0.6331	-0.2533	0.0452 *	0.1555	0.2237	-0.0368	0.7749
S3.FP2.P3.200to400ms.Amp.mV.	-0.0794	0.5361	-0.0368	0.7748	-0.2423	0.0537	-0.0039	0.9759	0.0596	0.6429	-0.0999	0.4361
S3.FP2.P3.200to400ms.Lat.ms.	-0.0120	0.9258	0.1716	0.1786	-0.0852	0.5032	-0.1243	0.3316	0.0614	0.6328	0.0655	0.6102
S3.F3.P3.200to400ms.Amp.mV.	-0.0478	0.6902	-0.1263	0.2904	-0.2512	0.0321 *	-0.1633	0.1706	-0.1215	0.3092	-0.1490	0.2118
S3.F3.P3.200to400ms.Lat.ms.	-0.1177	0.3248	-0.0977	0.4144	-0.1489	0.2085	-0.1393	0.2433	-0.0693	0.5630	-0.0660	0.5820
S3.F4.P3.200to400ms.Amp.mV.	-0.1777	0.1381	-0.0629	0.6025	-0.2148	0.0700	-0.1839	0.1248	-0.1192	0.3223	-0.1882	0.1160
S3.F4.P3.200to400ms.Lat.ms.	-0.1272	0.2905	-0.0994	0.4097	-0.0994	0.4063	-0.3089	0.0088 *	-0.0253	0.8341	-0.0643	0.5940
S3.F7.P3.200to400ms.Amp.mV.	-0.0249	0.8343	-0.0431	0.7174	-0.0646	0.5845	0.0569	0.6327	-0.0387	0.7452	-0.0512	0.6671
S3.F7.P3.200to400ms.Lat.ms.	-0.0651	0.5845	0.0003	0.9978	-0.0149	0.8997	-0.1173	0.3229	-0.0216	0.8562	-0.0265	0.8239
S3.F8.P3.200to400ms.Amp.mV.	0.0176	0.8830	0.0270	0.8218	0.0212	0.8586	0.0985	0.4103	-0.0561	0.6398	0.0352	0.7691
S3.F8.P3.200to400ms.Lat.ms.	-0.1907	0.1085	-0.0803	0.5026	0.0083	0.9444	-0.1267	0.2888	-0.0215	0.8575	-0.0992	0.4069
S3.FP1.Wide.200to800ms.Amp.mV	-0.0164	0.8987	-0.1129	0.3782	-0.3500	0.0046 *	-0.1623	0.2039	-0.1099	0.3913	-0.0967	0.4507
S3.FP1.Wide.200to800ms.Lat.ms.	0.1652	0.1957	-0.1413	0.2692	0.1401	0.2694	0.0052	0.9679	-0.2062	0.1049	0.0581	0.6510
S3.FP2.Wide.200to800ms.Amp.mV	-0.0602	0.6394	-0.0562	0.6616	-0.2707	0.0305 *	-0.1473	0.2494	-0.0172	0.8933	-0.1252	0.3284
S3.FP2.Wide.200to800ms.Lat.ms.	0.1104	0.3890	0.0298	0.8164	-0.0114	0.9288	0.0428	0.7389	-0.0011	0.9930	0.1401	0.2733
S3.F3.Wide.200to800ms.Amp.mV.	-0.1203	0.3140	-0.1925	0.1052	-0.1830	0.1212	-0.2116	0.0744	-0.2508	0.0336 *	-0.2395	0.0427 *
S3.F3.Wide.200to800ms.Lat.ms.	0.0547	0.6480	0.0002	0.9989	-0.0871	0.4637	-0.0028	0.9815	-0.0448	0.7087	-0.0146	0.9030
S3.F4.Wide.200to800ms.Amp.mV.	-0.2224	0.0623	-0.1219	0.3114	-0.0953	0.4260	-0.2119	0.0760	-0.3088	0.0088 *	-0.1854	0.1215
S3.F4.Wide.200to800ms.Lat.ms.	0.0790	0.5124	0.0190	0.8748	0.2274	0.0548	0.0047	0.9690	-0.1879	0.1166	0.0426	0.7244
S3.F7.Wide.200to800ms.Amp.mV.	-0.0435	0.7146	-0.0457	0.7010	-0.0541	0.6470	-0.0237	0.8422	-0.1344	0.2571	-0.0387	0.7453
S3.F7.Wide.200to800ms.Lat.ms.	0.0175	0.8833	-0.0672	0.5723	0.0548	0.6429	-0.1259	0.2884	-0.0817	0.4918	0.0522	0.6609
S3.F8.Wide.200to800ms.Amp.mV.	-0.0795	0.5067	0.0425	0.7231	0.0382	0.7481	-0.0113	0.9250	-0.1488	0.2123	-0.0050	0.9666
S3.F8.Wide.200to800ms.Lat.ms.	0.0722	0.5470	0.2515	0.0331 *	0.0286	0.8103	0.0224	0.8515	0.0837	0.4846	0.1706	0.1519
S3.P3.P3.200to650ms.Amp.mV.	0.0352	0.7675	-0.1195	0.3141	0.1208	0.3052	0.0055	0.9631	-0.2497	0.0331 *	-0.0533	0.6541
S3.P3.P3.200to650ms.Lat.ms.	-0.0246	0.8364	-0.1036	0.3830	-0.1013	0.3906	-0.2039	0.0835	0.0885	0.4563	-0.1363	0.2501
S3.P4.P3.200to650ms.Amp.mV.	-0.0568	0.6356	-0.0912	0.4461	0.0261	0.8265	-0.1041	0.3843	-0.2534	0.0318 *	-0.1449	0.2247
S3.P4.P3.200to650ms.Lat.ms.	-0.0099	0.9341	-0.0985	0.4106	-0.1586	0.1803	-0.0738	0.5378	0.0101	0.9326	-0.0815	0.4963
S3.FP1.LPP.400to800ms.Amp.mV.	-0.0296	0.8177	-0.1188	0.3539	-0.3324	0.0073 *	-0.1760	0.1677	-0.1198	0.3498	-0.1061	0.4079
S3.FP1.LPP.400to800ms.Lat.ms.	0.0865	0.5003	-0.1121	0.3819	0.1021	0.4221	0.0211	0.8695	-0.1087	0.3966	0.0617	0.6312
S3.FP2.LPP.400to800ms.Amp.mV.	-0.0322	0.8019	-0.0474	0.7123	-0.2708	0.0304 *	-0.1661	0.1932	-0.0030	0.9814	-0.1075	0.4015
S3.FP2.LPP.400to800ms.Lat.ms.	0.0961	0.4537	-0.0661	0.6067	-0.0028	0.9822	0.0180	0.8885	-0.0841	0.5124	0.0387	0.7635
S3.F3.LPP.400to800ms.Amp.mV.	-0.1052	0.3792	-0.1793	0.1319	-0.1944	0.0993	-0.2346	0.0473 *	-0.2407	0.0417 *	-0.2514	0.0332 *
S3.F3.LPP.400to800ms.Lat.ms.	-0.0108	0.9285	-0.0207	0.8630	0.0575	0.6288	0.1317	0.2701	-0.0325	0.7861	0.0560	0.6405
S3.F4.LPP.400to800ms.Amp.mV.	-0.2166	0.0696	-0.1262	0.2943	-0.0623	0.6030	-0.2519	0.0341 *	-0.3265	0.0054 *	-0.2119	0.0760
S3.F4.LPP.400to800ms.Lat.ms.	0.1775	0.1386	0.0956	0.4278	0.2086	0.0786	0.1905	0.1116	-0.0466	0.6993	0.2062	0.0844
S3.F7.LPP.400to800ms.Amp.mV.	0.0078	0.9477	-0.0072	0.9520	-0.0737	0.5328	-0.0668	0.5746	-0.1034	0.3841	-0.0182	0.8782
S3.F7.LPP.400to800ms.Lat.ms.	0.0706	0.5529	0.0674	0.5712	0.0720	0.5424	0.0436	0.7141	0.0426	0.7206	0.1496	0.2066
S3.F8.LPP.400to800ms.Amp.mV.	-0.0522	0.6630	0.0449	0.7080	0.0681	0.5668	-0.0672	0.5748	-0.1256	0.2930	-0.0199	0.8684
S3.F8.LPP.400to800ms.Lat.ms.	0.0455	0.7042	0.1336	0.2631	0.2218	0.0593	0.0822	0.4926	0.0449	0.7077	0.1454	0.2231

	B9 ASSIST Spearma		B9 ASSIST Spearma		B7 ASRS PartB Spearma		B9 ASSIST Spearma		B9 ASSIST Spearma		B9 ASSIST Total Spearma	
Measures	**n's rho**	**p-values**	**n's rho**	**p-values**	**n's rho**	**p-values**	**n's rho**	**p-values**	**n's rho**	**p-values**	**n's rho**	**p-values**
TrickS.C3.P1.50to150ms.Amp.mV.	-0.0344	0.7727	0.1246	0.2937	0.1638	0.1632	0.0690	0.5616	-0.1068	0.3686	0.1003	0.3983

TrickS.C3.P1.50to150ms.Lat.ms.	0.0281	0.8134	0.2126	0.0710	-0.0775	0.5116	0.1346	0.2561	0.1080	0.3629	0.0116	0.9227
TrickS.C4.P1.50to150ms.Amp.mV.	-0.0340	0.7750	0.0810	0.4956	0.1615	0.1692	0.0941	0.4286	-0.0042	0.9720	0.0636	0.5928
TrickS.C4.P1.50to150ms.Lat.ms.	-0.1940	0.1000	-0.0841	0.4793	0.0244	0.8367	-0.0734	0.5372	-0.0584	0.6233	0.0483	0.6850
TrickS.P3.N1.50to150ms.Amp.mV.	-0.0615	0.6055	0.1000	0.4000	0.2033	0.0823	0.1064	0.3704	-0.0107	0.9285	0.1006	0.3970
TrickS.P3.N1.50to150ms.Lat.ms.	-0.0471	0.6923	0.0402	0.7354	-0.0674	0.5684	0.0087	0.9416	0.1667	0.1586	0.0577	0.6277
TrickS.P4.N1.50to150ms.Amp.mV.	0.0744	0.5313	0.2423	0.0389 *	0.0960	0.4159	0.1235	0.2979	0.0413	0.7287	0.1385	0.2427
TrickS.P4.N1.50to150ms.Lat.ms.	-0.1232	0.2990	-0.0885	0.4563	0.0283	0.8111	0.0090	0.9396	-0.0209	0.8606	-0.0482	0.6856
TrickS.FP1.P1.75to150ms.Amp.mV	0.0189	0.8759	0.0787	0.5144	-0.0132	0.9125	0.0526	0.6634	-0.1770	0.1397	-0.0021	0.9858
TrickS.FP1.P1.75to150ms.Lat.ms.	-0.0022	0.9852	0.1612	0.1793	-0.3262	0.0052 *	0.1954	0.1024	0.1835	0.1257	0.1426	0.2356
TrickS.FP2.P1.75to150ms.Amp.mV	0.0748	0.5354	0.0156	0.8971	0.1961	0.0988	0.0322	0.7897	-0.2009	0.0930	0.0976	0.4182
TrickS.FP2.P1.75to150ms.Lat.ms.	0.1285	0.2854	0.0777	0.5194	-0.0105	0.9301	0.2653	0.0254 *	0.1292	0.2827	0.2316	0.0520
TrickS.F3.P1.75to150ms.Amp.mV.	-0.0775	0.5175	-0.1048	0.3808	0.0468	0.6943	-0.1086	0.3639	-0.1534	0.1982	-0.0329	0.7839
TrickS.F3.P1.75to150ms.Lat.ms.	-0.0301	0.8020	-0.0554	0.6440	-0.1501	0.2049	-0.0884	0.4604	0.0714	0.5513	-0.1021	0.3936
TrickS.F4.P1.75to150ms.Amp.mV.	-0.1539	0.1968	-0.0585	0.6253	0.0532	0.6546	-0.1006	0.4007	-0.1169	0.3281	-0.0468	0.6961
TrickS.F4.P1.75to150ms.Lat.ms.	-0.1033	0.3881	0.0494	0.6800	-0.1005	0.3975	0.0584	0.6258	0.0801	0.5038	0.0066	0.9563
TrickS.F7.P1.75to150ms.Amp.mV.	-0.1349	0.2587	-0.0717	0.5494	0.1037	0.3825	0.0438	0.7146	-0.2253	0.0571	-0.1009	0.3990
TrickS.F7.P1.75to150ms.Lat.ms.	0.1119	0.3495	0.0713	0.5518	-0.1639	0.1658	0.1686	0.1567	0.1874	0.1150	0.0112	0.9258
TrickS.F8.P1.75to150ms.Amp.mV.	-0.0665	0.5789	-0.0201	0.8667	0.1049	0.3769	0.0538	0.6533	-0.1570	0.1877	0.0180	0.8810
TrickS.F8.P1.75to150ms.Lat.ms.	-0.0709	0.5540	0.2037	0.0861	0.0036	0.9758	0.1240	0.2992	0.3317	0.0044 *	0.0747	0.5329
TrickS.FP1.N1.100to200ms.Amp.m'	0.0733	0.5436	0.1104	0.3596	-0.0174	0.8850	0.0897	0.4569	-0.1685	0.1601	0.1134	0.3466
TrickS.FP1.N1.100to200ms.Lat.ms.	-0.1856	0.1213	-0.2594	0.0289 *	-0.0155	0.8973	-0.1077	0.3711	0.0327	0.7863	-0.3289	0.0051 *
TrickS.FP2.N1.100to200ms.Amp.m'	0.0721	0.5503	0.0021	0.9863	0.1415	0.2356	0.0089	0.9411	-0.2105	0.0780	0.0958	0.4270
TrickS.FP2.N1.100to200ms.Lat.ms.	-0.1104	0.3595	0.0175	0.8845	-0.0275	0.8183	-0.0713	0.5547	0.0183	0.8797	-0.1011	0.4016
TrickS.F3.N1.100to200ms.Amp.mV.	-0.0208	0.8622	-0.0179	0.8812	-0.0607	0.6101	0.0064	0.9575	0.0069	0.9545	0.0965	0.4199
TrickS.F3.N1.100to200ms.Lat.ms.	-0.1195	0.3172	0.1681	0.1582	-0.1121	0.3450	-0.0127	0.9155	0.1601	0.1791	-0.0071	0.9526
TrickS.F4.N1.100to200ms.Amp.mV.	-0.0123	0.9185	0.0070	0.9533	0.0335	0.7786	0.0111	0.9264	0.0411	0.7319	0.0476	0.6911
TrickS.F4.N1.100to200ms.Lat.ms.	-0.1336	0.2631	0.0963	0.4209	-0.0512	0.6673	0.0126	0.9162	-0.0289	0.8097	-0.0451	0.7066
TrickS.F7.N1.100to200ms.Amp.mV.	-0.0442	0.7125	0.0407	0.7343	0.0580	0.6260	0.0492	0.6816	-0.0948	0.4285	0.0039	0.9741
TrickS.F7.N1.100to200ms.Lat.ms.	0.0252	0.8337	0.0010	0.9931	-0.2001	0.0897	-0.0047	0.9687	0.0898	0.4533	0.0851	0.4773
TrickS.F8.N1.100to200ms.Amp.mV.	0.0430	0.7197	-0.0146	0.9034	0.0559	0.6387	0.0457	0.7028	-0.0671	0.5754	0.0977	0.4144
TrickS.F8.N1.100to200ms.Lat.ms.	-0.1837	0.1225	0.0329	0.7836	-0.0578	0.6269	-0.0326	0.7855	-0.1619	0.1743	-0.2522	0.0326 *
TrickS.P3.P1.100to200ms.Amp.mV.	0.0273	0.8188	0.1246	0.2934	0.2507	0.0312 *	0.2055	0.0811	-0.0937	0.4304	0.1080	0.3630
TrickS.P3.P1.100to200ms.Lat.ms.	0.1394	0.2397	-0.0483	0.6849	0.0861	0.4658	0.2069	0.0791	0.1276	0.2822	0.1021	0.3903
TrickS.P4.P1.100to200ms.Amp.mV.	0.0801	0.5006	0.1381	0.2440	0.1559	0.1846	0.1246	0.2935	-0.1198	0.3129	0.1274	0.2827
TrickS.P4.P1.100to200ms.Lat.ms.	0.0097	0.9348	0.1411	0.2337	-0.0480	0.6846	0.2845	0.0147 *	0.2305	0.0497 *	0.1517	0.2001
TrickS.P3.N2.150to250ms.Amp.mV	0.0578	0.6271	0.1821	0.1231	0.2790	0.0161 *	0.1518	0.1997	-0.0848	0.4754	0.1090	0.3586
TrickS.P3.N2.150to250ms.Lat.ms.	-0.3687	0.0013 *	-0.1560	0.1874	0.0484	0.6820	-0.1513	0.2012	-0.1337	0.2595	-0.2409	0.0401 *
TrickS.P4.N2.150to250ms.Amp.mV	0.1496	0.2064	0.1424	0.2295	0.0824	0.4851	0.1083	0.3616	-0.0812	0.4948	0.0745	0.5309
TrickS.P4.N2.150to250ms.Lat.ms.	-0.0393	0.7412	0.0835	0.4824	0.0210	0.8594	0.1999	0.0899	0.1351	0.2543	0.1327	0.2631
TrickS.C3.P2.175to300ms.Amp.mV	0.0650	0.5846	0.2228	0.0582	0.1719	0.1430	0.1688	0.1535	0.0106	0.9291	0.2305	0.0498 *
TrickS.C3.P2.175to300ms.Lat.ms.	-0.0480	0.6865	0.2043	0.0829	0.0394	0.7386	-0.0071	0.9525	0.1437	0.2251	-0.0019	0.9869
TrickS.C4.P2.175to300ms.Amp.mV	-0.0118	0.9210	0.0757	0.5245	0.1457	0.2156	0.1299	0.2733	0.0935	0.4312	0.1001	0.3993
TrickS.C4.P2.175to300ms.Lat.ms.	-0.0418	0.7254	0.0944	0.4269	-0.0415	0.7254	0.0532	0.6550	0.1651	0.1627	-0.0294	0.8051
TrickS.FP1.P3.200to450ms.Amp.m'	-0.0057	0.9621	0.1979	0.0980	0.0526	0.6611	0.1253	0.2978	-0.2225	0.0621	0.1725	0.1503
TrickS.FP1.P3.200to450ms.Lat.ms.	-0.0094	0.9380	0.1502	0.2112	0.1585	0.1837	0.1044	0.3861	-0.1121	0.3522	0.0070	0.9535
TrickS.FP2.P3.200to450ms.Amp.m'	0.0575	0.6341	-0.0921	0.4447	0.2140	0.0710	-0.0624	0.6050	-0.2650	0.0255 *	0.0552	0.6473
TrickS.FP2.P3.200to450ms.Lat.ms.	0.0798	0.5084	0.1249	0.2992	0.2465	0.0369 *	0.2206	0.0645	0.0434	0.7192	-0.0140	0.9080
TrickS.F3.P3.200to450ms.Amp.mV.	-0.0224	0.8520	0.0086	0.9429	0.1519	0.1995	0.0396	0.7410	-0.1625	0.1726	0.0659	0.5824
TrickS.F3.P3.200to450ms.Lat.ms.	-0.0558	0.6417	0.0250	0.8348	0.1154	0.3311	0.0560	0.6401	-0.1903	0.1094	-0.1380	0.2475
TrickS.F4.P3.200to450ms.Amp.mV.	-0.1276	0.2855	0.0256	0.8307	0.1608	0.1742	0.0909	0.4478	-0.0883	0.4610	-0.0050	0.9667
TrickS.F4.P3.200to450ms.Lat.ms.	-0.0428	0.7209	0.0878	0.4634	0.2689	0.0214 *	0.0977	0.4144	-0.0391	0.7442	0.0240	0.8417
TrickS.F7.P3.200to450ms.Amp.mV.	-0.1257	0.2928	0.0794	0.5075	0.1635	0.1670	0.0507	0.6723	-0.1813	0.1274	-0.0710	0.5532
TrickS.F7.P3.200to450ms.Lat.ms.	-0.0285	0.8119	0.0023	0.9844	0.0751	0.5280	-0.0745	0.5338	-0.1118	0.3497	-0.2046	0.0848
TrickS.F8.P3.200to450ms.Amp.mV.	-0.0642	0.5923	-0.0754	0.5288	0.1474	0.2132	0.0297	0.8045	-0.1376	0.2491	0.0193	0.8719
TrickS.F8.P3.200to450ms.Lat.ms.	-0.0309	0.7964	0.0535	0.6553	-0.0766	0.5195	-0.0416	0.7285	-0.0013	0.9915	-0.1360	0.2546
TrickS.P3.P2.200to300ms.Amp.mV.	0.0345	0.7718	0.1838	0.1196	0.1616	0.1691	0.1451	0.2205	0.0081	0.9457	0.1327	0.2630
TrickS.P3.P2.200to300ms.Lat.ms.	0.2166	0.0657	0.3479	0.0026 *	0.0135	0.9089	0.1279	0.2807	0.1866	0.1139	0.2331	0.0472 *
TrickS.P4.P2.200to300ms.Amp.mV.	0.1294	0.2753	0.2260	0.0545	0.0886	0.4529	0.1317	0.2669	0.0646	0.5869	0.1420	0.2307
TrickS.P4.P2.200to300ms.Lat.ms.	0.2078	0.0777	0.2362	0.0442 *	0.0095	0.9362	0.1448	0.2215	0.2632	0.0245 *	0.1788	0.1301
TrickS.P3.N3.250to375ms.Amp.mV	0.0830	0.4850	0.2584	0.0273 *	0.1488	0.2058	0.1520	0.1991	0.0766	0.5195	0.1276	0.2820
TrickS.P3.N3.250to375ms.Lat.ms.	0.0003	0.9982	0.0233	0.8451	0.1494	0.2038	0.0111	0.9256	-0.0414	0.7280	-0.0474	0.6902
TrickS.P4.N3.250to375ms.Amp.mV	0.1985	0.0923	0.3663	0.0014 *	-0.0294	0.8038	0.2450	0.0367 *	0.2322	0.0481 *	0.2354	0.0450 *
TrickS.P4.N3.250to375ms.Lat.ms.	-0.0193	0.8710	-0.0565	0.6352	0.1540	0.1902	-0.0325	0.7850	-0.1992	0.0911	-0.1001	0.3996
TrickS.C3.P3.300to600ms.Amp.mV	-0.0622	0.6011	0.1993	0.0910	0.1786	0.1278	0.1392	0.2402	-0.0373	0.7541	0.0435	0.7146
TrickS.C3.P3.300to600ms.Lat.ms.	-0.0070	0.9533	0.0141	0.9055	0.1013	0.3902	0.2177	0.0642	-0.0739	0.5344	0.0613	0.6063
TrickS.C4.P3.300to600ms.Amp.mV	-0.0549	0.6446	0.1136	0.3388	0.1820	0.1207	0.1643	0.1649	0.0979	0.4101	0.0414	0.7280
TrickS.C4.P3.300to600ms.Lat.ms.	0.0342	0.7740	-0.1201	0.3115	0.1236	0.2941	0.0073	0.9511	-0.2373	0.0433 *	-0.0273	0.8188
TrickS.P3.P3.300to650ms.Amp.mV.	0.0241	0.8398	0.1773	0.1335	0.0633	0.5920	0.1700	0.1504	-0.0050	0.9664	0.0558	0.6392
TrickS.P3.P3.300to650ms.Lat.ms.	-0.1347	0.2560	0.0079	0.9468	0.0331	0.7797	0.2378	0.0428 *	-0.0576	0.6285	-0.0422	0.7228
TrickS.P4.P3.300to650ms.Amp.mV.	0.0317	0.7903	0.2855	0.0143 *	-0.0064	0.9565	0.2539	0.0302 *	0.0914	0.4420	0.1765	0.1352
TrickS.P4.P3.300to650ms.Lat.ms.	-0.1789	0.1299	0.0903	0.4471	-0.0129	0.9133	0.0515	0.6654	-0.0679	0.5681	-0.0785	0.5091

D.2.2 Spearman Correlations of continuous variables for MAP and SCZ groups

Measure	Years with Diagnosis Spearma n's rho	p-value	B1 PANSS Positive Subscale Spearma n's rho	p-value
S3.RT	0.1984	0.1718	0.2551	0.0801
S3.Response	-0.1808	0.2139	-0.3679	0.0101 *
S3.Omit	0.1808	0.2139	0.3679	0.0101 *
NonT.Response	0.1243	0.3947	0.1921	0.1908
TrickS.Response	0.1119	0.4438	-0.0379	0.7980
S1.Response	0.0989	0.4989	-0.0600	0.6854
S2.Response	-0.1739	0.2321	-0.1279	0.3862
A.Total.Correct	-0.2172	0.1382	-0.4403	0.0017 *
A.S3.Delayed.Response	0.1690	0.2509	0.2924	0.0437 *
A.S3.Delayed.RT	0.3778	0.0081 *	0.0375	0.8002
A.S2.Responses	-0.0598	0.6863	-0.0965	0.5143
A.Omissions	0.2727	0.0608	0.2461	0.0918
A.TrickS.Responses	0.2713	0.0621	0.0047	0.9749
A.S3.RT	0.2599	0.0713	0.4255	0.0026 *
Measure	**Years with Spearma n's rho**	**p-value**	**B1 PANSS Spearma n's rho**	**p-value**
S1.FP1.P50.0to100ms.Amp.mV.	0.2025	0.2102	0.0418	0.7978
S1.FP1.P50.0to100ms.Lat.ms.	0.1618	0.3187	0.0472	0.7724
S1.FP2.P50.0to100ms.Amp.mV.	0.1188	0.4652	0.0042	0.9797
S1.FP2.P50.0to100ms.Lat.ms.	-0.1284	0.4296	-0.2166	0.1795
S1.F3.P50.0to100ms.Amp.mV.	0.1269	0.4062	0.2115	0.1630
S1.F3.P50.0to100ms.Lat.ms.	-0.1596	0.2949	-0.0381	0.8037
S1.F4.P50.0to100ms.Amp.mV.	0.0318	0.8378	0.1052	0.4969
S1.F4.P50.0to100ms.Lat.ms.	-0.0796	0.6077	0.1858	0.2271
S1.F7.P50.0to100ms.Amp.mV.	0.2305	0.1233	0.2259	0.1312
S1.F7.P50.0to100ms.Lat.ms.	0.0539	0.7222	-0.2086	0.1642
S1.F8.P50.0to100ms.Amp.mV.	0.0728	0.6348	-0.0069	0.9642
S1.F8.P50.0to100ms.Lat.ms.	-0.2767	0.0658	0.1183	0.4389
S1.P3.Nc.0to100ms.Amp.mV.	0.2200	0.1418	0.1689	0.2618
S1.P3.Nc.0to100ms.Lat.ms.	-0.0660	0.6630	0.0347	0.8189
S1.P4.Nc.0to100ms.Amp.mV.	0.1861	0.2211	0.1073	0.4828
S1.P4.Nc.0to100ms.Lat.ms.	0.0856	0.5759	0.2394	0.1132
S1.C3.P1.50to140ms.Amp.mV.	-0.0445	0.7690	-0.0542	0.7204
S1.C3.P1.50to140ms.Lat.ms.	-0.0126	0.9340	0.0094	0.9508
S1.C4.P1.50to140ms.Amp.mV.	-0.0319	0.8334	-0.1011	0.5037
S1.C4.P1.50to140ms.Lat.ms.	-0.1727	0.2512	-0.1931	0.1985
S1.P3.P1.50to150ms.Amp.mV.	-0.0660	0.6630	-0.0347	0.8188
S1.P3.P1.50to150ms.Lat.ms.	0.1573	0.2965	0.1603	0.2871
S1.P4.P1.50to150ms.Amp.mV.	-0.1136	0.4575	-0.1453	0.3411
S1.P4.P1.50to150ms.Lat.ms.	0.1271	0.4055	0.0686	0.6543
S1.Fp1.N1.75to200ms.Amp.mV.	0.1817	0.2556	0.1500	0.3492
S1.Fp1.N1.75to200ms.Lat.ms.	0.0839	0.6021	0.1412	0.3786
S1.Fp2.N1.75to200ms.Amp.mV.	0.1124	0.4841	0.0696	0.6653
S1.Fp2.N1.75to200ms.Lat.ms.	0.1875	0.2404	0.0169	0.9162
S1.F3.N1.75to200ms.Amp.mV.	0.1100	0.4721	0.1494	0.3274
S1.F3.N1.75to200ms.Lat.ms.	-0.0198	0.8975	0.3944	0.0073 *
S1.F4.N1.75to200ms.Amp.mV.	0.1590	0.3027	0.1118	0.4702
S1.F4.N1.75to200ms.Lat.ms.	-0.0383	0.8048	0.1305	0.3984
S1.F7.N1.75to200ms.Amp.mV.	0.1025	0.4978	0.0956	0.5275
S1.F7.N1.75to200ms.Lat.ms.	0.0874	0.5635	0.3156	0.0327 *
S1.F8.N1.75to200ms.Amp.mV.	-0.1079	0.4806	0.0195	0.8987
S1.F8.N1.75to200ms.Lat.ms.	0.3120	0.0370 *	0.0959	0.5309
S1.C3.N1.100to150ms.Amp.mV.	-0.0084	0.9560	0.0153	0.9197
S1.C3.N1.100to150ms.Lat.ms.	0.0103	0.9458	0.0242	0.8729

S1.C4.N1.100to150ms.Amp.mV.	0.1218	0.4202	0.0742	0.6242
S1.C4.N1.100to150ms.Lat.ms.	0.1787	0.2347	0.0506	0.7386
S1.P3.N1.120to180ms.Amp.mV.	0.0251	0.8686	-0.0184	0.9036
S1.P3.N1.120to180ms.Lat.ms.	0.0331	0.8271	0.0079	0.9585
S1.P4.N1.120to180ms.Amp.mV.	-0.0323	0.8330	-0.1272	0.4049
S1.P4.N1.120to180ms.Lat.ms.	0.1898	0.2117	0.0028	0.9854
S1.C3.P2.150to300ms.Amp.mV.	0.0534	0.7244	-0.0942	0.5333
S1.C3.P2.150to300ms.Lat.ms.	0.0635	0.6752	0.0716	0.6364
S1.C4.P2.150to300ms.Amp.mV.	0.0326	0.8299	-0.1410	0.3501
S1.C4.P2.150to300ms.Lat.ms.	-0.0130	0.9317	-0.0655	0.6654
S1.FP1.P2.150to350ms.Amp.mV.	0.3667	0.0199 *	-0.1306	0.4219
S1.FP1.P2.150to350ms.Lat.ms.	0.1993	0.2176	0.0663	0.6842
S1.FP2.P2.150to350ms.Amp.mV.	0.2437	0.1297	-0.0502	0.7582
S1.FP2.P2.150to350ms.Lat.ms.	0.1841	0.2556	0.2326	0.1487
S1.F3.P2.150to350ms.Amp.mV.	0.0696	0.6495	-0.0510	0.7392
S1.F3.P2.150to350ms.Lat.ms.	-0.1322	0.3867	-0.0356	0.8163
S1.F4.P2.150to350ms.Amp.mV.	0.1194	0.4400	0.1527	0.3224
S1.F4.P2.150to350ms.Lat.ms.	0.0621	0.6890	0.1579	0.3061
S1.F7.P2.150to350ms.Amp.mV.	0.2587	0.0826	0.0953	0.5286
S1.F7.P2.150to350ms.Lat.ms.	0.2499	0.0940	0.0810	0.5927
S1.F8.P2.150to350ms.Amp.mV.	-0.0642	0.6751	0.0802	0.6007
S1.F8.P2.150to350ms.Lat.ms.	0.1448	0.3425	-0.0314	0.8378
S1.FP1.P2.150to400ms.Amp.mV.	0.3689	0.0192 *	-0.1363	0.4017
S1.FP1.P2.150to400ms.Lat.ms.	0.1290	0.4276	0.2450	0.1275
S1.FP2.P2.150to400ms.Amp.mV.	0.2572	0.1092	-0.0433	0.7909
S1.FP2.P2.150to400ms.Lat.ms.	0.0881	0.5889	0.2316	0.1504
S1.F3.P2.150to400ms.Amp.mV.	0.1029	0.5013	0.0290	0.8502
S1.F3.P2.150to400ms.Lat.ms.	-0.0524	0.7325	0.1157	0.4490
S1.F4.P2.150to400ms.Amp.mV.	0.1222	0.4295	0.1486	0.3356
S1.F4.P2.150to400ms.Lat.ms.	0.0129	0.9339	0.0819	0.5972
S1.F7.P2.150to400ms.Amp.mV.	0.2563	0.0855	0.1120	0.4585
S1.F7.P2.150to400ms.Lat.ms.	0.1475	0.3280	0.1335	0.3766
S1.F8.P2.150to400ms.Amp.mV.	-0.0560	0.7147	0.0692	0.6514
S1.F8.P2.150to400ms.Lat.ms.	0.1337	0.3811	-0.0580	0.7052
S1.P3.P2.150to250ms.Amp.mV.	0.0799	0.5975	-0.0202	0.8940
S1.P3.P2.150to250ms.Lat.ms.	0.1822	0.2256	0.1680	0.2643
S1.P4.P2.150to250ms.Amp.mV.	-0.0182	0.9053	-0.1429	0.3490
S1.P4.P2.150to250ms.Lat.ms.	0.1581	0.2995	0.0090	0.9532
S1.P3.N2.200to350ms.Amp.mV.	-0.0148	0.9223	-0.0444	0.7697
S1.P3.N2.200to350ms.Lat.ms.	-0.0382	0.8012	0.1076	0.4764
S1.P4.N2.200to350ms.Amp.mV.	-0.1646	0.2800	-0.2559	0.0898
S1.P4.N2.200to350ms.Lat.ms.	0.1233	0.4198	0.1028	0.5014
S1.C3.P3.300to550.ms.Amp.mV.	0.0734	0.6278	-0.0810	0.5926
S1.C3.P3.300to550.ms.Lat.ms.	0.0210	0.8899	-0.1069	0.4795
S1.C4.P3.300to550.ms.Amp.mV.	0.0519	0.7321	0.0128	0.9326
S1.C4.P3.300to550.ms.Lat.ms.	0.0581	0.7013	-0.0277	0.8548
S1.P3.P3.300to550ms.Amp.mV.	0.0367	0.8086	0.0665	0.6604
S1.P3.P3.300to550ms.Lat.ms.	0.2279	0.1278	-0.0023	0.9877
S1.P4.P3.300to550ms.Amp.mV.	-0.0370	0.8095	-0.1797	0.2376
S1.P4.P3.300to550ms.Lat.ms.	0.2555	0.0903	0.2101	0.1659
	Years with		**B1 PANSS**	
Measure	**Spearman's rho**	**p-value**	**Spearman's rho**	**p-value**
S2.C3.Nc.0to100ms.Amp.mV.	0.2145	0.1523	0.2615	0.0792
S2.C3.Nc.0to100ms.Lat.ms.	-0.1127	0.4557	-0.2843	0.0555
S2.C4.Nc.0to100ms.Amp.mV.	0.2733	0.0661	0.2656	0.0745
S2.C4.Nc.0to100ms.Lat.ms.	-0.3616	0.0136 *	-0.2972	0.0449 *
S2.FP1.P1.0to150ms.Amp.mV.	0.1910	0.2378	0.2915	0.0680
S2.FP1.P1.0to150ms.Lat.ms.	0.0030	0.9855	0.2589	0.1067

S2.FP2.P1.0to150ms.Amp.mV.	0.1521	0.3488	0.0752	0.6445
S2.FP2.P1.0to150ms.Lat.ms.	-0.0322	0.8437	0.1647	0.3100
S2.F3.P1.0to150ms.Amp.mV.	0.1004	0.5115	0.1522	0.3182
S2.F3.P1.0to150ms.Lat.ms.	0.1234	0.4192	0.1457	0.3394
S2.F4.P1.0to150ms.Amp.mV.	0.1871	0.2240	0.0585	0.7060
S2.F4.P1.0to150ms.Lat.ms.	0.2002	0.1926	0.2093	0.1728
S2.F7.P1.0to150ms.Amp.mV.	-0.0621	0.6819	0.1178	0.4354
S2.F7.P1.0to150ms.Lat.ms.	0.2192	0.1433	0.2058	0.1701
S2.F8.P1.0to150ms.Amp.mV.	0.0791	0.6055	-0.0723	0.6372
S2.F8.P1.0to150ms.Lat.ms.	-0.2298	0.1289	0.0341	0.8239
S2.P3.Nc.0to100ms.Amp.mV.	0.1063	0.4818	0.3048	0.0394 *
S2.P3.Nc.0to100ms.Lat.ms.	-0.1008	0.5051	-0.1388	0.3577
S2.P4.Nc.0to100ms.Amp.mV.	0.0436	0.7759	0.3137	0.0359 *
S2.P4.Nc.0to100ms.Lat.ms.	-0.1577	0.3008	-0.0221	0.8853
S2.FP1.N1.75to200ms.Amp.mV.	0.1309	0.4208	0.3655	0.0204 *
S2.FP1.N1.75to200ms.Lat.ms.	0.3281	0.0387 *	-0.0316	0.8467
S2.FP2.N1.75to200ms.Amp.mV.	0.1301	0.4235	0.1872	0.2474
S2.FP2.N1.75to200ms.Lat.ms.	0.0342	0.8342	-0.1052	0.5182
S2.F3.N1.75to200ms.Amp.mV.	0.0559	0.7155	0.0743	0.6275
S2.F3.N1.75to200ms.Lat.ms.	-0.0524	0.7325	0.0860	0.5745
S2.F4.N1.75to200ms.Amp.mV.	0.2099	0.1714	0.1805	0.2409
S2.F4.N1.75to200ms.Lat.ms.	-0.2284	0.1360	-0.1558	0.3126
S2.F7.N1.75to200ms.Amp.mV.	-0.1348	0.3717	0.0617	0.6839
S2.F7.N1.75to200ms.Lat.ms.	0.1108	0.4635	0.0747	0.6216
S2.F8.N1.75to200ms.Amp.mV.	0.0053	0.9725	-0.0571	0.7093
S2.F8.N1.75to200ms.Lat.ms.	0.0196	0.8982	-0.3169	0.0339 *
S2.C3.N2.100to250ms.Amp.mV.	0.2371	0.1125	0.1975	0.1883
S2.C3.N2.100to250ms.Lat.ms.	0.2399	0.1083	0.0420	0.7817
S2.C4.N2.100to250ms.Amp.mV.	0.3825	0.0087 *	0.3011	0.0420 *
S2.C4.N2.100to250ms.Lat.ms.	0.1119	0.4592	0.1139	0.4510
S2.P3.N2.100to300ms.Amp.mV.	0.1426	0.3444	0.3151	0.0329 *
S2.P3.N2.100to300ms.Lat.ms.	0.1426	0.3445	-0.1114	0.4610
S2.P4.N2.100to300ms.Amp.mV.	0.0844	0.5813	0.3102	0.0381 *
S2.P4.N2.100to300ms.Lat.ms.	0.0601	0.6952	0.1468	0.3359
S2.FP1.P3.150to450ms.Amp.mV.	0.1186	0.4659	0.2939	0.0656
S2.FP1.P3.150to450ms.Lat.ms.	0.1465	0.3670	0.1228	0.4501
S2.FP2.P3.150to450ms.Amp.mV.	0.0558	0.7324	0.0889	0.5856
S2.FP2.P3.150to450ms.Lat.ms.	0.0405	0.8039	0.1971	0.2227
S2.F3.P3.150to450ms.Amp.mV.	-0.0956	0.5321	0.0595	0.6980
S2.F3.P3.150to450ms.Lat.ms.	0.1872	0.2182	0.2188	0.1487
S2.F4.P3.150to450ms.Amp.mV.	-0.0526	0.7344	0.0747	0.6298
S2.F4.P3.150to450ms.Lat.ms.	-0.1510	0.3279	0.0179	0.9082
S2.F7.P3.150to450ms.Amp.mV.	-0.0005	0.9974	0.1031	0.4952
S2.F7.P3.150to450ms.Lat.ms.	-0.2850	0.0548	-0.3059	0.0387 *
S2.F8.P3.150to450ms.Amp.mV.	0.1245	0.4150	0.0165	0.9141
S2.F8.P3.150to450ms.Lat.ms.	0.1166	0.4456	0.0598	0.6963
S2.C3.P3.250to500ms.Amp.mV.	-0.1839	0.2213	0.0666	0.6601
S2.C3.P3.250to500ms.Lat.ms.	0.0203	0.8937	-0.0025	0.9867
S2.C4.P3.250to500ms.Amp.mV.	-0.1109	0.4632	0.0395	0.7943
S2.C4.P3.250to500ms.Lat.ms.	-0.1292	0.3922	-0.0647	0.6691
S2.P3.P3.250to500ms.Amp.mV.	-0.1540	0.3068	0.1641	0.2758
S2.P3.P3.250to500ms.Lat.ms.	0.1056	0.4847	0.1074	0.4773
S2.P4.P3.250to500ms.Amp.mV.	-0.1551	0.3090	0.1649	0.2790
S2.P4.P3.250to500ms.Lat.ms.	0.1010	0.5090	0.2193	0.1477

	Years with		B1 PANSS	
Measure	Spearman's rho	p-value	Spearman's rho	p-value
S3.C3.Nc.0to100ms.Amp.mV.	0.0872	0.5644	0.2763	0.0631
S3.C3.Nc.0to100ms.Lat.ms.	-0.0288	0.8492	-0.0633	0.6760

S3.C4.Nc.0to100ms.Amp.mV.	0.2752	0.0641	0.3113	0.0352 *
S3.C4.Nc.0to100ms.Lat.ms.	0.0108	0.9430	0.0226	0.8817
S3.P3.P50.0to60ms.Amp.mV.	0.0037	0.9808	-0.0386	0.7988
S3.P3.P50.0to60ms.Lat.ms.	0.0942	0.5337	0.0511	0.7358
S3.P4.P50.0to60ms.Amp.mV.	0.0101	0.9474	-0.0162	0.9159
S3.P4.P50.0to60ms.Lat.ms.	0.2968	0.0477 *	0.0778	0.6115
S3.FP1.P1.50to180ms.Amp.mV.	0.1409	0.3859	-0.0308	0.8503
S3.FP1.P1.50to180ms.Lat.ms.	0.1712	0.2908	0.0191	0.9068
S3.FP2.P1.50to180ms.Amp.mV.	0.1732	0.2852	-0.0201	0.9021
S3.FP2.P1.50to180ms.Lat.ms.	0.2763	0.0844	0.0942	0.5632
S3.F3.P1.50to180ms.Amp.mV.	0.1031	0.5004	0.2057	0.1751
S3.F3.P1.50to180ms.Lat.ms.	-0.1305	0.4347	-0.1990	0.2310
S3.F4.P1.50to180ms.Amp.mV.	0.0797	0.6072	0.1839	0.2322
S3.F4.P1.50to180ms.Lat.ms.	0.0153	0.9276	0.0474	0.7775
S3.F7.P1.50to180ms.Amp.mV.	0.2862	0.0538	0.1637	0.2769
S3.F7.P1.50to180ms.Lat.ms.	0.2355	0.1382	0.0701	0.6630
S3.F8.P1.50to180ms.Amp.mV.	0.2276	0.1327	0.0934	0.5417
S3.F8.P1.50to180ms.Lat.ms.	-0.0086	0.9555	0.0179	0.9072
S3.P3.N1.50to110ms.Amp.mV.	0.0787	0.6030	0.0605	0.6894
S3.P3.N1.50to110ms.Lat.ms.	0.1470	0.3295	0.1889	0.2086
S3.P4.N1.50to110ms.Amp.mV.	0.1283	0.4011	0.1293	0.3971
S3.P4.N1.50to110ms.Lat.ms.	0.1473	0.3342	0.0278	0.8561
S3.C3.P1.75to175ms.Amp.mV.	0.0683	0.6521	0.0764	0.6136
S3.C3.P1.75to175ms.Lat.ms.	-0.1158	0.4434	-0.0783	0.6051
S3.C4.P1.75to175ms.Amp.mV.	0.2244	0.1338	0.2142	0.1528
S3.C4.P1.75to175ms.Lat.ms.	-0.1187	0.4319	-0.2525	0.0904
S3.P3.P2.100to180ms.Amp.mV.	-0.0503	0.7398	-0.1803	0.2304
S3.P3.P2.100to180ms.Lat.ms.	0.3199	0.0302 *	-0.2160	0.1494
S3.P4.P2.100to180ms.Amp.mV.	0.0685	0.6548	-0.0823	0.5910
S3.P4.P2.100to180ms.Lat.ms.	0.0297	0.8465	-0.1315	0.3893
S3.C3.N2.120to220ms.Amp.mV.	-0.0095	0.9502	0.0020	0.9897
S3.C3.N2.120to220ms.Lat.ms.	0.0895	0.5542	0.1843	0.2200
S3.C4.N2.120to220ms.Amp.mV.	0.2855	0.0544	0.0903	0.5508
S3.C4.N2.120to220ms.Lat.ms.	-0.0549	0.7169	0.3741	0.0104 *
S3.P3.N2.150to250ms.Amp.mV.	0.0561	0.7109	-0.2062	0.1693
S3.P3.N2.150to250ms.Lat.ms.	0.1109	0.4630	0.2204	0.1411
S3.P4.N2.150to250ms.Amp.mV.	0.1217	0.4257	-0.1271	0.4054
S3.P4.N2.150to250ms.Lat.ms.	-0.1240	0.4170	0.1940	0.2017
S3.C3.P3.200to650ms.Amp.mV.	-0.0344	0.8204	-0.1897	0.2067
S3.C3.P3.200to650ms.Lat.ms.	0.0171	0.9101	0.0325	0.8300
S3.C4.P3.200to650ms.Amp.mV.	0.0183	0.9041	-0.1644	0.2748
S3.C4.P3.200to650ms.Lat.ms.	-0.1978	0.1875	0.0549	0.7169
S3.FP1.P3.200to350ms.Amp.mV.	0.0314	0.8476	-0.1011	0.5347
S3.FP1.P3.200to350ms.Lat.ms.	-0.3168	0.0464 *	-0.1157	0.4772
S3.FP2.P3.200to350ms.Amp.mV.	0.0616	0.7056	-0.0901	0.5803
S3.FP2.P3.200to350ms.Lat.ms.	-0.1362	0.4022	0.0713	0.6618
S3.F3.P3.200to350ms.Amp.mV.	-0.0378	0.8055	-0.0365	0.8118
S3.F3.P3.200to350ms.Lat.ms.	-0.2038	0.1793	-0.0450	0.7692
S3.F4.P3.200to350ms.Amp.mV.	0.0272	0.8607	-0.0831	0.5917
S3.F4.P3.200to350ms.Lat.ms.	-0.1497	0.3322	-0.0379	0.8068
S3.F7.P3.200to350ms.Amp.mV.	0.2666	0.0733	0.0769	0.6116
S3.F7.P3.200to350ms.Lat.ms.	0.2823	0.0573	0.1466	0.3310
S3.F8.P3.200to350ms.Amp.mV.	0.0927	0.5446	-0.0278	0.8564
S3.F8.P3.200to350ms.Lat.ms.	-0.0318	0.8356	0.1242	0.4164
S3.FP1.P3.200to400ms.Amp.mV.	0.0245	0.8807	-0.1121	0.4909
S3.FP1.P3.200to400ms.Lat.ms.	-0.1738	0.2833	0.0849	0.6026
S3.FP2.P3.200to400ms.Amp.mV.	0.0125	0.9388	-0.1819	0.2613
S3.FP2.P3.200to400ms.Lat.ms.	-0.2123	0.1884	0.0516	0.7520
S3.F3.P3.200to400ms.Amp.mV.	-0.0428	0.7802	-0.0359	0.8148

S3.F3.P3.200to400ms.Lat.ms.	-0.2397	0.1128	-0.0790	0.6061
S3.F4.P3.200to400ms.Amp.mV.	-0.0319	0.8371	-0.0954	0.5379
S3.F4.P3.200to400ms.Lat.ms.	-0.1725	0.2630	-0.1319	0.3935
S3.F7.P3.200to400ms.Amp.mV.	0.2603	0.0806	0.0878	0.5617
S3.F7.P3.200to400ms.Lat.ms.	-0.0032	0.9832	-0.0183	0.9040
S3.F8.P3.200to400ms.Amp.mV.	0.0505	0.7417	-0.0878	0.5664
S3.F8.P3.200to400ms.Lat.ms.	-0.0624	0.6839	-0.0941	0.5385
S3.FP1.Wide.200to800ms.Amp.mV.	-0.1872	0.2475	-0.3061	0.0547
S3.FP1.Wide.200to800ms.Lat.ms.	-0.0458	0.7790	0.1029	0.5274
S3.FP2.Wide.200to800ms.Amp.mV.	-0.0438	0.7883	-0.1935	0.2317
S3.FP2.Wide.200to800ms.Lat.ms.	-0.1007	0.5362	-0.1562	0.3357
S3.F3.Wide.200to800ms.Amp.mV.	0.0052	0.9728	-0.1737	0.2537
S3.F3.Wide.200to800ms.Lat.ms.	-0.0989	0.5181	0.0281	0.8548
S3.F4.Wide.200to800ms.Amp.mV.	-0.0504	0.7450	-0.2137	0.1637
S3.F4.Wide.200to800ms.Lat.ms.	-0.0555	0.7206	0.0241	0.8765
S3.F7.Wide.200to800ms.Amp.mV.	0.2432	0.1035	-0.0956	0.5273
S3.F7.Wide.200to800ms.Lat.ms.	0.1369	0.3641	0.0633	0.6758
S3.F8.Wide.200to800ms.Amp.mV.	0.0669	0.6622	-0.1771	0.2446
S3.F8.Wide.200to800ms.Lat.ms.	0.0774	0.6134	0.0246	0.8727
S3.P3.P3.200to650ms.Amp.mV.	-0.0141	0.9262	-0.3057	0.0388 *
S3.P3.P3.200to650ms.Lat.ms.	-0.0007	0.9961	0.0359	0.8126
S3.P4.P3.200to650ms.Amp.mV.	0.0458	0.7650	-0.2698	0.0731
S3.P4.P3.200to650ms.Lat.ms.	-0.2010	0.1855	-0.1090	0.4762
S3.FP1.LPP.400to800ms.Amp.mV.	-0.1756	0.2783	-0.2917	0.0678
S3.FP1.LPP.400to800ms.Lat.ms.	0.1084	0.5056	0.1127	0.4887
S3.FP2.LPP.400to800ms.Amp.mV.	-0.0433	0.7910	-0.2330	0.1480
S3.FP2.LPP.400to800ms.Lat.ms.	-0.1069	0.5116	-0.0393	0.8099
S3.F3.LPP.400to800ms.Amp.mV.	-0.0314	0.8377	-0.1814	0.2331
S3.F3.LPP.400to800ms.Lat.ms.	0.0189	0.9019	-0.1800	0.2366
S3.F4.LPP.400to800ms.Amp.mV.	-0.0737	0.6344	-0.2030	0.1862
S3.F4.LPP.400to800ms.Lat.ms.	-0.0599	0.6995	-0.0554	0.7211
S3.F7.LPP.400to800ms.Amp.mV.	0.2133	0.1546	-0.0944	0.5325
S3.F7.LPP.400to800ms.Lat.ms.	0.0138	0.9275	-0.1400	0.3536
S3.F8.LPP.400to800ms.Amp.mV.	0.0762	0.6189	-0.0969	0.5266
S3.F8.LPP.400to800ms.Lat.ms.	0.2102	0.1657	0.0417	0.7857

	Years with		B1 PANSS	
Measure	Spearman's rho	p-value	Spearman's rho	p-value
TrickS.C3.P1.50to150ms.Amp.mV.	0.0465	0.7590	-0.0555	0.7142
TrickS.C3.P1.50to150ms.Lat.ms.	0.0533	0.7251	-0.1007	0.5055
TrickS.C4.P1.50to150ms.Amp.mV.	0.0838	0.5800	0.0244	0.8723
TrickS.C4.P1.50to150ms.Lat.ms.	-0.0330	0.8276	0.0087	0.9541
TrickS.P3.N1.50to150ms.Amp.mV.	0.0339	0.8232	0.0677	0.6547
TrickS.P3.N1.50to150ms.Lat.ms.	0.1648	0.2737	0.1461	0.3325
TrickS.P4.N1.50to150ms.Amp.mV.	-0.0636	0.6744	-0.0302	0.8419
TrickS.P4.N1.50to150ms.Lat.ms.	0.3400	0.0208 *	0.2190	0.1436
TrickS.FP1.P1.75to150ms.Amp.mV.	0.1212	0.4332	-0.1106	0.4748
TrickS.FP1.P1.75to150ms.Lat.ms.	-0.2074	0.1767	-0.0973	0.5300
TrickS.FP2.P1.75to150ms.Amp.mV.	0.1195	0.4397	-0.0348	0.8226
TrickS.FP2.P1.75to150ms.Lat.ms.	-0.2266	0.1391	0.0794	0.6084
TrickS.F3.P1.75to150ms.Amp.mV.	-0.0101	0.9474	0.0276	0.8573
TrickS.F3.P1.75to150ms.Lat.ms.	0.0777	0.6119	0.1786	0.2406
TrickS.F4.P1.75to150ms.Amp.mV.	0.0431	0.7785	-0.0112	0.9416
TrickS.F4.P1.75to150ms.Lat.ms.	0.1921	0.2062	0.1403	0.3580
TrickS.F7.P1.75to150ms.Amp.mV.	0.0946	0.5318	0.0592	0.6959
TrickS.F7.P1.75to150ms.Lat.ms.	-0.0126	0.9338	-0.0877	0.5620
TrickS.F8.P1.75to150ms.Amp.mV.	-0.0838	0.5800	-0.1793	0.2331
TrickS.F8.P1.75to150ms.Lat.ms.	0.0238	0.8753	-0.0102	0.9461
TrickS.FP1.N1.100to200ms.Amp.m\	-0.0968	0.5320	-0.0993	0.5214

TrickS.FP1.N1.100to200ms.Lat.ms.	0.2546	0.0954	0.0614	0.6920
TrickS.FP2.N1.100to200ms.Amp.m\	-0.0478	0.7579	-0.0388	0.8024
TrickS.FP2.N1.100to200ms.Lat.ms.	0.2869	0.0590	-0.0164	0.9160
TrickS.F3.N1.100to200ms.Amp.mV.	-0.0280	0.8552	-0.0044	0.9773
TrickS.F3.N1.100to200ms.Lat.ms.	0.3213	0.0314 *	0.1751	0.2498
TrickS.F4.N1.100to200ms.Amp.mV.	0.0765	0.6173	0.0443	0.7728
TrickS.F4.N1.100to200ms.Lat.ms.	0.2194	0.1477	0.0181	0.9058
TrickS.F7.N1.100to200ms.Amp.mV.	-0.0046	0.9756	0.0733	0.6284
TrickS.F7.N1.100to200ms.Lat.ms.	0.0909	0.5479	0.1898	0.2065
TrickS.F8.N1.100to200ms.Amp.mV.	-0.1738	0.2480	-0.2197	0.1423
TrickS.F8.N1.100to200ms.Lat.ms.	0.2610	0.0798	0.1996	0.1836
TrickS.P3.P1.100to200ms.Amp.mV.	-0.0147	0.9229	-0.2592	0.0819
TrickS.P3.P1.100to200ms.Lat.ms.	0.0261	0.8630	-0.0020	0.9897
TrickS.P4.P1.100to200ms.Amp.mV.	-0.1132	0.4538	-0.2016	0.1792
TrickS.P4.P1.100to200ms.Lat.ms.	-0.0173	0.9091	0.0095	0.9502
TrickS.P3.N2.150to250ms.Amp.mV.	0.0629	0.6780	-0.1226	0.4170
TrickS.P3.N2.150to250ms.Lat.ms.	0.0893	0.5550	0.1198	0.4279
TrickS.P4.N2.150to250ms.Amp.mV.	-0.0649	0.6684	0.0252	0.8680
TrickS.P4.N2.150to250ms.Lat.ms.	0.1804	0.2301	0.0799	0.5978
TrickS.C3.P2.175to300ms.Amp.mV.	0.0150	0.9213	-0.0995	0.5104
TrickS.C3.P2.175to300ms.Lat.ms.	0.2595	0.0816	0.1262	0.4035
TrickS.C4.P2.175to300ms.Amp.mV.	0.0310	0.8382	-0.0696	0.6460
TrickS.C4.P2.175to300ms.Lat.ms.	0.0652	0.6671	0.1201	0.4265
TrickS.FP1.P3.200to450ms.Amp.m\	-0.0578	0.7094	-0.1607	0.2975
TrickS.FP1.P3.200to450ms.Lat.ms.	0.2735	0.0724	0.1982	0.1971
TrickS.FP2.P3.200to450ms.Amp.m\	0.0174	0.9107	-0.1152	0.4565
TrickS.FP2.P3.200to450ms.Lat.ms.	0.1771	0.2502	-0.0291	0.8513
TrickS.F3.P3.200to450ms.Amp.mV.	-0.1230	0.4210	-0.2000	0.1877
TrickS.F3.P3.200to450ms.Lat.ms.	0.2630	0.0809	-0.1809	0.2343
TrickS.F4.P3.200to450ms.Amp.mV.	-0.1245	0.4153	-0.1720	0.2586
TrickS.F4.P3.200to450ms.Lat.ms.	0.2647	0.0789	0.1625	0.2863
TrickS.F7.P3.200to450ms.Amp.mV.	-0.0038	0.9801	-0.0166	0.9128
TrickS.F7.P3.200to450ms.Lat.ms.	0.1090	0.4708	-0.0124	0.9348
TrickS.F8.P3.200to450ms.Amp.mV.	-0.0903	0.5506	-0.1867	0.2142
TrickS.F8.P3.200to450ms.Lat.ms.	-0.0857	0.5710	-0.0445	0.7689
TrickS.P3.P2.200to300ms.Amp.mV.	0.0354	0.8153	-0.3307	0.0248 *
TrickS.P3.P2.200to300ms.Lat.ms.	0.0339	0.8231	0.0142	0.9252
TrickS.P4.P2.200to300ms.Amp.mV.	-0.1528	0.3108	-0.3087	0.0368 *
TrickS.P4.P2.200to300ms.Lat.ms.	0.0455	0.7638	0.0548	0.7177
TrickS.P3.N3.250to375ms.Amp.mV.	0.1211	0.4226	-0.0620	0.6824
TrickS.P3.N3.250to375ms.Lat.ms.	0.1060	0.4831	0.0436	0.7738
TrickS.P4.N3.250to375ms.Amp.mV.	-0.0695	0.6462	-0.1711	0.2555
TrickS.P4.N3.250to375ms.Lat.ms.	0.0511	0.7359	0.0925	0.5411
TrickS.C3.P3.300to600ms.Amp.mV.	-0.0103	0.9456	-0.1292	0.3921
TrickS.C3.P3.300to600ms.Lat.ms.	0.0794	0.5997	0.2042	0.1735
TrickS.C4.P3.300to600ms.Amp.mV.	-0.0110	0.9421	-0.0220	0.8845
TrickS.C4.P3.300to600ms.Lat.ms.	0.0808	0.5934	0.2438	0.1025
TrickS.P3.P3.300to650ms.Amp.mV.	-0.0175	0.9080	-0.1144	0.4491
TrickS.P3.P3.300to650ms.Lat.ms.	0.0623	0.6809	0.0601	0.6914
TrickS.P4.P3.300to650ms.Amp.mV.	-0.0781	0.6061	-0.1952	0.1935
TrickS.P4.P3.300to650ms.Lat.ms.	0.0357	0.8138	-0.0963	0.5243

D.2.3 Non-parametric fANCOVAs of Group Comparisons with addition of potential confounding factors

Variable	Potential Confounder	T	p-value
S3.RT	BMI	626.1	0.3284
S3.RT	Weight	642.7	0.2438
S3.Response	B9_ASSIST_Subscore_Methaqualone	67.04	0.07463
S3.Response	Total_Years_of_Education	43.81	**0.04975***
S3.Response	Years_at_School	687.9	0.6667
S3.Response	Years_of_Tertiary_Education	374.8	0.3682
S3.Omit	B9_ASSIST_Subscore_Methaqualone	53.23	**0.004975***
S3.Omit	Total_Years_of_Education	43.81	0.06965
S3.Omit	Years_at_School	107.3	**0.00995***
S3.Omit	Years_of_Tertiary_Education	161.1	**0.03483***
NonT.Response	B9_ASSIST_Subscore_Methaqualone		
NonT.Response	BMI	5.143	**0.004975***
NonT.Response	Total_Years_of_Education	6.744	**0.004975***
NonT.Response	Years_of_Tertiary_Education	11.63	**0.00995***
TrickS.Response	BMI		
TrickS.Response	Weight		
S2.Response	B9_ASSIST_Subscore_Methaqualone	9.778	0.1891
S2.Response	Total_Years_of_Education	14.08	**0.03483***
S2.Response	Years_at_School	20.63	0.0597
A.Total.Correct	B9_ASSIST_Subscore_Methaqualone	63.96	**0.02985***
A.Total.Correct	BMI	81.3	**0.004975***
A.Total.Correct	Total_Years_of_Education	53.12	**0.0398***
A.Total.Correct	Years_at_School	635.4	0.4826
A.Total.Correct	Years_of_Tertiary_Education	393.7	0.2388
A.S3.Delayed.Response	B7_ASRS_PartB_above_cut_off	12.21	0.2388
A.S3.Delayed.Response	Total_Years_of_Education	14.47	**0.00995***
A.S3.Delayed.Response	Years_of_Tertiary_Education	25.7	**0.004975***
A.S3.Delayed.RT	B9_ASSIST_Subscore_Methaqualone	202.9	0.602
A.S3.Delayed.RT	BMI	30420	**0.004975***
A.S3.Delayed.RT	Years_at_School	117500	0.7413
A.S2.Responses	B9_ASSIST_Subscore_Methamphetamine		
A.S2.Responses	B9_ASSIST_Subscore_Methaqualone		
A.S2.Responses	Total_Years_of_Education	12.81	**0.0199***
A.S2.Responses	Years_at_School		
A.Omissions	BMI	2.374	**0.004975***
A.Omissions	Total_Years_of_Education	1.402	0.2289
A.Omissions	Weight	1.213	**0.01493***
A.Omissions	Years_at_School		
A.TrickS.Responses	B9_ASSIST_Subscore_Methaqualone		
A.TrickS.Responses	BMI		
A.TrickS.Responses	Total_Years_of_Education		
A.TrickS.Responses	Years_at_School		
A.TrickS.Responses	Years_of_Tertiary_Education		
A.S3.RT	B7_ASRS_PartB_above_cut_off	6139	**0.01493***
A.S3.RT	BMI	3538	0.1045
A.S3.RT	Total_Years_of_Education	5576	0.07463
A.S3.RT	Weight	11550	**0.02985***
A.S3.RT	Years_at_School	28530	0.06468
S1.F7.P50.0to100ms.Amp.mV.	BMI	0.1663	0.1841
S1.F7.P50.0to100ms.Amp.mV.	Weight	0.315	0.08955
S1.F8.P50.0to100ms.Lat.ms.	B9_ASSIST_Subscore_Methamphetamine	129.3	0.08458
S1.P3.Nc.0to100ms.Amp.mV.	Age_on_Day_of_Testing	0.03032	0.8259
S1.P3.Nc.0to100ms.Amp.mV.	BMI	0.1127	0.2935
S1.P3.Nc.0to100ms.Amp.mV.	Weight	0.2686	0.06965
S1.P4.Nc.0to100ms.Amp.mV.	Age_on_Day_of_Testing	0.06173	0.7413

Variable	Potential Confounder	T	p-value
S1.P4.Nc.0to100ms.Amp.mV.	Weight	0.6126	**0.02985***
S1.C3.P1.50to140ms.Lat.ms.	B9_ASSIST_Subscore_Cannabis	3885	0.4577
S1.C3.P1.50to140ms.Lat.ms.	B9_ASSIST_Subscore_Methamphetamine	311.5	0.2786
S1.C3.P1.50to140ms.Lat.ms.	B9_ASSIST_Total_Score	83.94	0.1443
S1.C4.P1.50to140ms.Lat.ms.	B9_ASSIST_Subscore_Methamphetamine	386.7	0.1343
S1.C4.P1.50to140ms.Lat.ms.	Total_Years_of_Education	108.8	0.07463
S1.C4.P1.50to140ms.Lat.ms.	Years_at_School	2994	0.3184
S1.P3.P1.50to150ms.Amp.mV.	BMI	0.317	0.1343
S1.P3.P1.50to150ms.Amp.mV.	Weight	0.2111	0.4925
S1.P3.P1.50to150ms.Lat.ms.	B9_ASSIST_Subscore_Methamphetamine	364.5	0.204
S1.P3.P1.50to150ms.Lat.ms.	B9_ASSIST_Subscore_Methaqualone	2255	**0.00995***
S1.P3.P1.50to150ms.Lat.ms.	B9_ASSIST_Total_Score	102.1	**0.04478***
S1.P4.P1.50to150ms.Amp.mV.	Years_at_School	2.876	0.3184
S1.P4.P1.50to150ms.Lat.ms.	B9_ASSIST_Subscore_Methamphetamine	658.7	0.1592
S1.P4.P1.50to150ms.Lat.ms.	B9_ASSIST_Total_Score	85.46	**0.02488***
S1.Fp1.N1.75to200ms.Lat.ms.	B9_ASSIST_Subscore_Tobacco	183.4	0.1095
S1.F3.N1.75to200ms.Lat.ms.	B7_ASRS_PartB_above_cut_off	54.37	0.7214
S1.F3.N1.75to200ms.Lat.ms.	Weight	161.7	0.1045
S1.F4.N1.75to200ms.Lat.ms.	B7_ASRS_PartB_above_cut_off	110.8	0.3383
S1.F7.N1.75to200ms.Amp.mV	B9_ASSIST_Subscore_Methaqualone	2.024	**0.004975***
S1.F8.N1.75to200ms.Amp.mV	B9_ASSIST_Subscore_Methaqualone	0.035	0.4975
S1.F8.N1.75to200ms.Lat.ms.	B7_ASRS_PartB_above_cut_off	79.06	0.5672
S1.P3.N1.120to180ms.Amp.m	Weight	0.2943	0.1493
S1.P3.N1.120to180ms.Lat.ms.	B9_ASSIST_Subscore_Methaqualone	5310	**0.00995***
S1.P3.N1.120to180ms.Lat.ms.	B9_ASSIST_Subscore_Tobacco	104.7	0.06468
S1.P3.N1.120to180ms.Lat.ms.	Total_Years_of_Education	20.22	0.6368
S1.P3.N1.120to180ms.Lat.ms.	Years_at_School	6335	0.4925
S1.P3.N1.120to180ms.Lat.ms.	Years_of_Tertiary_Education	4499	0.2388
S1.FP1.P2.150to350ms.Amp.m	Age_on_Day_of_Testing	0.2958	0.1244
S1.FP1.P2.150to350ms.Lat.ms	B9_ASSIST_Subscore_Methaqualone	16980	**0.004975***
S1.FP2.P2.150to350ms.Amp.m	Age_on_Day_of_Testing	0.2865	0.3383
S1.F3.P2.150to350ms.Amp.m\	Weight	0.737	**0.01493***
S1.F4.P2.150to350ms.Amp.m\	B9_ASSIST_Subscore_Tobacco	0.5321	0.0597
S1.F4.P2.150to350ms.Amp.m\	B9_ASSIST_Total_Score	0.4439	0.2488
S1.F4.P2.150to350ms.Lat.ms.	Total_Years_of_Education	303.5	0.09453
S1.F4.P2.150to350ms.Lat.ms.	Years_of_Tertiary_Education	16920	0.4129
S1.FP1.P2.150to400ms.Amp.m	Age_on_Day_of_Testing	0.2489	0.08458
S1.FP2.P2.150to400ms.Amp.m	Age_on_Day_of_Testing	0.2704	0.2836
S1.F3.P2.150to400ms.Amp.m\	Weight	0.7651	**0.004975***
S1.F3.P2.150to400ms.Lat.ms.	B9_ASSIST_Total_Score	366.8	0.5522
S1.F4.P2.150to400ms.Amp.m\	B9_ASSIST_Subscore_Tobacco	0.5809	0.05473
S1.F4.P2.150to400ms.Amp.m\	B9_ASSIST_Total_Score	0.4697	0.2338
S1.P4.N2.200to350ms.Lat.ms.	Weight	159.2	0.1393
S1.C4.P3.300to550.ms.Amp.m	BMI	0.4181	0.1493
S1.C4.P3.300to550.ms.Amp.m	Weight	0.2877	0.5771
S1.P3.P3.300to550ms.Lat.ms.	Weight	430.3	0.1692
S1.P4.P3.300to550ms.Amp.m\	BMI	0.6698	0.0995
S1.P4.P3.300to550ms.Amp.m\	Weight	0.4718	0.4129
S1.P4.P3.300to550ms.Lat.ms.	B7_ASRS_PartB_above_cut_off	291.6	0.2289
S2.C3.Nc.0to100ms.Amp.mV.	Age_on_Day_of_Testing	0.2711	**0.0398***
S2.C3.Nc.0to100ms.Amp.mV.	B7_ASRS_PartB_above_cut_off	0.2754	0.4527
S2.C3.Nc.0to100ms.Amp.mV.	B9_ASSIST_Subscore_Methamphetamine	0.2512	0.06965
S2.C3.Nc.0to100ms.Amp.mV.	B9_ASSIST_Subscore_Tobacco	0.4326	**0.03483***
S2.C3.Nc.0to100ms.Amp.mV.	Total_Years_of_Education	0.3254	**0.0199***
S2.C3.Nc.0to100ms.Amp.mV.	Years_at_School	2.374	0.403

Variable	Potential Confounder	T	p-value
S2.C3.Nc.0to100ms.Amp.mV.	Years_of_Tertiary_Education	1.428	**0.0398***
S2.C3.Nc.0to100ms.Lat.ms.	B7_ASRS_PartB_above_cut_off	108.7	0.1542
S2.C4.Nc.0to100ms.Amp.mV.	Age_on_Day_of_Testing	0.3585	0.0796
S2.C4.Nc.0to100ms.Amp.mV.	B7_ASRS_PartB_above_cut_off	0.4038	0.1393
S2.C4.Nc.0to100ms.Amp.mV.	Years_at_School	2.741	0.2587
S2.FP1.P1.0to150ms.Lat.ms.	BMI	297.3	0.2338
S2.F3.P1.0to150ms.Amp.mV.	B7_ASRS_PartB_above_cut_off	0.2639	0.1891
S2.F4.P1.0to150ms.Amp.mV.	B9_ASSIST_Subscore_Tobacco	0.3622	**0.04478***
S2.F7.P1.0to150ms.Lat.ms.	B7_ASRS_PartB_above_cut_off	54.95	0.8408
S2.F8.P1.0to150ms.Lat.ms.	Total_Years_of_Education	125.6	0.8109
S2.F8.P1.0to150ms.Lat.ms.	Years_of_Tertiary_Education	1742	0.7065
S2.P3.Nc.0to100ms.Amp.mV.	Age_on_Day_of_Testing	0.3707	0.1194
S2.P3.Nc.0to100ms.Amp.mV.	B9_ASSIST_Subscore_Methamphetamine	0.775	0.1443
S2.P3.Nc.0to100ms.Amp.mV.	Total_Years_of_Education	0.3066	0.398
S2.P3.Nc.0to100ms.Amp.mV.	Years_at_School	3.88	0.5174
S2.P4.Nc.0to100ms.Amp.mV.	B7_ASRS_PartB_above_cut_off	0.6352	0.1144
S2.P4.Nc.0to100ms.Amp.mV.	Total_Years_of_Education	0.5034	0.2189
S2.FP1.N1.75to200ms.Lat.ms.	BMI	109.1	0.3781
S2.FP1.N1.75to200ms.Lat.ms.	Years_of_Tertiary_Education	3488	0.5025
S2.F4.N1.75to200ms.Amp.mV	B9_ASSIST_Subscore_Tobacco	0.615	0.1294
S2.F7.N1.75to200ms.Lat.ms.	BMI	40.97	0.7861
S2.F8.N1.75to200ms.Lat.ms.	Total_Years_of_Education	72.78	0.3632
S2.F8.N1.75to200ms.Lat.ms.	Years_at_School	5798	0.5323
S2.F8.N1.75to200ms.Lat.ms.	Years_of_Tertiary_Education	3623	0.3085
S2.C3.N2.100to250ms.Amp.m	Age_on_Day_of_Testing	0.3923	0.1493
S2.C3.N2.100to250ms.Amp.m	B7_ASRS_PartB_above_cut_off	0.3859	0.3234
S2.C3.N2.100to250ms.Amp.m	B9_ASSIST_Subscore_Tobacco	0.4793	0.09453
S2.C3.N2.100to250ms.Amp.m	Total_Years_of_Education	0.3646	0.05473
S2.C3.N2.100to250ms.Amp.m	Years_at_School	3.035	0.3831
S2.C3.N2.100to250ms.Lat.ms.	Age_on_Day_of_Testing	178.5	0.08955
S2.C3.N2.100to250ms.Lat.ms.	B9_ASSIST_Subscore_Cannabis	2373	0.05473
S2.C4.N2.100to250ms.Amp.m	B7_ASRS_PartB_above_cut_off	0.3782	0.2935
S2.C4.N2.100to250ms.Amp.m	B9_ASSIST_Subscore_Tobacco	0.448	**0.02985***
S2.C4.N2.100to250ms.Amp.m	Total_Years_of_Education	0.3505	0.0796
S2.C4.N2.100to250ms.Amp.m	Years_at_School	3.204	0.3333
S2.C4.N2.100to250ms.Lat.ms.	B9_ASSIST_Subscore_Cannabis	12820	0.3184
S2.P3.N2.100to300ms.Amp.m	Age_on_Day_of_Testing	0.6402	**0.0199***
S2.P3.N2.100to300ms.Amp.m	B7_ASRS_PartB_above_cut_off	0.5093	0.3333
S2.P3.N2.100to300ms.Amp.m	Total_Years_of_Education	0.3473	0.4478
S2.P3.N2.100to300ms.Amp.m	Years_at_School	4.682	0.602
S2.P4.N2.100to300ms.Amp.m	Age_on_Day_of_Testing	0.8826	**0.004975***
S2.FP1.P3.150to450ms.Lat.ms	B7_ASRS_PartB_above_cut_off	406.5	0.5721
S2.FP2.P3.150to450ms.Amp.n	Years_of_Tertiary_Education	4.342	0.5224
S2.F3.P3.150to450ms.Amp.m	B7_ASRS_PartB_above_cut_off	0.3715	0.2438
S2.F3.P3.150to450ms.Lat.ms.	B7_ASRS_PartB_above_cut_off	315.7	0.4776
S2.F4.P3.150to450ms.Amp.m	B9_ASSIST_Subscore_Cannabis	4.292	0.2189
S2.F7.P3.150to450ms.Amp.m	B7_ASRS_PartB_above_cut_off	0.6818	**0.02985***
S2.F8.P3.150to450ms.Amp.m	B9_ASSIST_Subscore_Methaqualone	4.687	**0.004975***
S2.F8.P3.150to450ms.Lat.ms.	B7_ASRS_PartB_above_cut_off	662.8	0.7015
S2.C3.P3.250to500ms.Amp.m	B7_ASRS_PartB_above_cut_off	1.1	**0.02985***
S2.P3.P3.250to500ms.Amp.m	B9_ASSIST_Subscore_Methaqualone	5.23	**0.00497***
S2.P3.P3.250to500ms.Lat.ms.	B9_ASSIST_Subscore_Methamphetamine	6446	0.1692
S2.P3.P3.250to500ms.Lat.ms.	B9_ASSIST_Subscore_Tobacco	793.3	0.05473
S2.P3.P3.250to500ms.Lat.ms.	B9_ASSIST_Total_Score	998.9	0.08955
S2.P4.P3.250to500ms.Amp.m	B9_ASSIST_Subscore_Methaqualone	5.79	**0.004975***

Variable	Potential Confounder	T	p-value
S3.C3.Nc.0to100ms.Amp.mV.	Years_at_School	1.66	0.2438
S3.C3.Nc.0to100ms.Lat.ms.	Years_at_School	986.6	0.8557
S3.C4.Nc.0to100ms.Amp.mV.	Total_Years_of_Education	0.1139	0.4428
S3.C4.Nc.0to100ms.Amp.mV.	Years_at_School	1.255	0.5274
S3.C4.Nc.0to100ms.Lat.ms.	B9_ASSIST_Subscore_Tobacco	129.4	0.08458
S3.P3.P50.0to60ms.Amp.mV.	B7_ASRS_PartB_above_cut_off	0.2629	0.1642
S3.P3.P50.0to60ms.Amp.mV.	BMI	0.2615	0.209
S3.P3.P50.0to60ms.Amp.mV.	Weight	0.08759	0.8159
S3.P3.P50.0to60ms.Lat.ms.	BMI	35.94	0.1393
S3.P3.P50.0to60ms.Lat.ms.	Years_at_School	168.9	0.204
S3.P4.P50.0to60ms.Lat.ms.	Total_Years_of_Education	33.14	0.1144
S3.P4.P50.0to60ms.Lat.ms.	Years_at_School	228.7	0.3831
S3.FP1.P1.50to180ms.Lat.ms.	Total_Years_of_Education	230.7	0.0597
S3.FP1.P1.50to180ms.Lat.ms.	Years_at_School	342.3	0.1144
S3.F3.P1.50to180ms.Lat.ms.	B7_ASRS_PartB_above_cut_off	163.8	0.1194
S3.F7.P1.50to180ms.Amp.mV.	Total_Years_of_Education	0.7435	**0.0398***
S3.F7.P1.50to180ms.Amp.mV.	Years_at_School	1.794	0.1194
S3.F7.P1.50to180ms.Lat.ms.	Years_at_School	2423	0.4428
S3.F8.P1.50to180ms.Amp.mV.	Total_Years_of_Education	0.3789	**0.03483***
S3.F8.P1.50to180ms.Amp.mV.	Years_at_School	0.7823	0.1592
S3.F8.P1.50to180ms.Amp.mV.	Years_of_Tertiary_Education	1.112	0.09453
S3.F8.P1.50to180ms.Lat.ms.	B9_ASSIST_Subscore_Methamphetamine	602.3	**0.04478***
S3.F8.P1.50to180ms.Lat.ms.	B9_ASSIST_Subscore_Tobacco	166.1	0.3383
S3.P3.N1.50to110ms.Amp.mV	Total_Years_of_Education	0.4488	0.0995
S3.P3.N1.50to110ms.Amp.mV	Years_at_School	2.089	0.204
S3.P4.N1.50to110ms.Amp.mV	Years_at_School	3.778	0.2935
S3.P4.N1.50to110ms.Lat.ms.	BMI	30.79	0.06468
S3.C3.P1.75to175ms.Lat.ms.	Age_on_Day_of_Testing	120	**0.0199***
S3.C3.P1.75to175ms.Lat.ms.	B7_ASRS_PartB_above_cut_off	54.05	0.2736
S3.C3.P1.75to175ms.Lat.ms.	BMI	144.2	0.1493
S3.P4.P2.100to180ms.Amp.m\	B9_ASSIST_Subscore_Methaqualone	0.1725	0.4776
S3.C3.N2.120to220ms.Amp.m	Years_at_School	2.251	0.2637
S3.C3.N2.120to220ms.Lat.ms.	Years_of_Tertiary_Education	6231	0.4179
S3.C4.N2.120to220ms.Lat.ms.	Total_Years_of_Education	47.32	0.2139
S3.C4.N2.120to220ms.Lat.ms.	Years_at_School	9180	0.4925
S3.P4.N2.150to250ms.Lat.ms.	B9_ASSIST_Subscore_Tobacco	111.4	0.0995
S3.C3.P3.200to650ms.Lat.ms.	BMI	2963	0.1294
S3.C4.P3.200to650ms.Lat.ms.	Years_at_School	61520	0.4478
S3.FP1.P3.200to350ms.Lat.ms	Age_on_Day_of_Testing	111.6	0.6567
S3.F3.P3.200to350ms.Amp.m\	Age_on_Day_of_Testing	0.3386	0.5771
S3.F3.P3.200to350ms.Amp.m\	B7_ASRS_PartB_above_cut_off	0.4919	0.408
S3.F3.P3.200to350ms.Amp.m\	Total_Years_of_Education	0.72	0.1592
S3.F4.P3.200to350ms.Amp.m\	Total_Years_of_Education	0.2741	0.5572
S3.F4.P3.200to350ms.Amp.m\	Years_at_School	2.049	0.4776
S3.F7.P3.200to350ms.Amp.m\	Total_Years_of_Education	0.591	0.1393
S3.F7.P3.200to350ms.Amp.m\	Years_at_School	1.212	0.2189
S3.F7.P3.200to350ms.Amp.m\	Years_of_Tertiary_Education	1.932	0.2388
S3.F8.P3.200to350ms.Amp.m\	Total_Years_of_Education	0.8724	**0.02985***
S3.F8.P3.200to350ms.Amp.m\	Years_at_School	1.739	0.1592
S3.FP1.P3.200to400ms.Lat.ms	B9_ASSIST_Subscore_Tobacco	815.7	**0.0398***
S3.F3.P3.200to400ms.Amp.m\	B7_ASRS_PartB_above_cut_off	0.4711	0.4478
S3.F3.P3.200to400ms.Lat.ms.	Total_Years_of_Education	767.4	**0.02488***
S3.F4.P3.200to400ms.Amp.m\	Years_at_School	3.252	0.5871
S3.F4.P3.200to400ms.Lat.ms.	B9_ASSIST_Subscore_Tobacco	816.2	**0.02985***
S3.F4.P3.200to400ms.Lat.ms.	Total_Years_of_Education	480.8	0.1144

Variable	Potential Confounder	T	p-value
S3.F4.P3.200to400ms.Lat.ms.	Years_of_Tertiary_Education	23480	0.602
S3.F7.P3.200to400ms.Amp.m\	Total_Years_of_Education	0.4824	0.1891
S3.F7.P3.200to400ms.Amp.m\	Years_at_School	1.546	0.2637
S3.F7.P3.200to400ms.Amp.m\	Years_of_Tertiary_Education	2.264	0.403
S3.F8.P3.200to400ms.Amp.m\	Total_Years_of_Education	0.8131	**0.03483***
S3.F8.P3.200to400ms.Amp.m\	Years_at_School	2.407	0.2786
S3.F8.P3.200to400ms.Amp.m\	Years_of_Tertiary_Education	3.406	0.06965
S3.FP1.Wide.200to800ms.Am	B7_ASRS_PartB_above_cut_off	1.636	0.5572
S3.FP2.Wide.200to800ms.Am	B7_ASRS_PartB_above_cut_off	0.654	0.9254
S3.F3.Wide.200to800ms.Amp.	B9_ASSIST_Subscore_Methaqualone	5.934	**0.004975***
S3.F3.Wide.200to800ms.Amp.	B9_ASSIST_Total_Score	1.123	0.5323
S3.F4.Wide.200to800ms.Amp.	B9_ASSIST_Subscore_Methaqualone	11.14	**0.004975***
S3.F7.Wide.200to800ms.Lat.m	Total_Years_of_Education	2992	0.2736
S3.F7.Wide.200to800ms.Lat.m	Years_at_School	97960	0.801
S3.F7.Wide.200to800ms.Lat.m	Years_of_Tertiary_Education	56660	0.5274
S3.F8.Wide.200to800ms.Lat.m	B9_ASSIST_Subscore_Methamphetamine	12950	0.1294
S3.F8.Wide.200to800ms.Lat.m	Years_at_School	88750	0.5622
S3.P3.P3.200to650ms.Amp.m\	B9_ASSIST_Subscore_Methaqualone	3.538	**0.004975***
S3.P4.P3.200to650ms.Amp.m\	B9_ASSIST_Subscore_Methaqualone	4.029	**0.00497***
S3.P4.P3.200to650ms.Lat.ms.	Age_on_Day_of_Testing	1749	0.3234
S3.FP1.LPP.400to800ms.Amp.	B7_ASRS_PartB_above_cut_off	16.94	0.3383
S3.FP1.LPP.400to800ms.Lat.m	Total_Years_of_Education	1546	0.5274
S3.FP1.LPP.400to800ms.Lat.m	Years_of_Tertiary_Education	88570	0.4129
S3.FP2.LPP.400to800ms.Amp.	B7_ASRS_PartB_above_cut_off	12.67	0.5224
S3.FP2.LPP.400to800ms.Lat.m	Years_at_School	1385	0.6368
S3.F3.LPP.400to800ms.Amp.m	B9_ASSIST_Subscore_Methaqualone	6.219	**0.004975***
S3.F3.LPP.400to800ms.Amp.m	B9_ASSIST_Subscore_Tobacco	1.351	0.2338
S3.F3.LPP.400to800ms.Amp.m	B9_ASSIST_Total_Score	1.535	0.3284
S3.F4.LPP.400to800ms.Amp.m	B9_ASSIST_Subscore_Methaqualone	11.86	**0.004975***
S3.F4.LPP.400to800ms.Amp.m	B9_ASSIST_Subscore_Tobacco	1.077	0.204
S3.F7.LPP.400to800ms.Lat.ms	Total_Years_of_Education	883.9	0.6368
S3.F7.LPP.400to800ms.Lat.ms	Years_of_Tertiary_Education	72330	0.4279
S3.F8.LPP.400to800ms.Lat.ms	Total_Years_of_Education	3558	**0.004975***
S3.F8.LPP.400to800ms.Lat.ms	Weight	666	0.9303
S3.F8.LPP.400to800ms.Lat.ms	Years_of_Tertiary_Education	74130	0.2488
TrickS.C3.P1.50to150ms.Amp.	Years_at_School	3.125	0.0796
TrickS.C4.P1.50to150ms.Amp.	Total_Years_of_Education	0.4937	0.1443
TrickS.C4.P1.50to150ms.Amp.	Years_at_School	3.004	0.2289
TrickS.P4.N1.50to150ms.Amp.	B9_ASSIST_Subscore_Methamphetamine	0.08865	0.4577
TrickS.FP1.P1.75to150ms.Lat.r	Age_on_Day_of_Testing	23.54	0.6169
TrickS.FP1.P1.75to150ms.Lat.r	B7_ASRS_PartB_above_cut_off	67.51	0.1841
TrickS.FP2.P1.75to150ms.Lat.r	B9_ASSIST_Subscore_Tobacco	61.35	0.2935
TrickS.F3.P1.75to150ms.Amp.	Total_Years_of_Education	0.2944	0.393
TrickS.F3.P1.75to150ms.Amp.	Years_at_School	1.767	0.3483
TrickS.F4.P1.75to150ms.Amp.	Total_Years_of_Education	0.3433	0.1393
TrickS.F4.P1.75to150ms.Amp.	Years_at_School	2.11	0.1741
TrickS.F4.P1.75to150ms.Amp.	Years_of_Tertiary_Education	0.4948	0.2637
TrickS.F7.P1.75to150ms.Amp.	Age_on_Day_of_Testing	0.1172	0.5572
TrickS.F8.P1.75to150ms.Lat.m	B9_ASSIST_Subscore_Methaqualone	2162	**0.01493***
TrickS.FP1.N1.100to200ms.Lat	B9_ASSIST_Subscore_Methamphetamine	923.7	0.1741
TrickS.FP1.N1.100to200ms.Lat	B9_ASSIST_Total_Score	113.7	0.3234
TrickS.FP2.N1.100to200ms.An	Total_Years_of_Education	0.5193	0.1741
TrickS.FP2.N1.100to200ms.An	Years_at_School	0.8213	0.4627
TrickS.FP2.N1.100to200ms.An	Years_of_Tertiary_Education	1.348	0.5622
TrickS.F4.N1.100to200ms.Amp	Years_of_Tertiary_Education	0.8799	0.6716

Variable	Potential Confounder	T	p-value
TrickS.F8.N1.100to200ms.Lat.r	B9_ASSIST_Total_Score	40.51	0.4726
TrickS.P3.P1.100to200ms.Amp	B7_ASRS_PartB_above_cut_off	1.836	**0.00995***
TrickS.P4.P1.100to200ms.Lat.r	B9_ASSIST_Subscore_Methaqualone	4965	**0.004975***
TrickS.P4.P1.100to200ms.Lat.r	B9_ASSIST_Subscore_Tobacco	87.93	0.1343
TrickS.P4.P1.100to200ms.Lat.r	Weight	67.59	0.1542
TrickS.P3.N2.150to250ms.Amp	B7_ASRS_PartB_above_cut_off	1.074	**0.0199***
TrickS.P3.N2.150to250ms.Lat.	B9_ASSIST_Subscore_Cannabis	24520	0.5075
TrickS.P3.N2.150to250ms.Lat.	B9_ASSIST_Total_Score	190.3	0.194
TrickS.C3.P2.175to300ms.Amp	B9_ASSIST_Total_Score	0.5438	0.2488
TrickS.FP2.P3.200to450ms.Am	B9_ASSIST_Subscore_Methaqualone	5.871	**0.004975***
TrickS.FP2.P3.200to450ms.Lat	B7_ASRS_PartB_above_cut_off	397	**0.02488***
TrickS.F3.P3.200to450ms.Amp	Years_at_School	5.592	0.3781
TrickS.F3.P3.200to450ms.Lat.r	Years_of_Tertiary_Education	23960	0.4179
TrickS.F4.P3.200to450ms.Lat.r	B7_ASRS_PartB_above_cut_off	1035	**0.00995***
TrickS.F4.P3.200to450ms.Lat.r	Total_Years_of_Education	985.7	**0.0199***
TrickS.F4.P3.200to450ms.Lat.r	Years_of_Tertiary_Education	25580	0.2488
TrickS.P3.P2.200to300ms.Lat.r	B9_ASSIST_Subscore_Methamphetamine	2225	0.1642
TrickS.P3.P2.200to300ms.Lat.r	B9_ASSIST_Total_Score	34.63	0.4527
TrickS.P4.P2.200to300ms.Lat.r	B9_ASSIST_Subscore_Methamphetamine	2356	0.1791
TrickS.P4.P2.200to300ms.Lat.r	B9_ASSIST_Subscore_Methaqualone	10360	**0.004975***
TrickS.P3.N3.250to375ms.Amp	B9_ASSIST_Subscore_Methamphetamine	0.3061	0.1294
TrickS.P3.N3.250to375ms.Lat.	Age_on_Day_of_Testing	129.3	**0.00995***
TrickS.P4.N3.250to375ms.Amp	B9_ASSIST_Subscore_Methamphetamine	0.153	0.1343
TrickS.P4.N3.250to375ms.Amp	B9_ASSIST_Subscore_Methaqualone	0.003316	0.9303
TrickS.P4.N3.250to375ms.Amp	B9_ASSIST_Subscore_Tobacco	1.976	**0.004975***
TrickS.P4.N3.250to375ms.Amp	B9_ASSIST_Total_Score	1.23	0.08955
TrickS.C4.P3.300to600ms.Lat.r	B9_ASSIST_Subscore_Methaqualone	43690	**0.00995***
TrickS.P3.P3.300to650ms.Lat.r	B9_ASSIST_Subscore_Tobacco	1071	0.06965
TrickS.P4.P3.300to650ms.Amp	B9_ASSIST_Subscore_Methamphetamine	1.649	**0.01493***
TrickS.P4.P3.300to650ms.Amp	B9_ASSIST_Subscore_Tobacco	2.058	**0.0199***

D.2.4 Non-parametric fANCOVAs of MAP and SCZ groups with addition of potential confounding factors

Variable	Potential Confounder	T	p-value
S3.Response	B1_PANSS_Positive_Subscale_Score	17.01	0.6318
S3.Omit	B1_PANSS_Positive_Subscale_Score	17.01	0.6866
A.Total.Correct	B1_PANSS_Positive_Subscale_Score	8.921	0.607
A.S3.Delayed.Response	B1_PANSS_Positive_Subscale_Score	10.97	0.3682
A.S3.Delayed.RT	Years_with_Diagnosis	440.3	0.4478
A.S3.RT	B1_PANSS_Positive_Subscale_Score	4949	0.06965
S1.F3.N1.75to200ms.Lat.ms.	B1_PANSS_Positive_Subscale_Score	153.1	0.3234
S1.F7.N1.75to200ms.Lat.ms.	B1_PANSS_Positive_Subscale_Score	101.8	0.6169
S1.F8.N1.75to200ms.Lat.ms.	Years_with_Diagnosis	39.34	0.8159
S1.FP1.P2.150to350ms.Amp.mV.	Years_with_Diagnosis	1.149	0.3234
S1.FP1.P2.150to400ms.Amp.mV.	Years_with_Diagnosis	0.2757	0.3831
S2.C4.Nc.0to100ms.Lat.ms.	B1_PANSS_Positive_Subscale_Score	89.14	0.607
S2.C4.Nc.0to100ms.Lat.ms.	Years_with_Diagnosis	39.26	0.1592
S2.P3.Nc.0to100ms.Amp.mV.	B1_PANSS_Positive_Subscale_Score	0.6439	0.1791
S2.P4.Nc.0to100ms.Amp.mV.	B1_PANSS_Positive_Subscale_Score	0.9554	**0.0398***
S2.FP1.N1.75to200ms.Amp.mV.	B1_PANSS_Positive_Subscale_Score	0.3001	0.592
S2.FP1.N1.75to200ms.Lat.ms.	Years_with_Diagnosis	73.88	0.4179
S2.F8.N1.75to200ms.Lat.ms.	B1_PANSS_Positive_Subscale_Score	37.24	0.8109
S2.C4.N2.100to250ms.Amp.mV.	B1_PANSS_Positive_Subscale_Score	0.6113	0.05473
S2.C4.N2.100to250ms.Amp.mV.	Years_with_Diagnosis	0.5854	0.1443
S2.P3.N2.100to300ms.Amp.mV.	B1_PANSS_Positive_Subscale_Score	1.066	**0.02985***
S2.P4.N2.100to300ms.Amp.mV.	B1_PANSS_Positive_Subscale_Score	1.823	**0.00995***
S2.F7.P3.150to450ms.Lat.ms.	B1_PANSS_Positive_Subscale_Score	856.8	0.3134
S3.C4.Nc.0to100ms.Amp.mV.	B1_PANSS_Positive_Subscale_Score	0.04152	0.9801
S3.P4.P50.0to60ms.Lat.ms.	Years_with_Diagnosis	29.1	0.2985
S3.P3.P2.100to180ms.Lat.ms.	Years_with_Diagnosis	26.13	0.4478
S3.C4.N2.120to220ms.Lat.ms.	B1_PANSS_Positive_Subscale_Score	151.1	0.1144
S3.FP1.P3.200to350ms.Lat.ms.	Years_with_Diagnosis	103.1	0.5224
S3.P3.P3.200to650ms.Amp.mV.	B1_PANSS_Positive_Subscale_Score	0.89	0.3582
TrickS.P4.N1.50to150ms.Lat.ms.	Years_with_Diagnosis	82.29	**0.03483***
TrickS.F3.N1.100to200ms.Lat.ms.	Years_with_Diagnosis	74.91	0.1244
TrickS.P3.P2.200to300ms.Amp.mV.	B1_PANSS_Positive_Subscale_Score	0.741	0.5224
TrickS.P4.P2.200to300ms.Amp.mV.	B1_PANSS_Positive_Subscale_Score	1.329	0.1741