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The neurobiology of groupthink: a qEEG approach to the study of followership

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THE NEUROBIOLOGY OF GROUPTHINK:

A qEEG APPROACH TO THE STUDY OF FOLLOWERSHIP

A dissertation submitted in partial satisfaction

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by

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This dissertation, written by

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

DEDICATION

First, and foremost, for my Heavenly Father. Your love is extravagant and the favor with which you have showered me is beyond my comprehension. It is amazing what You can do with one broken life. Let there not be one tittle or iota that does not bring You glory, but in this, I pray You be glorified.

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VITA

Education

Ed.D. Organizational Leadership, Pepperdine University — *ABD*
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M.S. Counseling Psychology, California Baptist University — *July, 1999*

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Pertinent Experience

California Baptist University — *August 2010 – Present (Prev.: Lecturer November '08 – August '10; Adjunct faculty May 2000 – May '03; August '08 – November '08)*
Assistant Professor,
Director Counseling Psychology Program, *Riverside, CA*
Instruct & conduct classes for the School of Behavioral Sciences including *MFT Techniques, Family Therapy Theory and Techniques, MFT Practicum, Psychophysiology (Behavioral Neuroscience), Psychology Across the Life Span, & Tests & Measures* (also Experimental Psychology, Methods of Research, & Statistics, etc.)

Doulos Community Services (Private Practice) — *May 2007- Present*
Administrative Director, LMFT, *Rancho Cucamonga, CA*
Oversee daily operations, supervisions of interns, adherence to policies and procedures and standards of practice, oversight to fiscal management.

Therapy, treatment & evaluation for general & special populations (the aged, children & adolescents, developmentally disabled, the chronically mentally ill, dual diagnosis/chemically dependent).

Perform therapy for individuals (adults & children), families & couples.

Country Villa Riverside Healthcare Center *July 2006 – January 2008*
Program Director
Managed the Special Treatment Program for this 120 bed-inpatient psychiatric hospital.

Supervise the Program, Activities, & Vocational Rehabilitation Departments, & their staff.

Run and provide oversight to Interdisciplinary Team Meetings; ensure adherence to state and federal regulations

Annually updated the P&P manuals, organize Pro-Act (safety and restraint) training, oversee internal investigations and reviews

Provide support to Psychology team, crisis interventions, individual and group therapy services provided as needed

Christian Family Counseling Service *March 2000 – January 2007*
Executive Director, *Riverside, CA*
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Oversee daily fiscal & administrative operations for agency.

Develop & implement treatment programs, policies & procedures, & community outreach programs.

LMFT
Handle therapy treatment & evaluation for special populations (the aged, children & adolescents, developmentally disabled, the chronically mentally ill, dual diagnosis/chemically dependent).

Perform therapy for individuals, families & couples.

Lead, teach, & coordinate group therapy & psycho-education (Anger Management, Parenting, Communication, Self Worth, Drama & Art Therapy

South Atlantic Medical Group ***(On behalf of State of CA Department of Mental Health)*** *October 2004 – October 2005*

Level II PASRR Evaluator, *Long Beach, CA*

Evaluate & perform complete assessments for patients diagnosed with a Mental Illness in SNFs & STPs under the Federal PASRR Requirements (Pre-Admission Screening & Resident Review).

Create multidimensional treatment plans.

Order consults & make appropriate referrals as necessary.

San Bernardino County Superintendent of Schools *August 1998 – July 2000*

MFT Intern

Perform therapy for children & adolescents in Alternative Education Placement

Create & Implement Behavior Modification Programs in homes & in the classroom for children with Axis I & Axis II disorders

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Develop & lead group therapy (Drug & Alcohol Treatment, Anger Management, Parenting, Gang Diversion, Boundaries, Self Worth, etc.)

Develop procedures & instruments for documenting intervention & progress for the State of CA/Medi-Cal program. Train other Interns in documentation procedures.

Post-Graduate Training

Portland State University, Certificate Program in Interpersonal Neurobiology	January 2012 - Present
Training in Clinical qEEG	September 2013

Licenses and Certification

Licensed Marriage and Family Therapist, California BBS	October 2003 to Present
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Certification in Neurotherapy (Clinical Track), BCIA	In Process

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Holloway-Deulen, A (2006). The bipolar bear family: When a parent has bipolar disorder. Wheaton, IL: Authorhouse.

Previous Contributor to Suite101.com (online magazine) for their Psychology and Marriage and Family sections.

Research Experience

School of Behavioral Sciences research Center, CBU: Committee Member	2011 - 2013
Began work on a project on Cranial Electrical Stimulation (using Alpha Wave Stimulation) for Depression and Insomnia	2014

Other Consulting and Teaching Experience

Brandman University, Adjunct Professor	July 2009 – June 2013
Seminario Internacional Teológico Baptista (International Baptist Theological Seminary) Buenos Aires: Consultancy, create multi-dimensional analysis and action plan to update library and university resources	June 2011 – January 2012
Provide consultancy services to churches and Christian Businesses	2003 to Present

Affiliations/Memberships

California Association of Marriage and Family Therapists	1998 to Present
Christian Neuroscience Society	2012 to Present
National Council on Family Relations	2012 to Present
Inland Empire Chapter of the MFT Consortium of California	2011 to Present

ABSTRACT

In recent decades, the study of leadership has focused on the qualities of leaders rather than on those of followers. However, it has been argued that there can be no meaningful construct of leadership without a coherent understanding of followership and group behavior. While the body of literature is replete with information on the study of groupthink and conformity as it relates to followership, the neurobiological drivers of such behavior remain under-investigated. The purpose of this work was to investigate the neurobiological basis of groupthink (conformity of thought) as a component of followership. Specifically, this work seeks to investigate six research questions: How does cognitive rigidity and ideological commitment interact to influence groupthink, does the presence or absence of decision-making protocol affect groupthink outcomes, to what extent does the presence or absence of a leader, as well as leader bias drive groupthink, and how does the brain respond in each of these conditions with regard to groupthink and conformity. Two separate experiments were used. The first experiment served as a pilot condition to test the efficacy of a hypothetical vignette. However, an opportunity was seen to test an interactional matrix of cognitive rigidity and ideological commitment (the first research question). In the second experiment, the research questions were tested in a similar mock decision-making group using the same vignette. However, quantitative electroencephalography (qEEG) baseline pretest data and posttest data were taken and compared to assess for changes in the brain related to groupthink. Both studies utilized confederates to form the groups to which the researcher measured conformity. While no statistically significant relationships were found directly for any of the research questions, the research did show some interesting patterns. The use of decision-making protocol did seem to slow down conformity when taken into account with other variables, such as leader style. Additionally, consistent with

the pre-existing literature, patterns were seen in study two with regard to changes in the frontal cortex, including the medial frontal gyrus, and anterior cingulate. Implications for organizations and churches as well as suggestions for future studies are presented in the final chapter.

Keywords: neurobiology, conformity, groupthink, followership, medial frontal gyrus, frontal cortex, anterior cingulate

Chapter One: Introduction

"It is easier to say what loyalty is not than what it is. It is not conformity. It is not passive acquiescence to the status quo . . . It is the realization that America was born of revolt, flourished on dissent, became great through experimentation."

Henry Steele Commager (1947)

Emile Durkheim argued that a critical error occurs when one denies the social origins of thought (Douglas, 1986). It is plausible that often when an individual asserts that they are an independent thinker, they are in fact denying the social influences that have shaped their thoughts. This kind of *groupthink* typically results from external pressures from within a group to conform, deterring critical thinking processes (Robbins & Judge, 2010).

Agazarian (1997) developed a theory of living human systems, defining a hierarchy of isomorphic organisms that operate interdependently to organize energy, function as a goal-directed unit, and are system-correcting. As members of these living systems, people have a need to belong (Baumeister & Leary, 1995). Not belonging has consequences, not the least of which is a visceral anxiety that drives us to forge new relationships or mend available relationships in order to restore a sense of well-being (Baumeister & Tice, 1990; Nesdale & Pelyhe, 2009). Conformity, therefore, may be a survival mechanism that allows individuals to belong by minimizing, or sometimes even negating, individual thought (M. L. Hoffman, 1957). In the very least, it minimizes the anxiety associated with not being part of the in-group (Nesdale & Pelyhe, 2009).

Though the word itself may have a negative connotation, conformity does have a place in society (Baron, Branscomb, & Byrne, 2009). Imagine a world where no one followed traffic

laws, children held no innate sense directing them to follow familial rules or patterns, and no one understood a need for governmentalized order. Conformity in the workplace is especially important for efficiency, as well as brand development and maintenance (Shafritz, Ott, & Jang, 2001).

In recent decades, much of the conformity research has centered on what is referred to as the groupthink phenomena, a term first coined by William Whyte in the 1950's (Whyte, 1952) but made popular by Irving Janis (Esser, 1998; Janis, 1971). Groupthink occurs when a group makes faulty decisions because group pressures lead to a deterioration of "mental efficiency, reality testing, and moral judgment" (Janis, 1972, p. 9). In short, groupthink, conformity of thought, occurs when a group shares a common mindset about something in such a way that the group's process iteratively reinforces the same thinking, blocking new ideas, problem solving strategies, and alternative viewpoints. The destructive nature of groupthink is well documented in the literature (Esser, 1998). Some infamous episodes of groupthink disasters include policy decisions made regarding the Bay of Pigs, the US involvement in both North Korea and Viet Nam, and the failure to appropriately prepare for the attack on Pearl Harbor, all originally studied by Janis and later supported by many other researchers in the years that followed (Esser, 1998; Janis, 1972; Janis, 1982) as well as the Space Shuttle Challenger disaster (Moorhead, Ference, & Neck, 1991) and the Columbia tragedy (Ferraris & Carveth, 2003).

Need for the Study

Leadership, a continually evolving field of study, plays a central role in understanding organizational behavior (Robbins & Judge, 2010). However, studies have focused more on the qualities of leaders and on followers as they relate to those leaders, than on the qualities of followers themselves (P. Hoffman, 2009). It could be said that it may not be possible to truly

understand leadership without developing a robust understanding of why people follow in the first place. However, the study of "followership" remains an under-investigated domain (Meindl, 1995).

The little that has been studied regarding followership is perhaps best represented in the disciplines of anthropology, sociology, and social psychology. A review of the literature provides a wealth of information regarding group dynamics that can logically be applied to an operational understanding of followership. Concepts that translate well from these behavioral sciences to a study of followership include phenomenon such as group dynamics, conformity, and groupthink.

As stated earlier, conformity itself is not always a negative event. Conformity provides several benefits (Baron et al., 2009). A tendency toward conformity can aid the decision making process. This can be especially helpful in large groups or when consensus is needed within an organization. Conformity also helps to uphold group standards and social mores. Further, conformity helps to bring order to chaos (imagine a world where no one considered traffic laws).

However, while conformity certainly has its place in society (Baron et al., 2009), unquestioned conformity can have a horrific outcome. Perhaps the most incredible example of this from modern times is that of the Fübrerprinzip, "one leader, one Reich, one people" (Chaleff, 2009, p. VII) in the era leading up to the rise of Hitler. Under this cultural norm, unquestioned obedience to leadership was nothing short of noble (Chaleff, 2009). Those who did not conform were not well received by their fellow countrymen, let alone the leaders loyal to the Führer. Many "non-conformists" suffered the same fate as those they tried to defend. Other destructive examples of conformity of thought, what Janis called groupthink, include those stated earlier (the Bay of Pigs, US involvement in North Korea, the US failure to prevent the 1941

attack on Pearl Harbor, US involvement in Viet Nam, and both the space shuttle disasters) as well as Watergate (Janis, 1982), the US decision to invade Iraq to find weapons of mass destruction (Tavris & Aronson, 2007) and several corporate fiascos including the Enron scandal (Prentice, 2007). There is also some evidence in the literature that while groupthink may not always end with these sorts of terrible or consequences, groupthink in the very least blocks not only organizational growth and development, but can completely thwart a leader's attempt at initiating any type of change process (Greyvenstein & Cilliers, 2012).

But why do people conform? Two reasons have been proposed to address this question: The need to belong, and the need to be right (Baron et al., 2009; Deutsch & Gerard, 1955). However, it has been noted that the need to be right can result in defensive routines that shut down the learning process, blocking growth and forward movement (Argyris, 2008). Further, studies on conformity reveal a strong groupthink phenomenon, which may be stronger in organizations and situations with a moral component (Hornsey, Majkut, Terry, & McKimmie, 2003). This would seem to make certain organizations (for example faith based and cause-driven institutions) especially vulnerable.

Some early researchers (e.g. Costell & Leiderman, 1968) suggested that conformity, at least in part, is a result of an autonomic response in the central nervous system. Numerous others (as outlined in Chapter Two) have begun to argue that the need to belong, as well as the need to be right, is neurobiological in nature. However, while behavioral neuroscience is a growing field, very little literature studying the neurological or psychophysiological dimensions of conformity exists (Chen, Wu, Tong, Guan, & Zhou, 2012). One could assert the argument that it is not possible to completely understand the function of conformity without understanding the neuro-physiological drive behind the phenomenon.

In sum, while conformity certainly has a place in society, conformity left unchecked can have disastrous consequences. However, too little literature exists with regard to followership itself, let alone the neurobiological correlates of identified dimensions of followership such as conformity and groupthink. Further, not only is an understanding of this phenomenon imperative to creating healthy leadership strategies, but a new integrative model informed by an understanding of followership and the neurobiology of groupthink conformity is needed to really accomplish this end.

Problem Statement

A review of the literature reveals several problems. To begin, as stated earlier, leadership has been the focus of research within the field for the last several years, while followership remains understudied. Further, while the literature is replete with information on conformity, such studies lack a focus on the neurobiological basis of such phenomenon. A more robust understanding of followership is needed to create more effective learning organizations. Finally, groupthink as a component of followership is certainly worthy of research attention as it has powerful and sometimes even devastating consequences for individuals, their organizations, and the people they serve or impact.

Purpose of the Study

The best approach to leadership is one that will consider followership as important, if not more important, than leadership itself, and, in so doing, will foster a community that creates courageous followers that can appropriately stand up to their leaders, dissent when needed, question the status quo and offer alternative viewpoints (Chaleff, 2009). The purpose of this study is to investigate the neurobiological basis of groupthink as a dimension of conformity, a

component of followership, in order to advance understanding of effective leadership strategies and the development of healthy organizations.

Research Questions

This study will address the following research questions:

1. To what extent, if any, might groups higher in rigidity and commitment demonstrate high levels of groupthink?
2. What difference, if any, does the implementation of decision-making protocols make in the final outcome?
3. How does the presence of a leader impact the final decisional outcome with regard to groupthink?
4. To what extent, if any, does the presence of a perceived leader moderate the neurobiological dimensions of conformity?
5. To what extent, if any, does the partiality of the leader impact the final outcome?
6. To what extent, if any, does the partiality of a perceived leader moderate the neurobiological dimensions of conformity?

Limitations of the Study

As is the case with all research studies, the present design has several limitations. To begin, while empirical research is preferable for establishing relationships between variables, one cannot hope to replicate group dynamics in a lab that normally develop over time. Secondly, as Hewlin (2003) notes, this type of empirical research cannot capture the "facades" of conformity (pretenses of compliance). Further, it cannot capture the phenomenon of what the literature refers to as "tempered radicals," those that think differently than the group but choose to temper their dissenting thought to maintain group norms (Zemke, 2010).

Another limitation is that of assessing brain function under this type of social-performance situation. While qEEG (quantitative encephalography) measures, like those proposed in the methods section of chapter three, provide some of the most temporally sensitive data, it is not an in-depth measure. Further, there is no way in the present study to control for error variance in qEEG recording related to pathology (e.g. histories of child abuse that have impacted brain function, brain injuries, organic disease and pathology, the impact of prescribed medication, etc.). Additionally, the age of the subjects (traditional undergraduate college students) presents another limitation in that the brain of a young adult is still not completely mature and usually undergoing rapid synaptogenesis (Carlson, 2010).

A clear limitation is the religious nature of the institution from which the participants will be drawn; all the participants (and nearly all the confederates) will be drawn from a mid-sized Southern Baptist University. As will be noted in chapter two, religiosity and spirituality play important roles in conformity, as well as brain function (Newberg & Waldman, 2011). However, in the current approach, there is no practical way to control for the influence of faith on conformity.

An additional limitation revolves around the use of the cognitive flexibility inventory (CFI) that will be used, as outlined in chapter three. This inventory, while practical for this approach and demonstrated to yield test-retest reliability as well as construct and content validity (Dennis & Vander Wal, 2010) has poor face validity. A savvy participant will be able to see through the questions and answer according to their own bias.

The use of EEG and qEEG also produces its own limitations. One of the biggest limitations in this study centers on the need to control for artifacting. In an EEG or qEEG, an artifact is any part of the recording that is not part of the brain's electrical potential, but rather an

unrelated event. Breathing, chewing, eye movements, muscle movements, and pulse are all common examples of artifacts that frequently show up on EEG and qEEG recordings. These artifacts can interfere with the interpretation of the data and should be reduced as much as possible during EEG and qEEG recordings.

Finally, an important limitation in the proposed study to note is related to the amount of time and cost involved in doing a brain study of any kind. For this reason, a smaller sample size was used.

Definition of Terms

The following is a list of terms as they have been operationally defined for use in the present study:

Anterior: For the purpose of this study, this will refer to the portion of the central nervous system located near or toward the head.

Artifact: Any thing that shows up in the EEG that is not actually the result of electrical potential in the cortex. Possible examples include movement, swallowing, eye movement and blinking, heart rate or electro-cardio output, muscle tension, and signal interference from electrical equipment such as computers and air conditioners.

Caudal/Caudate: Literally meaning "toward the tail;" for the purpose of this study, this will refer to the portion of the central nervous system furthest away from the front of the face.

Cerebral Cortex: This is the outer layer of tissue in the brain referred to as grey matter. It includes the four types of lobe structures (the temporal, occipital, parietal, and frontal lobes). It is approximately 1.5 - 5 mm thick. It covers the cerebrum and the cerebellum.

Cingulate system: This is the most medial part of cortex and includes the cingulate gyrus. It is part of the limbic system, and therefore involved in emotion formation, processing, learning, and

memory. Note: The rostral cingulate zone may play a role in a wide variety of autonomic functions (e.g. blood pressure, heart rate) and rational cognitive functions, such as reward anticipation, decision-making, empathy, impulse-control and emotion.

Cognitive Dissonance: Described as a part of dissonance theory, cognitive dissonance occurs when a person holds two opposing behaviors or thoughts, resulting in a state of distress, generally both psychological and physiological.

Compliance: A change in overt behavior generally produced by a specific request; it involves getting other people to do what one wants them to do.

Conformity: Change induced by general rules concerning what behavior is appropriate or required in a given situation. In essence, it is the degree to which one individual modifies the behavior to match the behavior of another individual, a group, or to a social norm.

Dissonance Theory: This theory suggests that when individuals experience cognitive dissonance, they will resort to compensatory mechanisms, including but not limited to self-justification, in order to relieve the distress they experience associated with the dissonance.

Downregulation: This refers to a decrease in the quantity of cells, cellular connections, or a cell's receptors in the central nervous system.

Electroencephalography (EEG): This is a measure of electrical activity along the scalp that results from the firing of neurons within the brain. An EEG recording generally captures these data in the form of alpha, beta, delta, and theta waves.

Feigned Conformity: Referred to in the literature as facades of conformity, this refers to a behavioral or outward conformity that is not necessarily congruent with thought. Specifically, it refers to the accommodating behavior of an individual to match a norm or expectation, when the accompanying belief is not actually held.

Frontal Lobe: This structure is the most anterior part of the brain. It is often referred to as the "social brain" as it is what governs much of the social part of human behavior. It is also involved with decision-making, problem solving, and planning. However, it is also associated with some motor functions, planning, reasoning, judgment, impulse control, and memory.

Followership: An emerging field of study that focuses on the qualities of followers as well as follower development, rather than on models of leadership.

Group mind: A neurobiological term developed by Siegel, and expanded by Gantt and Agazarian, it refers to the interpersonal and relational aspects how information is shared and regulated within an isomorphic group.

Groupthink: A term first coined by Whyte but made popular by Janis, it refers to the process by which a group unquestioningly thinks together in one accord. In essence, it is conformity of thought, which, may develop over time, or perhaps more quickly when high levels of group cohesion and resonance exist. In this research, the terms conformity and groupthink are used interchangeable, but in both cased refer to conformity of thought.

Gyrus: A gyrus (gyri in the plural form) is a ridge on the cerebral cortex. Gyri are found in all four lobes of the brain.

In-group: A social psychology term used to refer to members belonging together to a group. It is opposite of the out-group, composed of members that do not belong to the identified in-group.

Lateral: With regard to the central nervous system, this direction implies away from the middle.

Limbic System: This is sometimes referred to as the paleomammalian brain due to its prehistoric nature; it is the oldest part of the brain. The limbic system is a set of structures that includes the hippocampus, amygdala, hypothalamus, and thalamus. This complex system is involved in emotion, behavior, motivation, and the formation of long-term memory.

Low Resolution Brain Electromagnetic Tomography (LORETA): This is brain imaging software that allows for three-dimensional imaging based on EEG recordings, as well as for quantitative analysis and comparison.

Medial: With regard to the central nervous system, this direction implies toward the middle, away from the side.

Neuroscience: For the purpose of this study, this will refer to the discipline of research and study of the human nervous system and its function.

Non-conformity: This refers to the act of choosing not to conform to a group whether passively, or through more active dissent.

Nucleus Accumbens: This structure is a component of the ventral striatum, a part of the basal ganglia. Its function is connected to pleasure as well as reward processing, and reinforcement learning. It is also believed to play a role in addiction, fear, aggression, and impulsivity.

Obedience: Change induced by direct orders or commands from others is described as obedience.

Occipital Lobe: This structure is the most anterior part of the brain located within the skull and controls vision.

Orbitofrontal Cortex: This term is synonymous with the ventromedial prefrontal cortex. It is part of the prefrontal cortex responsible for decision-making.

Organizational Neuroscience: For the purpose of this study, this will refer to the incorporation of neuroscience and organizational behavior.

Out-group: A social psychology term used to refer to those who do not belong to an identified group. It is opposite of the in-group, composed of members that do belong to the identified in-group.

Parietal Lobe: The parietal lobes (one in each hemisphere) are caudally located (toward the back of the head) and sit between the occipital and frontal lobes. These structures are involved in the reception and processing of sensory information, including pain and touch. However, they are also associated with cognition, speech, and some visual perception.

Posterior: For the purpose of this study, this will refer to the portion of the central nervous system away from the head, or "toward the tail."

Posterior Medial Frontal Cortex: This structure is thought to be involved in the processing of performance errors and to interact with other parts of the brain to create adaptations.

Prefrontal Cortex (PFC): The most evolved part of the human brain (compare to the limbic system), it is the most anterior part of the brain's frontal lobe. It includes the dorsolateral and orbitofrontal cortexes. It is responsible for executive functioning, including planning, problem solving, verbal reasoning, mental flexibility, and inhibition, attention, and working memory.

Promotional Leadership: The influence exercised by a leader toward his or her own bias. It is the degree to which a leader directs the group toward this bias.

Quantitative Electroencephalography (qEEG): This is a technique that measures brain function in such a way as to allow for quantitative analysis and comparison. It is generally thought of as the analysis of a digital EEG and is sometimes referred to as brain mapping.

Rostral: Literally meaning "toward the beak;" for the purpose of this study, this will refer to the portion of the central nervous system closest to the front of the face.

Striatum: Also known as the neostriatum or striate nucleus, is a part of the forebrain. This structure receives input from the cerebral cortex and in turn, sends input to the basal ganglia system. It is necessary for planning and execution of movement as well as cognition and working memory.

Subcortical: Referring to structures or regions under or below the cerebral cortex.

Temporal Lobe: This structure, which sits below the parietal lobes on either side of the skull, contains structures of the limbic system, including the amygdala and hippocampus. These lobes are associated with memory, emotion, hearing, and language.

Upregulation: This refers to an increase in the quantity of cells, cellular connections, or a cell's receptors in the central nervous system.

Polyvagal Nerve Theory: This theory describes behavior in terms of the vagal nerve system. Developed by George Porges, it asserts that different vagal nerves serve different purposes, based on evolutionary needs and hierarchies. It is thought to mediate automatic behaviors related to fear from both survival and social frameworks.

Ventral: Meaning "toward the belly;" for the purpose of this study, this will refer to the portion of the central nervous system toward the bottom of the skull.

Organization of the Study

This study is organized into five chapters.

Chapter one: Introduction. This chapter discusses the background of the study, the need for the study, a statement of the problem, as well as the purpose statement. This chapter includes research questions, limitations, and definitions of terms. Chapter One concludes with the organization of the study.

Chapter two: Literature review. Chapter Two provides an overview of the key concepts incorporated in the development of this study. The literature review covers the following domains: followership, conformity, groupthink, behavioral neuroscience, organizational neuroscience, neuroscience of conformity and groupthink, and measurement techniques.

Chapter three: Methodology. Chapter Three begins with an introduction to the methodology to be used. The introduction is followed by a description of the nature of the study. The hypotheses are then stated followed by a description of population, sample and sampling technique. The characteristics under study are then described followed by definitions of those characteristics. This chapter also outlines the data collection plan, and proposed analytical techniques. The chapter concludes with a summary.

Chapter four: Results. Chapter Four outlines the results for both studies an provides information regarding the analytical techniques used. This chapter also concludes with a summary.

Chapter five: Discussion. Chapter Five discusses the results, the limitations discovered during the course of both experiments, and provides suggestions for future research designs. Further, this chapter explores organizational possibilities for limiting groupthink and promoting organizational health. The chapter concludes with a summary.

Chapter Two: Literature Review

Background

It was a Sunday afternoon when the present author was watching a documentary on the mass murder-suicide of the Peoples Temple Agricultural Project, more commonly known as the massacre at Jonestown in 1978. It is still astonishing to consider how 900 people could somehow agree that drinking cyanide laced Cool-Aid, and giving it to their young children, was a good idea given their circumstances. This incident may serve as an extreme example of the horrific outcomes that may follow poor collective thought, but recent history is littered with dozens of examples of groupthink at all levels, and in all types of groups, from corporations (Tavris & Aronson, 2007) to higher education (Hensley & Griffin, 1986) to the Federal Government of the United States of America (Herek, Janis, & Huth, 1987; Janis, 1972; McCauley, 1989). No one is immune from falling victim to the social influence of groupthink within the organizations to which they belong (Janis, 1982).

That being said, the number of individuals directly impacted by groupthink roughly estimates the population. As the consequences of groupthink in many circumstances can have far reaching effects, for example in the case of public policy, groupthink disasters impact not only the "thinkers" but anyone who can be touched by a decision's ripple effects. Therefore, the number of people impacted by groupthink in our society becomes almost immeasurable.

While the groupthink phenomenon was first studied in relation to organizational behavior during the American Soldier Project of the 1950's (Janis, 1971; Janis, 1982) several case studies in the last four decades have provided support that many of the most consequential policy decisions of the last half of the 20th century were incidents of groupthink including the failure to anticipate or prevent the attack on Pearl Harbor, the Bay of Pigs, US involvement in North Korea

and Viet Nam, and Watergate (Esser, 1998). Further, groupthink has been determined to be the underlying cause of at least two Space Shuttle fiascos: Challenger (Moorhead et al., 1991) and Columbia (Ferraris & Carveth, 2003). More recently, the literature has referred to the decision to invade Iraq in search of weapons of mass destruction as the result of pervasive groupthink (Tavris & Aronson, 2007). While each of these incidents and the groupthink that fostered them will be discussed in this chapter in light of the literature and empirical research supporting these ideas, it is important to begin by noting the breadth and far reaching scope of the problem. Groupthink is almost an insidious disease for which there is a cure, but without an understanding of its drivers, we are ill equipped to treat or prevent.

It is well documented in the literature that there exists an important connection between an organization's ability to think well, creatively problem solve, and learn and overall organizational health (Argyris, 2008; Bolman & Deal, 2008; Chaleff, 2009; Senge, 2006). Further, while the literature will demonstrate that in most (if not all) cases where groupthink prevails in a destructive form, the outcome was a direct result of a lack of checks and balances such as decision making protocol, or accountability efforts that foster critical thinking (Courtright, 1978; Neck & Moorhead, 1992) the cost of non-conformity can be very great for some individuals. Included in this chapter is a brief discussion of examples of positive change that have risen out of a refusal to conform to the normative group's consensus (Quirk & Richardson, 2010). These dissenters, as they are referred to in the literature, are credited with a variety of feats such as working to change a mindset about slavery, for example (Quirk & Richardson, 2010).

Also discussed in this chapter are the reasons why people conform. Conformity does in fact have an important place in society. If people were not hard-wired in their neurobiology to

conform, society may very well disintegrate due to wide spread chaos; it would be a world without rules, mores, structure, or normative expectations. One could argue that there would be no waiting your turn at the stop light, no quiet libraries, and no children that attempted to emulate positive or pro-social behaviors of the adults they admire. As the literature will discuss, despite the fact that the neuroscience of conformity is still in its infancy, the drive to conform seems to be neurobiological, as well as adaptive to our survival.

Literature Search Strategies

The literature review for this study was conducted in three basic phases:

Phase One: A literature search was done using Proquest, EBSCO Host, and Academic Search Premier data bases for scholarly articles and dissertations in the areas of conformity and neuroscience.

Phase Two: The present researcher accessed text books and dissertations on topics related to the present design, analyzed their literature reviews, researched pertinent articles and findings, pulling as many original sources as possible.

Phase Three: The present researcher examined the gaps in her literature review. Then, returning to EBSCO Host, and Academic Search Premier, the present researcher commenced an additional search for information that appeared to be lacking from the literature.

Overview of the Organization of the Literature Review

There are several theoretical considerations that makeup the context for the present literature review. Each of those theoretical dimensions has been delineated into their perspective sections, and will occupy the remainder of this chapter. The theoretical elements to be covered in this literature review are:

A. Followership studies

B. Conformity

    i. The Asch Paradigm

    ii. Groupthink as a specific dimension of conformity

C. Behavioral neuroscience

    i. Organizational Neuroscience as an Emerging Field

D. The Neuroscience of conformity and groupthink

Literature Review

Followership. It has been argued that to truly understand any model of leadership, one must start with an understanding of followership (Bligh & Kohles, 2012). In point of fact, Meindl (1995) argued that any approach to the study on leadership should first be follower-centric. However, the literature has focused more on the qualities of leaders and on followers as they relate to those leaders, than on the qualities of followers themselves (P. Hoffman, 2009). Therefore, the study of "followership" remains an under-investigated domain. However, most of us, in some capacity or another, are not just leaders; we are followers also (Chaleff, 2009). Further, it can be argued, that one could spend a century studying the attributes of great leaders, however, one cannot make complete sense of why people follow a particular leader without studying those who follow him or her. In other words, without studying the follower, one cannot completely formulate a leadership postulate.

It has been asserted that one of the reasons leadership theories fall short of completeness, has to do with a lack of understanding of followers (Rosenau, 2004). This is because, even for the most likeable leaders, his or her "charisma is embedded in the orientation and needs of his or her followers" (Rosenau, 2004, p.16). While leaders may lead followers, followers also lead

leaders, so much so that it is often unclear "who is leading and who is following" (Rosenau, 2004, p.17). Further, studies demonstrate that within institutions of strong organizational cultural identity, followers may reject leaders or leadership changes more vehemently (Nauta, 2007) choosing instead to reinforce the leadership of those who are more culturally homogenous to the group's identity.

Perhaps the freshest perspective on followership is the work of Ira Chaleff (2009) in his book *Courageous Followership: Standing up to and for our Leaders.* In this pivotal book, Chaleff discusses the need to address followership:

> We need a dynamic model of followership that balances and supports dynamic leadership. We need a model that helps us embrace rather than reject the identity of follower because the model speaks to our courage, power, integrity, responsibility, and sense of service. (p.1)

The work on followership within the context of conformity has powerful ramifications. In many organizations, "expulsion for nonconformity is a very real threat" (Chaleff, 2009, p. 5). This may be truer when nonconformity is deemed to be akin to sin (Zemke, 2010) as may be the case in religious or faith-based organizations. Further still, some of the greatest changes within this type of organization over the last several centuries have come not from the top down (leadership) but from the bottom up (followership), from dissenting non-conformists like Martin Luther (P. Hoffman, 2009).

An outstanding question in this arena is why do people follow or dissent? While a few studies have been conducted on dissent (Packer, 2008), other researchers have found a number of factors that drive conformed followership (Carsten, Uhl-Bien, West, Patera, & McGregor, 2010). However, those drivers are difficult to define as follower behavior appears to be somewhat

contextually driven (Carsten et al., 2010). Other studies have validated this premise that followership is contextual. For example, one study conducted with a large group of nurses found that "followers do not necessarily fit into one category but may move between categories depending on the situation" (Kean, Haycock-Stuart, Baggeley, & Carson, 2011). Those authors note that little is known about followership and augment the argument that has been made that leadership and followership need to be addressed as separate, but interdependent constructs (Kean et al., 2011). Still, it is important to highlight what the literature does reveal about a followership construct.

One of the primary problems that has resulted from a leadership model that emphasizes business leadership rather than followership issues is that followers tend to feel disregarded or unimportant as well as de-authorized to act in their own leader-like ways (Greyvenstein & Cilliers, 2012). As a further result, followers may compensate by withholding their "authorization" to participate in change or cooperate with leadership, perhaps even in a covert manner. This results in difficulty to the leader with regard to managing change and organizational development or transformation (Greyvenstein & Cilliers, 2012).

Just as the literature reveals that leadership paradigms are contextual, based on the needs and climate of the organization, followership models should also be contextually defined (Cox, Plagens, & Sylla, 2010). Further still is the need to differentiate between what it means to follow (the actual act of submission, compliance, or obedience) and followership in a broader framework (Cox et al., 2010). This broad approach to followership defines itself more in terms of how the subordinate, or follower, actually relates to the nominal leader (Cox et al., 2010). Therefore, while following is reactive, followership is driven by conscious choices regarding

behavior. This is especially important given the power that followers have to influence organizational outcomes and success (Cox et al., 2010).

Focusing on the power that lies in the hands of followers then, it is appropriate to discuss the relationship between followers and stated leaders. For example, we know that the more agreement a follower perceives exists between a leader's behavior and what the follower determines are ideal leader values, the more satisfied followers are with their leaders, independent of conditions (Quaquebeke, Kerschreiter, Buxton, & Dick, 2010). Further, it has been demonstrated that the behavior of followers has a direct influence on a leader's positive affect (mood) as well as feelings of psychological empowerment (Lapierre, Bremner, & McMullan, 2012). In turn, this dynamic reinforces a leader's demonstration of their charismatic capacities (Lapierre et al., 2012).

In an empirical study, two dimensions of followership were identified: independent critical thinking, and active engagement (Blanchard, Welbourne, Gilmore, & Bullock, 2009). These two dimensions do not always have positive outcomes for organizations however. For example, while active engagement is positively correlated with job satisfaction, independent critical thinking appears to be negatively correlated with both job satisfaction and organizational commitment (Blanchard et al., 2009). In other words, when an organization includes followers that are independent critical thinkers, those followers are less like to enjoy their jobs and less likely to be committed to their organizations. These findings are consistent with other research (Hoption, Christie, & Barling, 2012) that reveals that when an organization's individuals are labeled as "followers" those individuals report lower levels of positive affect and lower levels of extra-role behavior (initiative).

In another empirical study, researchers gave 302 undergraduate participants a series of vignettes describing a fictional organization (Thoroughgood, Hunter, & Sawyer, 2011). Participants were instructed to envision themselves as a subordinate to the leader who was male or female, aversive or not. The researchers found that leaders perceived as aversive elicited greater whistle-blowing responses. Perhaps more interesting however, is the finding that female aversive leaders were rated as more aversive than their aversive male counter-parts in the same story, perhaps indicating a higher tolerance for aversive male leadership than aversive female leadership (Thoroughgood et al., 2011).

Still, there remains no real theory of followership. Popper (2011) has attempted to develop a theory based on three existing theoretical constructs: psychodynamic theories of leadership in which the leader represents a parental figure, psycho-cognitive constructs where the leader represents a simplified explanation for organizational complexity, and social-psychological theory where the leader gives followership a meaningful narrative. This is a complex model, however, that has yet to be empirically demonstrated.

In a simpler approach, researchers proposed five reasons why people follow, and 9 types of leadership styles (Kim, Liss, Rao, Singer, & Compton, 2012). The following is a summary of the five reasons provided for followership:

1. Fear of Retribution: “If I do not follow, I may lose my job!”
2. Blind Hope: “We must do something. I hope this works!”
3. Faith in Leader: “What a great person. If anyone knows the answer, they do!”
4. Intellectual Agreement: “What a good idea. That makes real sense”
5. Buying the Vision: “What a brilliant idea. I don’t care who thought of it”

The nine types of followers described, all animal archetypes, range from the very independent but faithful (e.g. the eagle) to the interdependent and truly loyal (the lion) to the unquestioning follower (sheep) to the utterly destructive or counter-productive type (hyena) (Kim et al., 2012). While this is certainly a fun and creative approach to the development of a followership construct, as a model it has not been tested, and the proponents are not at all clear on what basis they have even derived their postulate. So, the construct of followership remains nebulous, at best.

Conformity. Conformity studies emerged from the larger body of work now referred to as Social Psychology, which emerged during the middle of the 1920's (Baron et al., 2009). One of the field's pioneers, Floyd Allport, argued that social behavior arises out of many different complex factors (Baron et al., 2009). Allport emphasized the value of experimentation in social psychology and openly discussed his research on topics such as conformity (as well as task performance, affective recognition, and scientific methodology (Allport, 1924).

Due in part to the work of Allport and others (in particular social psychology icons Muzafer Sherif and Kurt Lewin to whom we owe the emergence of leadership studies), the next two decades saw remarkable growth. These two decades were marked by a rapid increase in scientific experimentation as well as new modalities for data collection (Baron et al., 2009).

Two of the most important milestones in the development of the field during this period, which would contribute to our modern understanding of conformity, come from two of these pioneers:

1. In 1935, Muzafer Sherif developed a theory of social norms, thus contributing to our understanding of inter-personal pressures toward conformity (Baron et al., 2009).

2. Kurt Lewin and his colleagues carried out revealing research on the nature of leadership and other group processes (Lewin, 1935).

While these studies served as an interesting foundation to the context of conformity and social psychology, the aftermath of the Holocaust and Nazi behavior during World War II drove behavioral scientists in an attempt to make sense of the atrocities resulting from blind followership and conformity. As mentioned earlier, Nazi Germany operated under a collectivist Fübrerprinzip (leadership principle) that valued unquestioned conformity (Chaleff, 2009). While studies (Triandis, 1995; Triandis, 2001) have demonstrated that conformity does in fact occur with greater frequency in collectivist cultures, other studies have found a multitude of factors contributing to this phenomenon (Baron et al., 2009).

The Asch Paradigm. In 1955, a groundbreaking experiment took place that helped researchers in the field of social psychology begin to understand the phenomenon for conformity (Asch, 1955). The experiment (now commonly referred to as the Asch studies or Asch paradigm) divided subjects into two groups: A control group, where participants were assessed individually, and a treatment group where participants were placed into a room with one to eight confederates (Asch, 1955; Asch, 1956). Subjects were told they were participating in a study on visual perception. Subjects in both groups (n = 123 males) were shown a card with a black line on it. Subjects were then shown a second card with three lines of differing lengths and asked to identify which of the three was the same length as the first. Confederates unanimously gave false answers, in an attempt to determine whether participants would conform to the group norm.

When subjects were assessed in the control group, only one participant out of 35 incorrectly identified the correct match. However, the results were different in the treatment group. Results indicated that while one confederate had virtually no influence, the presence of a

second confederate resulted in slightly higher amounts of conformity. Further, the addition of three or more confederates revealed significantly higher amounts of conformity (Asch, 1956).

Follow up studies on the Asch experiments have also explored the impact of shame (Scheff, 1988), age (Walker & Andrade, 1996) as well as sexuality and gender (Tiegs, Perrin, Kaly, & Heesacker, 2007). More than four decades after the original experiment, researchers conducted a meta-analysis of all the replication studies that had been conducted using the Asch paradigm (Bond & Smith, 1996). The results suggest that conformity has declined in the United States since 1950 (at least for this type of line judgment task) and that conformity appears to be higher in collectivist cultures than in individualistic cultures (Bond & Smith, 1996).

Walker & Andrade (1996) replicated Asch's line judgment task experiment in order to examine age as a variable in conformity. These researchers note that previous studies did not find age a factor in conformity but state that those studies did not take into account whether the task assignment was ambiguous or non-ambiguous (Walker & Andrade, 1996). Based on their findings, they report that when ambiguity is controlled for, conformity decreases with age in perceptually unambiguous tasks. This seems highly important to note; groupthink phenomenon, such as that related to complex decision-making, typically follows along more ambiguous lines.

Related to how individuals conform in groups, researchers also using a replication approach, tested their hypothesis that conformity would be higher among participants "forming a group" in a face-to-face context rather than in an anonymous participation setting (Deutsch & Gerard, 1955). This may correlate with findings that conformity in the Asch paradigm appears, at least in part, to be related to constructions of shame (Scheff, 1988).

Factors affecting conformity. Although tremendously valuable, the Asch paradigm composes only a fraction of the conformity phenomenon. To really understand conformity as it

relates to followership and groupthink, one must step back and look at the literature in a broader context. The following summarizes factors identified in the literature affecting conformity.

Social influence. The literature reiterates that most people ignore or deny the social influences that shape their cognition and behavior (Douglas, 1986; Robbins & Judge, 2010; Cialdini, 2005). The literature notes three social influence factors impacting organizational behavior: People Frequently ignore or underestimate the extent to which their behavioral actions in a given situation are determined by others present, people ignore or underestimate the persuasive nature others' behavior can have on their own choices, and when one considers themselves an expert on the topic, people ignore or underestimate the extent to which the input of others can improve their decisions (Cialdini, 2005).

Psychological factors. According to social psychologists, there is two main reasons people conform: The need to belong to the group and the need to be right (Baron et al., 2009; Deutsch & Gerard, 1955).

The need to be right. While people tend to conform out of a need to be right, studies have demonstrated that conformists employ compensatory mechanisms and cognitive processes that allow them to fully justify the conformity (Buehler & Griffin, 1994). This dynamic is exacerbated by the fact that the pressure to conform can create a dissonance. Dissonance Theory explains that when a person encounters two opposing thoughts or behaviors (e.g. "I do not like prejudice" and "I do not want to work with 'a certain group of people'") the individual experiences a cognitive dissonance, most often experienced as an uncomfortable hyper arousal (i.e. physiological tension) (Baron et al., 2009). To resolve the dissonance, individuals engage in a self-justification regarding the conformity, choice, or behavior they decide to engage in order to resolve that dissonance (Tavris & Aronson, 2007).

The need to belong. In *The Art of Loving* (Fromm, 2006) the famed social psychologist and philosopher Erich Fromm argued that love is how humans experience belonging. He wrote about love and belonging in the context of conformity and its implications for the individual and society. Fromm argued that people insulate themselves from the frightening experience of being alone by conforming to group norms, and thus gain some sort of sense of pseudo-unity (Fromm, 2006). In this instance, if one experienced a dissonance as a result of conforming to belong, it is likely that one would use the same self-justification discussed by Tavris and Aronson (2007) to preserve this pseudo-unity.

The Pain of not Conforming. Eisenberger (2008) notes that social pain, the pain associated with not belonging to an in-group or with social exclusion, follows the same neural circuitry as physical pain, so much so that researchers have found that the use of Acetaminophen reduces social pain by both neural and behavioral evidence (DeWall et al., 2010). In a separate study, researchers examined the specific neural correlates of social and physical pain finding that the anterior cingulate cortex (ACC) was more active during exclusion than during inclusion and correlated positively with self-reported distress (Eisenberger, Lieberman, & Williams, 2003). The same study also found that the right ventral prefrontal cortex (RVPFC) was active during exclusion but was negatively correlated with self-reported distress. The researchers surmise that these ACC changes mediate the RVPFC-distress correlation, perhaps as a compensatory mechanism allowing the RVPFC to regulate, or even minimize the distress of social exclusion by disrupting ACC activity.

*Morality or Moral Rigidity***.** Perhaps tied to the need to be right is the need to be right with God, or in the least on matters of faith and religion. Research has demonstrated that situations with a moral dimension tend to produce greater degrees of conformity (Hornsey et al.,

2003). Further research has empirically demonstrated that extrinsic religiosity (those who hold a literal interpretation of the Bible) is positively correlated with higher levels of physical abuse (a conformity to a literal interpretation of not sparing the rod) toward children as compared with what researchers call intrinsic religiosity, a more internalized spirituality (Rodriguez & Henderson, 2010). Perkins (1976) found a similar correlation between higher levels of religiosity, defined as a level of belief in Christian dogma to measurements of bigotry. Perkins also notes that when religiosity is reconceptualized to distinguish between measurements of belief (which he refers to as orthodoxy) and an actual commitment to those beliefs (saliency) the effect is mediated. However, it is important to note that the extraneous variable in both of these studies is that of cognitive rigidity. Cognitive rigidity, a lack of flexibility of thought is tied to a number of cognitive and affective problems (Siegel, 2006) and numerous psychiatric disorders (Dennis & Vander Wal, 2010). It is reasonable to suggest that an interaction of morality and cognitive rigidity may produce higher levels of conformity in certain circumstances.

Cohesiveness and Conformity. The degree to which members experience group cohesiveness has been demonstrated to promote greater degrees of conformity (J. C. Turner, 1991). Further, the more one values being a part of the group, and the more one wants to be accepted and liked by members of the group, the more one tends to conform (Baron et al., 2009). Similarly, acting and looking like others (conformity) is often a means to win approval and belonging (Baron et al., 2009).

Conformity and Group Size. Gerard, Wilhelmy, & Conolley (1968) as well as Asch (1956) found that conformity increases with group size but only up to about three or four members, and beyond that point, it appears to level off. However, later studies have

demonstrated greater variances, but none-the-less, strong correlations between group size and conformity (Baron et al., 2009).

Situational Norms: Awareness of situational norms or expectations has been demonstrated to play a large role in conformity (Cialdini & Trost, 1998). While some have found that what is known about the environment plays a role in social behavior and conformity (Aarts & Dijksterhuis, 2003) other findings suggest that such awareness is not necessary for conformity to occur (Baars & Gage, 2010). Additional research has demonstrated that when subjects are shown pictures of situations where behavioral norms are well know (e.g. the library) the stimuli elicited autonomic responses to behave in kind (Aarts & Dijksterhuis, 2003). These findings suggest that adherence to behavioral norms happens automatically, on the autonomic level, when behavioral norms are well established (Aarts & Dijksterhuis, 2003).

Public verses private behavior. Another way in which a situation affects conformity is along the private verses public dimension. Research has demonstrated that while many tend to publicly follow social norms, they do not always change in their private views (Maass & Clark, 1984). Deutsch & Gerard (1955) were the first to find that social influence is greater when participants belong to a group, and that there is less social influence when decisions are "anonymous" rather than made face to face. To this end, Hewlin (2003) discusses these "facades" of conformity, as well as the emotional and psychological consequences for this type of conformist. That being said, it is important to differentiate between behavioral conformity that only occurs on public and a cognitive conformity that transforms both the public and private life of the individual. This latter type of conformity, groupthink as it is referred to in the literature, is really true conformity. This assertion is consistent with research findings comparing the conformity paradigm against the minority influence paradigm, concluding that people are more

likely to yield to the majority in public (conformity) while accepting the position of the minority (dissent or minority influence) in private (Maass & Clark, 1984).

Gender Norms. Adherence to gender norms happens when individuals conform to the roles generally associated by society for individuals of a given gender; this is a very specific type of social norm has been linked to conformity (Baron et al., 2009). Studies have demonstrated that the tendency to conform to gender norms can have far reaching consequences for individuals, even interfere with sexual enjoyment among both women and men (Sanchez, Crocker, & Boike, 2005; Sanchez, Kiefer, & Ybarra, 2006).

Conformity in the Workplace. Famed anthropologist Mary Douglas noted that as early as the 1920's, the social sciences emphatically believed that primitive cultures were more conformist that developed cultures (Douglas, 1986). Douglas did assert however, that institutions do in fact have their own (collective) mind. Further, the need for conformity in the workplace is well documented (Robbins & Judge, 2010). Simon noted, conformity is necessary for unity of command and is essential for administrative effectiveness (Shafritz et al., 2001). Further, conformity has been positively correlated with higher levels of job satisfaction and more effective output (Bolman & Deal, 2008).

In a series of three experiments, researchers studying the chameleon effect found that participants report higher ratings of likability toward those who mimicked the participants' posture, mannerisms, and facial expressions (Chartrand & Bargh, 1999). In a separate study, researchers investigated the impact of followers flattery and opinion conformity toward leaders (CEOs), finding that such conformity increased the CEOs overconfidence resulting in a biased decision making process (S. H. Park, Westphal, & Stern, 2011). Similarly, Prentice (2007) investigated corporate systems, including Enron, to assess the effect of both conformity bias and

groupthink (as well as obedience to authority & other dimensions) on ethical decision-making. Prentice notes that each of these play a role in the final ethical outcome for many companies, adding that corporate officers do not just wake up one day deciding to start a life of crime, but over time, the influence of conformity pressures and groupthink result in an incremental ethical change in decision making processes which have consequences for the organization and beyond.

Non-Conformity. Sometimes the voice of a minority can attract new comers overtime, until those dissenters become either a loud enough minority, or even the majority. This was in fact the case of the abolitionist movement (Quirk & Richardson, 2010). But why do people dissent, or overtime, conform to a non-conforming entity?

Packer (2008) proposed what he calls a normative conflict model. This model distinguishes between non-conformity due to dissent and non-conformity due to disengagement. This is an important distinction in understanding conformity within organizations. Packer also notes that, in general, the more one identifies with a group, they more they conform. However, not all strong identifiers choose to conform and not all weak identifiers dissent to group norms. However, sometimes one will demonstrate what Packer refers to as superconformity, an extreme form of conformity whereby members dissent or violate a "norm" that will in turn get them praised by the group (Packer, 2008).

The dark side of conformity. In 1973, Phillip Zimbardo created what would come to be known as the Stanford Prison Experiment. He and his fellow researchers selected students and assigned them either to the role of prisoner or guard in a mock prison in the basement of the Stanford psychology building. However, participants conformed to their roles so well that the guards began to take on authoritarian personalities, some even beginning ultimately to subject some of the prisoners to torture. After only six days, the experiment had to be prematurely

terminated. This form of extreme conformity is sometime thought to be similar in some respects to what Stanley Milgram found in his obedience experiments (Baron et al., 2009). While both certainly had grim outcomes (not unlike the deaths at Jonestown), participants in the Stanford experiment were conforming out of role expectation (i.e. a belief on how prison guards are supposed to behave) whereas Milgram's participants were conforming out of obedience (more akin to what researchers have found in Nazi Germany) (Kenrick, Neuberg, & Cialdini, 2010).

Whether conforming to a role expectation, out of obedience, or for any of the other reasons identified in the literature, behavioral conformity can have devastating outcomes. In the very least, it can impact organizations in a negative way. However, because of the power of self-justification, conformity of thought or groupthink can be even more dangerous (Tavris & Aronson, 2007).

Conformity of Thought: Groupthink. When individuals or groups experience marked conformity of thought, this is referred to as group think. Groupthink is a term first coined in 1952 (Whyte, 1952) but made popular by the work of Irving Janis (Esser, 1998). Janis began his work in 1945 through the 1950's in what was known as the American Soldier Project (Janis, 1982). Janis found that as stress increased, so did group cohesion, followed by groupthink. Much of what Janis believed about groupthink can be summed up in what is known as Parkinson's Law:

> The more amiability and esprit de corps there is among the members of a policy-making ingroup, the greater the danger that independent critical thinking will be replaced by groupthink, which is likely to result in irrational and dehumanizing actions directed against outgroups. (Janis, 1971, p.43)

In the early 1970's, Janis conducted in-depth case studies on six important events to assess the degree to which groupthink was present. Those six cases included the Bay of Pigs, North Korea, the attack on Pearl Harbor, Viet Nam, the Marshall Plan, and the Cuban Missile Crisis. Janis concluded that four of those involved high levels of groupthink, while two (the Marshall Plan and the missile crisis) were not (Janis, 1972). Janis later analyzed Watergate and concluded that the individuals involved in that incident were also the victims of groupthink (Janis, 1982).

Janis' work produced new information about groupthink as a dimension of conformity. To Janis' surprise, groupthink happens to intelligent, educated people in the same way it does to others, citing the individuals involved in the Bay of Pigs fiasco (Janis, 1982). Secondly, there appears to be a lack of distinction between such groups & "ordinary citizens" with regard to groupthink, and, finally, victims of groupthink tend to be "soft" toward one another (judgment) but "hard-hearted" toward outgroups and perceived enemies (Janis 1982).

In his book titled *Groupthink,* Janis lists eight symptoms of groupthink. They are each summarized below (all taken from Janis, 1982).

1. Illusion of invulnerability. Janis defines this as an excessive optimism that encourages taking risks. Sometimes these risks may be extreme or unwarranted.
2. Collective rationalization. When this occurs, group members discount warnings about their behavior or choices and do not reconsider the underlying assumptions for them.
3. Belief in inherent morality. Group members believe in the rightness of their cause and therefore overlook the ethical or moral consequences of their decisions.
4. Stereotyped views of out-groups. Group members hold negative views of the "enemy." This in turn, makes an effective response to conflict seem unnecessary.

5. Direct pressure on dissenters. Group members fall under pressure not to express ideas that are against any of the group's views.
6. Self-censorship. Individual group members suppress doubts and deviations from the perceived group consensus.
7. Illusion of unanimity. The majority view and judgments are assumed to be unanimous.
8. Self-appointed 'mindguards.' Members protect the group and the leader from information that is problematic or contradictory to the group's cohesiveness, their shared view and group decisions.

Janis (1972; 1982) also determined that there are three antecedent conditions that tend to make a group vulnerable to groupthink:

1. High group cohesiveness: Janis argued that when groups are highly cohesive, the result is deindividuation and that the cohesiveness of the group becomes more important than individual interests.
2. Faulty group structure: Groups that are structured poorly suffer from the insulation of the group to outside experiences and ideas, partiality (or bias) of the leader, and a lack of norms decision-making procedures.
3. Situational context: Janis determined that when stress levels are high due to perceived external threats, when there have been recent failures of the group with regard to performance, when decisions become difficult for the group to make, or when they face moral dilemmas, groups are more likely to fall victim to groupthink behavior.

Janis (1982) also provided several suggestions on how to prevent groupthink based on his case studies:

1. The leader should assign the role of critical evaluator to each member.

2. The leader should avoid stating preferences and expectations (bias).
3. Encourage each member to seek outside opinions and to discuss them in the group.
4. Invite outside experts to each meeting, even if they may be somewhat ideologically different from the group.
5. Assign someone in the group to play the "Devil's Advocate," providing contrary or alternative points of view to each issue.
6. The leader should ensure that a sizeable amount of group time is spent on examining warning signals regarding decisions.

Other Work in the area of Groupthink. In the early years immediately following Janis' first works in the area of groupthink, other researchers began to apply other forms of analysis to the same events studied by Janis in order to rationally rule in, or rule out, groupthink as an official diagnosis for those events. For example, Raven (1998) conducted a sociometric analysis on each of the original six cases. He determined that two of the antecedent conditions (cohesiveness and insulation) and six groupthink symptoms (all except rationalizations & stereotypes) were present. With regard to the Watergate case, Raven noted that the Nixon group did not possess the "esprit de corps" typically described in the context of cohesiveness, but found that the group was cohesive through their loyalty to Nixon.

Another study used content analysis to explore the public statements made by key decision makers in the following cases: the Bay of Pigs, North Korea, Viet Nam, the Cuban Missile Crisis, and the Marshall Plan (Tetlock, 1979). Tetlock found that individuals associated with these cases were more simplistic in their approach to policy issues (as compared to decision makers in non-groupthink crises), and positive in evaluating their own groups, but that they were not necessarily negative in their evaluation of their opponents. A similar approach examined 19

US policy decisions from 1947- 1973 to study the relationship between symptoms of poor decision-making and decision outcomes (Herek et al., 1987). The researchers concluded that when more symptoms of groupthink and poor decisional processes were present, adverse outcomes were more likely.

McCauley (1989) analyzed the conditions originally hypothesized by Janis in each of the original six cases examined by Janis. McCauley found that, contrary to some of Janis's conclusions, the conditions themselves were conducive to compliance and internalization of group ideals. He argues that compliance was an important part of poor decision making in at least two of these cases. Further, McCauley argues that promotional leadership (leadership bias) and group insulation were strong predictors of whether or not groupthink would occur. McCauley did not find evidence to support cohesion as a predictor. Further, Esser (1998) has provided a summary of all of the literature on groupthink over a 25-year period finding that while there is an increase in the number of empirical designs validating many of the antecedents and consequences of groupthink, cohesion as a factor continues to fail to demonstrate itself as a factor in groupthink.

Smith (1985) examined the 1980 hostage rescue attempt in Iran (Operation Eagle Claw) to determine whether or not groupthink was a factor in the poor planning and execution of the attempt. He found that all eight symptoms of groupthink were present. However, in his study, Smith did not consider any of the antecedents conditions or the decision making protocol of those involved. In a similar approach that included an examination of symptoms, antecedents and a review of decision making protocol, researchers examined the controversial decision of the Kent State University Board of trustees to build a gymnasium annex on the site where students were infamously shot and killed by the Ohio National Guard in 1970 (Hensley & Griffin, 1986).

It was determined that every antecedent, seven groupthink symptoms (all except unanimity), and poor decision-making processes (incomplete survey of alternatives, failure to reconsider alternatives, poor or inadequate attempts at information search, and selective bias in processing information) were all present. This study added to the body of knowledge on groupthink as it identified three new symptoms of poor decision-making process: a failure to maintain contact with the opposition, a lack of cooperation with mediators, and a failure to extend deadlines when appropriate. Perhaps the most important of these three is the need to stay in contact with the opposition. This appears to have received little attention with regard to groupthink in the literature. However, Sims (1992) in studying the influence groupthink has on organizations, notes that these organizations suppress dissent by stating that the opposition "just doesn't get it."

Another study analyzed available information from the Iran Contra Affair to assess for the presence of groupthink ('t Hart, 1990). It was determined that all eight symptoms of groupthink and three antecedents (cohesiveness, insulation, and promotional leadership) were present in the decision making process. It is noted that individuals involved in the Iran Contra Affair as a group demonstrated poor decision-making processes, especially with regard to risk analysis and consideration. Conversely, however, Neck & Moorhead (1992) examined the jury's decision-making process during the United States' entrapment case against John DeLorean. It was determined that the jury avoided groupthink by exercising sound decision making processes.

At least two studies were conducted on the Space Shuttle Challenger disaster and groupthink (Moorhead et al., 1991; Esser & Lindoerfer, 1989). The Moorhead study approached the topic by conducting a textual analysis of all public documents related to the event and found that groupthink was certainly a dominating factor in the decision to launch. Follow up research came to the same conclusion regarding the Columbia disaster (Ferraris & Carveth,

2003). Another group of researcher examined groupthink through the use of a 100-item Q sort method, assessing group dynamics related to organizational groupthink in several of the previously described historical contexts (Tetlock, Peterson, McGuire, Chang, & Feld, 1992). These researchers determined that there is substantial support for Janis' previous classifications on groupthink but that there was much less support for Janis' causal model of groupthink. Further, the researchers argue that, according to their findings, neither group cohesiveness nor situational stress emerged as independent predictors of symptoms of groupthink. Conversely, however, it was noted that deficits in organizational structure as well as procedural inadequacies related to decision making did emerge as statistically significant predictors.

Another approach to the study of groupthink included the use of 64 ad hoc groups (composed of 256 undergrad student, with a mean age 21 that was 89% white) to empirically test Janis' entire model including all 24 variables (W. Park, 2000). This approach found mixed support for Janis' model, noting that there does appear to be a correlation between antecedent conditions & decision making process, as well as decision making processes and final outcomes. However, this researcher does not feel that is can be used as a predictive model in terms of chronology. It should be noted that group dynamics may be to complicated to analyze in a linear fashion such as most of these approaches.

Empirical studies. Flowers (1977) appears in the literature as the first researcher to empirically test any of the components of Janis' work on groupthink. In a pseudo-lab experiment, Flowers tested the viability of a two-dimensional model examining levels of group cohesion (high vs. low) against leadership style (directive vs. non-directive, what has also been referred to as promotional/non-promotional leadership). The significant finding in this study was a strong correlation between leadership style and decisional outcome. Specifically, more

solutions, and more facts were produced from groups with a non-directive (non-promotional) leader. Leana (1985) also used this same two-dimensional model (high and low levels of cohesion against directive and non-directive approaches to leadership). The later study concluded that fewer facts were mentioned in non-cohesive groups and that groups with directive leaders proposed and discussed fewer possible solutions. It was also noted that groups with directive leaders were more likely to outwardly accept the leader's solution but reported lower levels of private agreement. Ahlfinger & Esser (2001) examined the influence of a promoting leader's direct influence on groupthink. The researchers found partial support for a positive correlation between the two variables. However, they found no support for any correlation between antecedent conditions (predispositions to groupthink) and actual groupthink behavior. Still, that could simply be because groupthink is a phenomenon that typically develops overtime.

Courtright (1978) examined cohesiveness against the impact of decision-making procedures (present or absent). The researcher determined that there was markedly less disagreement in groups with higher levels of cohesiveness and limited decision-making procedures, thus suggesting a tendency toward collective thinking. Callaway & Esser (1984) also examined cohesiveness in conjunction with the presence or absence of decision-making procedures. These researchers found that groups with medium levels of cohesion (rather than high or low) made the highest quality decisions. This same study also suggests that groups with the highest levels of cohesion were the most confident about their decisions and that the worst decisions were made by groups that were high in cohesion where decision making procedures were absent.

Another important factor in groupthink is that of perceived threat (as indicated in all of the policy decisions previously discussed in this chapter). To this end, researchers have

conducted a series of experiments in which the researchers examined two independent variables: level of threat (low or high) and levels of cohesion (M. E. Turner, Probasco, Pratkanis, & Leve, 1992). These researchers determined that higher levels of threat resulted in greater levels of rationalization, or justification of group decisions. These researchers also determined that higher levels of cohesions resulted in less self-censorship, and less risk assessment (as determined by fewer conclusions that the solution may be risky). Further, the worst decisions were made on high-threat/high-cohesion groups.

Several other studies have looked at the influence of decision-making procedures on group outcomes. Foder & Smith (1982) found that in instances where fewer facts where mentioned and where fewer proposals were considered, groups expressed a need for a leader with a higher level of "power" (influence). In contrast to leader dominance, Callaway, Marriott, & Esser (1985) conducted an experiment to examine the influence of member dominance and decision-making procedures on group consensus. These researchers found that groups with more dominant members tended to make better decisions and report lower levels of decisional anxiety. Further, these groups took more time to make their decisions, as did groups that were provided with decision-making protocols.

Venturing in bit of a different direction, Moorhead & Montanari (1986) used path analysis to examine the causal impact of Janis' three antecedents (cohesiveness, insulation, and leadership) as well as four groupthink symptoms (invulnerability, morality, self-censorship, and dissent) and two decision process symptoms (consideration of alternatives, and use of experts) on a decision quality rating. The researchers concluded that higher levels of cohesiveness resulted in lower levels of self-censorship, less dissent, and the discussion of more alternative approaches. On the other hand, insulation tended to lead toward lower measures of "invulnerability," as well

as an increase in the use of experts. However, groups with higher levels of insulation also discussed fewer possible alternatives and tended to make quality decisions. Further, promotional leadership led to greater feelings of morality, lower levels of dissent, and an increase in the number of alternatives discussed.

In a less empirical approach, researchers utilized a questionnaire approach to assess the impact that feelings of accountability, whether it is accountability to oneself, a group, or a non-report of feelings of accountability, were related to consensus and decision-making (Kroon, 't Hart, & van Kreveld, 1991). These researchers determined that feelings of individual accountability tended to result in increased difficulty (or length of time) in coming to a group consensus, more attempts to assert one's own influence over the group, greater levels of shared influence, and less risky decisions. In a follow up study, researchers examined these same constructs of accountability against the co-variable of gender (Kroon, Van Kreveld, & Rabbie, 1992). In this study, researchers found no support for their hypothesis that individual accountability (as opposed to collective accountability) resulted in lower levels of groupthink. However, male groups appeared to be more impacted by differing accountability styles than female groups. Further, while individually-accountable males shared influence more equally than individually-accountable females, women with no particular accountabilities were the most effective over all at sharing influence.

Neuroscience. Another emerging field holding importance for the disciplines of behavioral science and leadership is that of neuroscience (Van Hecke, Callahan, Kolar, & Paller, 2010). Neuroscience, the study of the brain and nervous systems is currently an interdisciplinary field that collaborates with other fields such as psychology, sociology, mathematics, chemistry, and medicine (Baars & Gage, 2010). Further, there are several modalities by which

neuroscience and the brain are studied (Baars & Gage, 2010). Such techniques include positron emission tomography (PET), single photon emission computed tomography (SPECT), functional magnetic resonance imaging (fMRI), and electroencephalography (EEG). While some techniques allow for detailed neural imaging (such as the fMRI) others allow for split-second imaging that can keep pace with the rapid shifts associated with cognition (Baars & Gage, 2010). Perhaps the best example of a temporally sensitive measure is the EEG.

History. Of course, the goal of all scientists is to explain the phenomena they study. However, the study of behavioral neuroscience is very complex, involving both social psychology and neurophysiology. Therefore, one might assert that a good behavioral neuroscientist is, therefore, both a good behaviorist and a good physiologist.

The study of the physiology of behavior has its roots in antiquity (Carlson, 2010). Although many ancient thinkers, including Hippocrates (460– 370 B. C.) believed the heart, not the brain, was the seat of reason and emotion (Carlson, 2010). However, Aristotle asserted that the function of the brain was to cool the passions of the heart (Carlson, 2010). Even Galen (130–200 C.E.), who had the greatest respect for the work of Aristotle, thought the notion that the heart was the seat of the mind was ridiculous (Carlson, 2010).

In later centuries, René Descartes, often referred to as the father of modern philosophy, made forward speculations about the mind and the brain, even going so far as to name parts of the brain and attempt to identify their function (Carlson, 2010). Descartes observed that many functions of the body and brain are autonomic and involuntary in nature. Descartes called these actions reflexes, from the Latin reflectere, “to bend back upon itself” (Carlson, 2010). While the tern is still in use today we tend to think about reflexes a little differently. The autonomic nature of such, however, is still the same.

During the 19th century, one of the most important figures in the development of experimental physiology was Johannes Müller (Carlson, 2010). However, Müller was a staunch advocate of the application of experimental techniques to physiology in a time when protective laws for animals (or human subjects) did not exist. He argued that advances in physiology could only be made through direct experimentation on animals (Carlson, 2010). Through his experiments, Müller observed that although all nerves carry the same basic message, an electrical impulse, we perceive the messages of different nerves in different ways (Carlson, 2010). He was the first to assert that the brain was somehow functionally divided.

Building on the work of Müller, Pierre Flourens, French physiologist from the same era, removed various parts of animals' brains in order to observe their behavior (Carlson, 2010). He created an experimental method known as ablation, which involved removal of various parts of the brain. "By seeing what the animal could no longer do, he could infer the function of the missing portion of the brain" (Carlson, 2010, p. 8). Soon after Flourens performed his experiments, Paul Broca, a French surgeon, applied the principle of experimental ablation to the human brain, using subjects whose brains were already damaged by stroke (Carlson, 2010). His observations led him to the discovery of what became known as the Broca region, an area thought to be involved in speech.

In 1870, German physiologists Gustav Fritsch and Eduard Hitzig used electrical stimulation as a tool for understanding the brain (Carlson, 2010). Applying a weak electrical stimulation to different portions of the brains of dogs, Fritsch and Hitzig discovered they could elicit a muscular response on the opposite side of the body(Carlson, 2010). We now refer to this part of the brain as the primary motor cortex.

Physiologist Hermann von Helmholtz was the first scientist to attempt to measure the speed of conduction through nerves (Carlson, 2010). While scientists had previously believed that such conduction was identical to the conduction that occurs in wires, such as telegraphs, Helmholtz found that neural conduction is much slower, moving at only about 90 feet per second (Carlson, 2010).

Modern Methods. Historically, many cases only allowed study to be conducted post-mortem. However, recent advances in X- ray techniques and computers have led to the development of several methods for studying the anatomy of the living brain (Carlson, 2010). The following is an outline of the most commonly used methods.

Positron emission tomography (PET): PET measures emissions from a radioactive substance that is injected into the bloodstream. This allows a computer interface to produce either a two- or three-dimensional image of the brain. While this is a spatially in-depth procedure, it is not at all temporally sensitive, capturing only still data and not split-second responses to stimuli (Baars & Gage, 2010).

Single photon emission computed tomography (SPECT): This procedure is very similar to PET and radioisotopes and a gamma camera to record dat. Just as the PET scan does, a computer interface creates a two- or three-dimensional image of the active brain regions. Like a PET it is not at all temporally sensitive, but it is effective with certain organic disorders such epilepsy. A significant limitation of SPECT is its poor resolution compared to that of MRI (Baars & Gage, 2010).

Magnetic resonance imaging (MRI): This technique uses magnetic fields and radio waves to produce high quality two- or three-dimensional images of brain structures without the use of radiation (X-rays) or radioactive chemical injections. During an MRI, the subject is put

through a large cylindrical machine that creates a magnetic field around the head of the patient. The magnetic-radio frequency allows a signal transmission to create a brain image of the subject. One of the great advantages of the MRI is that it is so vivid and precise that it allows detection of changes in brain structures over time (Baars & Gage, 2010). While it is one of the most spatially sensitive tests, like the others discussed so far, it is not at all temporally sensitive.

Functional magnetic resonance imaging (fMRI): This procedure uses paramagnetic properties of hemoglobin to create images of changing blood flow in the brain associated with neural activity (Baars & Gage, 2010). This allows images to be generated that reflect which brain structures are activated during task performance as well as how they are activated. It is more temporally sensitive than the others discussed so far.

Electroencephalography (EEG) is an imaging technique used to measure the electric fields in the brain via electrodes placed on the scalp of a human. EEG offers a very direct measurement of neural electrical activity with very high temporal resolution but relatively low spatial resolution. Current quantitative EEG measures (qEEG) allow for detection of organic pathology, as well as for diagnosis of psychiatric disturbances (Brietzke, 2007; Cloninger & Svrakic, 1997).

Organizational Neuroscience. The concept of organizational neuroscience as a field has only been recently proposed (Becker, Cropanzano, & Sanfey, 2011). Becker and his colleagues not only propose this discipline but also note that other related disciplines, such as economics and marketing, have already integrated neuroscience into their prospective fields. These authors further argue that, while the study of organizational behavior has been much slower to embrace the neuroscience aspect, it has built into its own theoretical constructs cogent models for understanding and including neuroscience, especially in the form of its models of organizational emotions and ethical decision making postulates (Becker et al., 2011).

Neuroleadership. Similar to the proposal of an organizational neuroscience, the concept of neuroleadership has been proposed but has caught on much more quickly (Ringleb & Rock, 2008). These authors attribute this shift to advances in technology, arguing that we now live and work in an era where there is a demand that "hard science" support our theories. The work of neuroleadership asserts that it shares work with at least four other organizational domains: decision-making and problem solving, emotional regulations, collaborating with and influencing others, and the facilitation of change (Ringleb & Rock, 2008).

Rock and Schwartz (2007) have made an impact in the emerging field of neuroleadership by making a connection from the neurological dimension of physical pain and the discomfort of organizational change. As these authors note, organizational change is difficult because it produces sensations of actual physical discomfort. They further argue that this neurobiology must be understood in any approach to organizational change, noting that the humanistic approach is overrated, as empathy and persuasion is not enough to sufficiently engage the organization in the change process, and that behaviorism does not work, as change efforts based on incentive and threat (the carrot and the stick) lack any real efficacy in relationship to the creation of change. Therefore, this new model is needed. Rock and Schwartz continue to make this argument by highlighting the fact that the way in which people pay attention creates both chemical and physical changes in the brain, shaping perception, personal realities, and identities. Further, purposeful and focused attention in certain directions, as fostered individually or by a leader, can lead to sustained personal (or organizational) actualization (Rock and Schwartz, 2007).

Neurobiological studies on conformity and groupthink. The first empirical approach to the neurobiology of conformity appears to be the work of Costell & Leiderman (1968). In this

ground breaking study, researchers replicated the Asch paradigm examining skin responses for subjects who were either part of a numeric minority or a numeric majority in the decision making process. These researchers found that participants had increased arousal levels when behaving as a dissenting minority.

Following the Costell and Leiderman study, years would pass before researchers resumed an empirical approach to the intersection of neurobiology and groupthink, in part because researchers needed to wait for technology to advance and become practical enough for such a use in research. However, proponents of such an idea continued their contribution in the form of theoretical development. For example, Agazarian (1997) proposed what she termed the theory of living human systems (TLHS). In her work, she compares groups to living systems of organism. This, however, is very similar to earlier work first proposed by Bronfenbrenner in his ecology of systems approach (Bronfenbrenner, 1979). Still, Agazarian's work has been utilized by others to create an understanding of how isomorphic groups function collectively to form a sort of unified mind. This unified mind has come to be called a "group mind" (Gantt & Agazarian, 2010). This work is important to an emerging concept of a neurobiology of groupthink in that isomorphic tendencies help explain the development of a group mind, or uniformity in thought and behavior. These authors also make a compelling argument for the role mirror neurons play in the development of a group mind. The mirror neuron system is highly complex in humans. However, its basic function is to create a complete neural resonance between individuals (Siegel, 2006). For example, watching someone perform a certain motor activity causes the observer's brain to fire in the same neural pattern, as if to prime the observer's brain to perform the same task. The same mirror neuron firing occurs when we watch someone take a hard hit during the Friday night game, or when we watch someone mourn the loss of

something or someone beloved. It is therefore believed that this mirror neuron system plays a vital role in empathy (Siegel, 2006) and in point of fact, persons with Autism appear to have severe deficits in their mirror neuron development (Dapretto et al., 2005). However, it is believed that the mirror neuron system also plays a vital role in the development of the group mind, linking group members together through shared neural experiences (Gantt & Agazarian, 2010; Siegel, 2006). This linking is most likely reinforced by the neural plasticity in the brain (Gantt & Agazarian, 2010). As the brain fires in certain patterns, frequently used neural networks become strengthened and unused networks become pruned. Therefore, the mirror neuron system interacts with the neural plasticity of the brain to reinforce the very patterns that link members together in the group mind.

It seems important to note at this point the probable interplay between the group mind as defined by both Siegel and Agazarian and the role the autonomic nervous system (ANS) plays in social behavior as determined by polyvagal theory. Developed by Stephen Porges in the last couple decades, polyvagal theory postulates the multiple branches of the vagal nervous system, which comprises part of the autonomic nervous system, are largely responsible for several facets of human interaction including the development of the social brain (Porges, 2001). Specifically, the human brain is wired to ensure survival. As such, potentially life-threatening events, which from an evolutionary perspective would include exclusion from a group, activate an alarm within the sympathetic nervous system (also comprising the ANS, and inter-related to the vagal nerve) that regulate the human to behave in such a way as to maintain their membership in the group (Porges, 2001). Mirror neuron responses that signal threat would no doubt also trigger this vagal response, and in turn the brain's synaptic strengthening or pruning, the use it or loose it principle, of information processing within the group, potentially reinforcing the group mind.

Other findings related to the neurobiology of a group mind. Other researchers have contributed to a growing body of work that can be logically related to a construct of the neurobiology of groupthink. For example, researchers have determined that the presence of persons identified, or known to the group, as "experts" triggered responses in the caudate nucleus involved in trustful behavior, reward processing, and learning (Klucharev, Smidts, & Fernández, 2008). Therefore, on a very neurobiological level, the presence of an expert triggers a brain response that results in attitudinal influence (Klucharev et al., 2008). However, it is not just the presence of experts that can impact how the brain responds to the environment. Researchers have found that the brain responds with marked increased firing patterns to familiar faces, such as grandmothers and certain well-liked celebrities, for example Jennifer Aniston, but not her former spouse, Brad Pitt (Quiroga, Reddy, Kreiman, Koch, & Fried, 2005). It is important to note that while we still do not completely understand this selective phenomenon, this neural firing pattern may be related to ways on which other information is retained, stored, or processed (Connor, 2005). This may, in time, help demonstrate the power of the celebrity spokesperson.

Another group of researchers used fMRI technology in conjunction with an assigned task of mental rotation to investigate the neurobiology of conformity when participants were subjected to peer pressure in contexts where they were given clearly wrong information (Berns et al., 2005). Conformity behavior was associated with changes in the occipital-parietal network (the part of the brain responsible for organizing visual information). However, non-conformist behavior was associated with increased activity in the amygdala (the emotional brain) as well as increased activity in the caudate nucleus, the part of the brain involved in learning and memory. The authors suggest that this data may provide the first biological evidence for the role of both perception and emotion related to conformity contexts (Berns et al., 2005).

Another group of researchers used fMRI technology to examine to role of social influence on conformity similar to the previous study. However, the purpose of the latter approach was to make a neurobiological distinction between true attitudinal conformity and a public pretense of conformity (Zaki, Schirmer, & Mitchell, 2011). These researchers noted that true social influence was associated with two particular brain regions: the nucleus accumbens, part of the reward circuitry of the brain, and orbitofrontal cortex, the portion of the brain involved in the cognitive aspect of decision-making (Zaki et al., 2011).

In a slightly different approach, researchers, again using fMRI, collected data on participants while they learned about reviewer opinions on certain musical compositions, examining the interaction effect of administered reward (tokens) and expert influence (Campbell-Meiklejohn, Bach, Roepstorff, Dolan, & Frith, 2010). These researchers were particularly interested in the ventral striatum. The ventral striatum, which contains the nucleus accumbens involved in learning, is considered one of the brain's important reward centers. Both receipt of the valued tokens as well as agreement with two or more experts resulted in increased activity in a particular region of the ventral striatum. The researchers determined that social influence on the value of an object, in this case musical compositions, was correlated with the brain's learning circuitry and may therefore be a determinant for any rapid spread of values throughout a population (Campbell-Meiklejohn et al., 2010).

While the current research certainly supports old-fashioned learning theory, an aspect of learning theory, and conformity, that has received little attention in neurological research is that of the "prediction-error" signal. When an individual finds that their opinion or thought is not in agreement with the group, the individual experiences dissonance. As a result, it has been postulated, that a message is unconsciously sent signaling that the individual's own opinion or

thought is in error, thus urging the person to conform to the group (Garrett, 2011). This has recently been tested in a study where participants we asked to make individual judgments of facial attractiveness before being exposed to opinions of the group. Responses that were divergent from the group resulted in increased activity in the rostral cingulate zone (believed to anticipate the likelihood of negative outcomes in response to errors) and the ventral striatum. This suggests that social group norms influence conformity through the learning and reinforcement centers of the brain (Klucharev, Hytönen, Rijpkema, Smidts, & Fernández, 2009). Others have conducted similar studies using electroencephalography (EEG) technology with similar results, suggesting that the brain responds to social norm violations as "errors" (Kim et al., 2012).

The neurobiology of reinforcement and learning circuitry may explain more than just conformity; it appears to play a vital role in decision making itself. For example, using the Ultimatum and Dictator games often used in business studies, researchers discovered marked increases in the anterior cingulate cortex (a part of the brain associated with autonomic functions as well as cognitive and emotional processes such as reward anticipation, decision making, and empathy) when participants were confronted with unfair offers to which subjects had to make a decision on how to respond (Hewig et al., 2011). This work highlights the emotional and social influences on a neurobiological level that drive decision-making and why human often deviate from what would seem to be rationale behavior (Hewig et al., 2011).

While others have continued to find links between the neural regions of the brain underlying reinforcement learning and conformity based on social expectation and error violation and correction (Harris & Fiske, 2010) as complex as the human brain is, no one area of the brain can be tied to a construct of the neurobiology of conformity or groupthink. Researchers

continue to identify parts of the brain associated with conformity and groupthink. Through the use of theta-burst transcranial magnetic stimulation to the posterior medial frontal cortex, (the PMFC, also associated with error identification as well as behavioral adjustment based on social norms) researchers determined that downregulation in the PMFC (a numeric decrease in the number of cells or cellular connections) resulted in a marked decrease in conformity by participants (Klucharev, Munneke, Smidts, & Fernández, 2011).

Summary

Leadership, a continually evolving field of study, plays a central role in understanding organizational behavior (Robbins & Judge, 2010). However, studies have focused more on the qualities of leaders and on followers as they relate to those leaders, than on the qualities of followers themselves (P. Hoffman, 2009). Therefore, the study of "followership" remains an under-investigated domain. It has been furthered argued that no model of leadership can be truly understood without a well-developed construct of followership.

The little that has been studied regarding followership is perhaps best represented in the disciplines of anthropology, sociology, and social psychology. The relationship between leaders and followers is said to be so powerful that sometimes it is difficult to determine who is doing the leading and who is doing the following. Further, some of the most important changes in social history have come, not from the top down (the leadership approach) but from the bottom-up (the followership approach). One such stated example is the Protestant Reformation. While followers generally do not fit into any fixed category, five reasons for followership were provided. Still, the relationship between followership and conformity also remains under investigated.

Conformity can serve a useful function when people adhere to the social norms of a group (Baron et al., 2009), such as standing in line to board a bus. However, conformity in certain forms can have devastating effects on a group or society (Baron et al., 2009). In fact, in the aftermath of the Holocaust, researchers like Solomon Asch and Phillip Zimbardo sought to investigate the type of conformity that could lead a nation to commit such atrocities (Baron et al., 2011). Janis took this information a step further in the development of his construct of groupthink. Research on groupthink has made connections among several U.S. policy decisions over the last three-quarters of a century, ranging from the failure to prevent the attack on Pearl Harbor to the decision to invade Iraq in search of weapons of mass destruction.

Several subject variables have been linked to tendencies to conform including gender and age. Persons from collectivists cultures are also slightly more inclined to conform to the group. Other factors include the basic human need to belong to the group as well as the need to be right. Researchers note that exclusion causes emotional pain to the individual and that emotional pain follows the same neural circuitry as physical pain. Other factors include religiosity, cognitive rigidity, group cohesiveness, group size, and awareness of group expectations or norms.

Janis provided eight symptoms of groupthink as well as three antecedent conditions. Researchers have found mixed support for each of these. However, among the strongest correlations are inherent morality and cohesiveness. Researchers also determined that the presence or absence of decision-making protocol was extremely important in predicting whether or not group members would engage in groupthink. The partiality of the leader (whether they were objective or biased in a certain direction) was also influential.

While neuroscience is a continuing emerging field, the intersection of neurobiology and groupthink or conformity remains relatively under-investigated. What is suggested by the

current literature is that the ANS plays a role in conformity as does certain other brain structures (the occipital-parietal lobe responsible for organizing important information, the amygdala, known as the seat of emotion, the caudate nucleus, responsible for learning and memory, and the ventral striatum, part of the reward and reinforcement circuitry in the brain). While these data have traditionally been captured through a wide range of technologies including fMRI, PET, and SPECT, EEG and in this instance qEEG, provides a temporally sensitive approach to the current elements under investigation.

Chapter Three: Methodology

Introduction

The purpose of this study is to investigate the neurobiological basis of groupthink as a dimension of conformity, a component of followership, in order to advance understanding of effective leadership strategies and the development of healthy organizations. Based on the literature review, the researcher has several assumptions regarding the expansion of a groupthink framework. Specifically, the researcher believes that the following social dynamics are integral to the groupthink phenomenon: rigid thinking, level of commitment (moral, philosophical, religious, political, ideological, etc.), leader bias and influence, and the presence or absence of decision-making protocols. The researcher also asserts that the tendency to conform is also neurobiological in nature; that as dissonance exists, or group pressures toward conformity threaten expulsion from the in-group, individuals will often attempt to mediate this neurophysiological distress by conforming.

In considering the interaction that rigid thinking may have on level of commitment, the researcher has conceptualized a matrix describing a possible outcome. That matrix is presented in Table 1. If rigid thinking and commitment levels interact with regard to conformity, one would expect to see the highest levels of groupthink among groups whose members were more cognitively rigid and reported higher levels of ideological commitment, and lower levels among those whose thinking is more flexible and less committed. For the purpose of this project, low levels of cognitive flexibility (high cognitive rigidity) were defined by scores in the bottom 50 percent of the distribution on a given inventory, whereas scores in the top 50 percent of the distribution defined high cognitive flexibility (lower cognitive rigidity). Scores on a given

inventory of 5 or lower defined low levels of commitment or lower, and high levels were defined by scores on the same inventory of 6 or higher.

Table 1.

Framework for Possible Interactions for Rigidity and Level of Commitment

	Low Commitment	High Commitment
Low Rigidity	(Anticipate lowest levels of groupthink)	
High Rigidity		(Anticipate highest levels of groupthink)

Research Questions

The research questions presented in chapter one will be used in the hypothesis testing of this design. Those questions are:

1. To what extent, if any, might groups higher in rigidity and commitment demonstrate high levels of groupthink?
2. What difference, if any, does the implementation of decision-making protocols make in the final outcome?
3. How does the presence of a leader impact the final decisional outcome with regard to groupthink?
4. To what extent, if any, does the presence of a perceived leader moderate the neurobiological dimensions of conformity?
5. To what extent, if any, does the partiality of the leader impact the final outcome?

6. To what extent, if any, does the partiality of a perceived leader moderate the neurobiological dimensions of conformity?

Nature of study

This study has been conceptualized in two phases, as discussed below in the methodology section of this chapter. The first phase was first conceived of as a pilot study to test the worthiness of the vignette to be used in the later groupthink experiment. However, this "pilot" condition appeared to be a perfect opportunity to test the researcher's interactional matrix, examining possible interactions between rigidity of thought and level of commitment with regard to groupthink. This pilot condition has been renamed as study 1. The specific details associated with study 1 are also outline in the methods section below.

The second phase is the actual experimental process. Although this phase, henceforth referred to as study 2, is also outlined below, it is important to state at this point that the nature of study 2 is a quasi-experimental design examining both socio-psychological factors (the influence of leader bias and the influence of the presence or absence of decision-making protocol) as well as neurobiological factors (as measured by qEEG and analyzed using LORETA software). A summary of these two studies can be found in Table 2.

Characteristics Studied

The characteristics under investigation include neurological responses to social pressure and conformity. However, this study was designed to include certain socio-psychological variables. Those variables include rigid thinking, ideological commitment, leader influence (present, not present, biased, or impartial) and the impact of decision-making protocol. Each of these, as well as other key operational definitions, is defined in the following section.

Definition of characteristics. The following is a list of operational definitions for the characteristics under investigation.

Conformity: The degree to which the participant acquiesces to the group. This is a basic categorical definition ("yes" or "no") as the participant could either conform or not conform.

Cortical changes: Differences in the brain's cortex from a baseline, pretest condition, was compared to data collected through qEEG in the posttest to ascertain possible changes related to the conformity experiment during study 2. Any change not better accounted for by mental activity was recorded.

Decision-making Protocol: In a broad sense, this refers to the procedures, whether fully developed or not, or formal or informal, available to an individual to guide the decision making process. However, specific to this design, a protocol patterned after Janis' recommendation to avoid group think (1972) was used in groups assigned as such. This is also a categorical, or nominal, measurement in that either the protocol was made available to the group, or it was not. Specific details of the protocol are discussed in the instrumentation section of study 2.

Groupthink: This refers to conformity of thought. In this research the terms groupthink and conformity will be used interchangeably.

Level of Ideological Commitment: This is a self-report measure along three domains, measuring commitment to political, religious, and general ideological viewpoints. For the purpose of this study, the data were measured along a 10-point ordinal level scale. This measure is outlined in specific detail in the instrumentation section of study 1.

Leader Influence: The degree to which the presence or absence, and biased or impartial nature of the leader impacts the group's ability to think or make decisions. This is also a bimodal,

categorical scale; the leader (an actor) will either attempt to persuade participants to a particular outcome, or he will present unbiased without an attempt to persuade.

Quantitative Electroencephalography (qEEG): This is the instrumentation that was used to record cortical behavior in both the pretest baseline and the posttest.

LORETA (Low Resolution Electromagnetic Topographic Assessment): This is a software interface that allowed the researcher to identify the subcortical structures that were generating the changes measured by the qEEG.

Rigid Thinking: This is demonstrated by a lack of ability to be flexible in thought, to consider alternative views, and to tolerate opposing information. For the purpose of this study, rigid thinking was measured using the Cognitive Flexibility Inventory (Dennis & Vander Wal, 2010). This instrument measures cognitive flexibility verses rigidity using 20 items on a seven-point semantic differential scale. Scores, therefore, could range from 20 to 140 with lower scores representing increased cognitive rigidity. This instrument is discussed in more detail in the instrumentation section of study 1.

Subcortical Source Generation: This refers to the subcortical structures of the brain that may be generating the electrical signals that are observed in the brain's cortex. Examples might include the limbic system, the thalamus, and the insula.

Methodology

The author proposes a two-study design. The first is a pilot condition to test the efficacy of a vignette, as well as the first research question. The second study was designed to test the remaining research in a mock decision-making group session that will include confederates and utilize the use of quantitative electroencephalography (qEEG) technology to examine the effects of such group activities and conformity on the brain. Some general information, applicable to

both studies, will be given below. Sections for both study 1 and study 2 will then follow, providing complete methodological details and participant data for each. Finally, information regarding risk to participants, debriefing procedures, and follow-up are provided toward the end of this chapter.

Population, sample and sampling technique. For the purpose of this study, participants were recruited from a mid-sized private university in Southern California. Participants were undergraduate level students participating in research as a part of a course requirement or as extra credit for a course (the investigator does not teach at the undergraduate level at this time and therefore, the students recruited were not her students for any classes). Further, while some students may have been recruited from classes that require research participation and/or offer extra credit for participation, those conditions were outside of the control or discretion of the investigator. While this form of convenience sampling is less than ideal, this approach allowed the researcher access to the number of participants needed to complete this research. Further, this strategy facilitated ease of debriefing at the conclusion of the study. The specific process of debriefing is outlined in the following paragraph under deception. Participants were not compensated for their time.

Recruitment Procedure. Participants were recruited from undergraduate courses in the School of Behavioral Sciences at California Baptist University using the information sheets found in Appendix A and B. These documents were handed out in all undergraduate psychology classes in the School of Behavioral Sciences by that course's faculty (not the researcher). This method is used routinely and students, apart from certain course requirements, know they are free to choose, or not choose, to participate in such studies. Further, because this is done so frequently within the School of Behavioral Sciences, students are provided several options in

which studies to participate; this is especially helpful for students in courses that require participation in research as they have more freedom to choose studies with which they feel comfortable. It also ensures that if they choose to withdraw from a study, there are still more choices available. Instructors for the courses from which participants were drawn were only informed about whether or not the subject participated in the research and not any other data or results. Therefore, faculty members had no information on which to reward or penalize students. Again, however, how the course is designed with regard to required research participation is beyond the investigator's control. Participants were told in their electronic consent (administered on Survey Monkey) that their participation was strictly voluntary and that they could withdraw from the study at any time. Further, the researcher, at the outset of the actual research, reminded them of that verbally.

Informed Consent. In both studies of the design, consent to participate was obtained from each participant before participation began. Further, participants were assured of their right to withdraw from the study at any point and were given a copy of the participant bill of rights. Copies of both the consent forms for both studies (Appendices C and D) and bill of rights (Appendix E) are attached.

Consent Process. From the information sheets disseminated to recruit subjects, participants were instructed to follow a Survey Monkey link that provided them the consent form and participant bill of rights. Participants provided consent by either clicking "I do consent to participate in the study" or "I do NOT consent to participate in the study." Participants that consented were directed to a page to sign up for a time to participate that best fit their schedule using ONLY their student ID number. Those that did not consent were directed to a

"disqualification page" that read "Thank you for your participation." This anonymous electronic process allowed for data collection without attaching names to the data.

Privacy, confidentiality, and data protection. To ensure confidentiality, no names were recorded on any of the data collected; only student ID numbers that were not easily recognized were used. Because the consent forms and bill of rights were also provided electronically, no names were recorded there either. Hard copies of data were (and will be) stored in a locked filing cabinet only accessible to the researcher and any electronic copies have been stored on a hard drive and have been password protected. Data will be stored for 5 years, and then destroyed. To ensure the highest levels of confidentiality, participants provided student ID numbers (rather than names) when they consented to the study; however, the researcher later removed these numbers and reassigned a non-identifiable number (code) to all data collected. In study two, the software being used to conduct the qEEG automatically generated those numbers. The key and passwords for all data have been secured and is accessible only to the researcher. This is in accordance with the Institutional Review Board policies of both institutions involved.

Use of private health information. This study did not include any private health information (PHI) or fall under HIPPA as outlined under federal and APA guidelines. Data were coded so that there would be no identifiable information. Further, the researcher does not meet the criteria of a "covered entity" as outlined in federal regulations or APA guidelines, and this study did not include a review of health/mental health information nor did it result in the addition of new information to a medical record.

Use of deception. Because the participants were initially told they would be participating in a study on decision-making (not conformity or groupthink) some use of deception, however

subtle, was involved. Therefore, debriefing was considered important for the ethical outcome of the study. Debriefing procedures are discussed in the section that follows.

Debriefing. At the conclusion of study, the researcher visited every psychology class from which students were drawn in order to provide an overview of the true nature of the study, to discuss the use of deception, and to share the results. Students were provided with a time for questions and reminded that they could withdraw their data should they choose. They were also assured that if they needed or wanted to speak with the investigator they were welcome to do so; contact information to that end was reiterated. Additionally, when all of the final data had been completely analyzed, participants (all students enrolled in classes where recruitment took place) were also debriefed by email. Those emails described the actual nature of the study with the findings, and informed participants of their right to withdraw their data or participation in the study. A sample email can be found in Appendix F.

Follow-up procedures. Participants were informed in advance that should they experience any anxiety or psychological discomfort following the study, they were welcome to a face-to-face debriefing with the PI, who is also a licensed clinical therapist. In the unlikely event that the distress should continue beyond the face-to-face debrief, participants would be provided with 3 referral sources for follow-up. Those referrals would be custom designed for the particular participant but would likely include the CBU counseling center. To date, no participant has come forward to state they experienced any anxiety or distress or stating a need or desire to be debriefed personally by the investigator.

Study 1

Initially, the present researcher wanted to study the neurobiological correlates of groupthink in a mock decision making activity using a vignette. However, the vignette would first have to be piloted. It was at this time that the present researcher saw an opportunity; it was determined to use the "pilot" condition as an opportunity to test the interactional matrix described earlier in this chapter. Therefore, study 1 of this experiment functions to test the worthiness of the vignette and make modifications as needed, and to test the matrix (research question 1).

Participants. Thirty-five participants (five male, and 30 female) were recruited from undergraduate classes at a midsized university using the procedures described earlier in this chapter. Demographic information for these participants is provided in chapter four.

Procedure and instrumentation. Participants arrived to the institution's research center according to the day and time for which they had previously volunteered. The study's confederates were already seated as if they had arrived early as participants. Time was streamlined as participants had already completed the online consent form process. Physical copies of the participant bill of rights were made available. Participants were thanked for coming and were again reminded that they could withdraw from the study at any time. Participants were provided with a self-report instrument simply titled "Participant Questionnaire," found in Appendix G, as well as the Cognitive Flexibility Inventory (CFI) found in Appendix H. Permission to use the CFI can be found in Appendix I. When all participants had completed the form, they were given a vignette to read then discuss aloud (see Appendix J). Participants (and confederates) were then given an "exit survey" to record privately their response to the vignette. The exit survey can be found in Appendix K.

The experiment was conducted over a two-day period. Groups on day one were designated as "no" groups, meaning the confederates would imply that they were going to vote no as well as the reasons why they would vote this way. Groups on day two were designated as "yes" groups, indicating that confederates would state they were going to vote yes, along with the reasons why. Participants (unknowingly) self-assigned themselves to these groups based on the day for which they signed up.

Participant Questionnaire. This instrument was designed as a self-report measure intended to assess an individual's reported level of commitment in three domains: political, religious, and ideological. Created specifically for the purpose of this project by the present researcher, this self-report measure (which includes the study's demographic questions) measures the three domains along a 10-point scale. This instrument can be found in Appendix G.

Cognitive Flexibility Inventory. To test the interactional matrix subjects were administered the Cognitive Flexibility Scale (CFI) demonstrated to be both valid and reliable (Dennis & Vander Wal, 2010). A copy of the CFI can be found in Appendix H. Permission to use the CFI was granted by Springer New York, LLC through the Copyright Clearance Center (see Appendix I).

Study 2

Study two is actually the original research design concept for this project, where it was determined that the present researcher would examine the neurobiological correlates of groupthink by taking pretest and posttest measures of electrical-cranial activity in the brain before and after a group decision making activity. This is a non-medical study that used digitalized electroencephalographic technology. However, the technology is FDA approved for multiple medical uses and is considered safe and non-invasive. This research did not include any

review of a participant's health history, nor did it result in new medical or mental health record or data.

Participants. Twenty-two participants (two male, and 20 female) were recruited from undergraduate classes at the same midsized university using the same procedures described earlier in this chapter. Demographic information for these participants is also provided in chapter four.

Procedure and Instrumentation. In this phase, subjects were assigned to one of six experimental conditions: Biased leader with decision-making protocols, biased leader without decision-making protocols, impartial leader with decision-making protocols, impartial leader without decision-making protocols, no clear leader (confederates only) with decision-making protocols, and no clear leader (confederates only) without decision-making protocols. The "leader" of these groups acted as an implicit, rather than explicit leader; specifically, the leader (confederate) knew he was assigned as the leader and was to take charge, but he was not identified to participants as a leader, nor were there any other indications that he was in fact the group leader.

Group assignment was made based on the day and time for which each participant signed up. These assignments were made in advance, and because the sign-up process was electronic and remote, the researcher had no influence on which days or times the participant selected. Group assignments to the six groups are visually displayed in Figure 1.

Participants arrived at their self-assigned time. They were then seated in a comfortable chair while the researcher asked for baseline information necessary to perform the qEEG. These questions and the instrument used to collect that data can be found in Appendix L. It is important to note, however, that the information collected on that form was for the sole purpose

of providing information to interpret the raw EEG data in the baseline condition. It was not considered medical information and was not used for inclusion/exclusion criteria.

After collecting the required information, the researcher then fitted the participant for the correct sized skullcap. A skullcap with pre-arranged electrodes was used to avoid the difficulty associated with having to properly and expediently manually place 19 electrodes (in addition to a ground electrode and two reference site electrodes) on the individual one at a time. The researcher elected to use the European Comby cap over the typical American Electrocap as the Comby cap had a much better signal quality in practice runs. Additionally, the Comby cap dried in between sanitations much quicker, speeding up the data collection process.

After fitting the participant with the correct size cap, the researcher then hooked the cap to the amplifier. For this study, the present researcher used the Neurofield Q20 amplifier, performing a visual inspection for potential signal impedance prior to every baseline, to ensure that all the connections at various points on the skull were properly connected and that the signal quality was good. After acclimating the participant to the device and process, the researcher then took 5 minutes of baseline data; two minutes with eyes closed, two minutes with eyes opened, and then one minute of mental activity (the participant was asked to perform serial sevens, a task that requires the subject to count backward from 100 by 7). This pretest data served as the point of reference to compare changes in the EEG based on the experimental condition. Participants were then ushered into an adjacent room where the confederates (all appearing to have already had their EEG data performed as the participant) awaited. An actor/psychologist with an expertise in interpersonal meta-communication (communication below the surface level, for example, manipulation and double-bind communication) was also seated in some of the settings where he played the role of leader in both biased and impartial conditions. Some of the

conditions included decision-making guidelines. These decision-making protocols (Appendix M) were influenced by the guidelines developed through Janis' research on how to mediate groupthink effects (Janis, 1982). Regardless of condition, all participants (and confederates) were then orally given the instructions by the researcher to read the vignette silently, then to discuss the vignette as a group. Participants were told when they were ready to decide what they thought the protagonist (Chad) should do, they could record their response of their private exit survey. Confederates generally covered their exit surveys up when writing their responses to add to the illusion of anonymity. The amount of time it took for the participant to decide was then recorded in minutes. These conditions, and the rest of the details about the design, are summarized in Table 2.

Following the study, participants were then instructed that they would be re-measured based on the order of the last one in the room. Therefore, the actual participant (not the confederate) was the first to be escorted to the research room where the equipment was located. The participant was then seated again in the comfortable chair and administered one last qEEG. Another two minutes of data were collected (one minute eyes closed and one minute eyes opened) while the participant was asked to recall their experience "working with the group to make a decision."

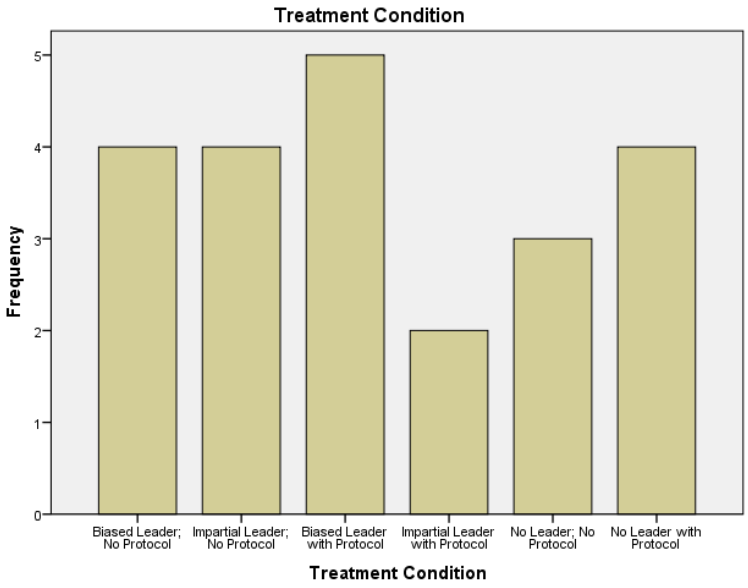

Figure 1. Treatment condition bar chart. This figure demonstrates the frequency of group assignment across all six conditions for study two.

EEG Defined. For the purposes of this discussion, Electroencephalography (EEG) is the recording of micro-electrical potentials by means of electrodes that are placed on the scalp. Specifically, 19 electrodes will be placed on the scalp using what is commonly known as an EEG cap (Comby cap). This cap allows for precise standardized placement. A standardized electrode placement system allows EEG data collected by one group to be meaningfully interpreted by another group (Lubar, Congedo, & Askew, 2003).

qEEG. A quantitative electroencephalogram is basically a digitalized form of a raw EEG (electroencephalogram) recording that is then translated into a topographic image often referred to as a brain map. Most commonly, a qEEG is performed using the universal 19 channel, 10-20 placement system (Lubar, Congedo, & Askew, 2003).

The 10-20 system of electrode placement is an international system that places electrodes at sites that are all either 10% or 20% of the distance of the total amount of space from the nasion to inion (front to back) or from one preauricular point to the other (side to side).

While imaging techniques such as MRI, PET and SPECT offer in-depth spatial resolution, especially of the deeper brain structures such as the hippocampus and amygdala, they are not temporally sensitive; that is to say they cannot provide information as to how the brain responds to split second stimuli. However, high resolution, quantitative electroencephalography (qEEG), also known as the digitalized EEG, does offer this ability. While there is considerable disparity in the literature with regard to the few number of qEEG studies in comparison with measures such as PET, MRI and fMRI, the qEEG is a relatively non-evasive practical approach to neuroimaging (Brietzke, 2007). Although it is often used in research, it has also been demonstrated effective in the detection of organicity (biologically driven pathology), as well as for diagnosis of psychiatric disturbances (Brietzke, 2007; Cloninger & Svrakic, 1997).

Montaging and Analysis. Modern qEEG software allows for data to be recorded once then montaged as many different ways as the researcher chooses or deems appropriate to the data. A montage is an arrangement of electrode reference combinations. This allows a researcher to reduce artifact and signal noise through identifying common modes in different arrangements. For the purpose of this study, it was determined that all of the brain maps (5 recordings per participant) would be montaged using three standard montages. Those montages included Average Reference, Linked Ears, and LaPlacian.

Raw EEG tracings were first inspected to remove artifact. Artifact refers to signal interference that shows up in the EEG but is not part of the EEG record itself. Common examples include eye blink or movement, swallowing, heartbeat, and muscle tension. Artifact

free data was then digitally analyzed to produce the appropriate brain maps in all three montages using Neuroguide software, the standard in the industry (Gunkleman & Lubar, 2013).

Low Resolution Electromagnetic Tomography (LORETA). While both PET analysis and fMRI studies provide good topographies of the brain, they are limited in their ability to capture the rapid firing phenomenon in the brain (Pascual-Marqui, Esslen, Kochi, & Lehmann, 2002). A quantitative EEG does, however, capture these neuro-electrical firing processes. Further, while the digital EEG allows for the creation of a brain map, interfacing that data with low resolution electromagnetic tomographic software such as LORETA allows for topographic analysis that is more temporally sensitive than PET or fMRI (Pascual-Marqui et al., 2002). Additionally, LORETA offers a particular advantage in that it allows a researcher to identify the subcortical source of the electromagnetic wave being generated (Gunkleman & Lubar, 2013). After all of the data was digitally analyzed in the different montages, artifact free data in the linked ears reference was selected and analyzed using the LORETA software. Specifically, differences between baseline and posttest conditions were noted and LORETA was used to identify the subcortical source generators for areas of interest.

Risk to Participants. The fact that EEG/qEEGs are safe and painless is well documented in the literature and is even stated on the Mayo Clinic website. Deception sometimes entails minor psychological risks. Should any participant report or present with any distress related to the study's deception, he or she would be assessed by a licensed clinician (the PI) and immediately referred to an appropriate outlet (counseling center, etc.).

Table 2.

Summary of Two-Phase Experiment

	Variables Tested	Instruments	Number of Subjects	Procedure
Phase 1.	Rigid v flexible thinking X Level of commitment (2x2 matrix). This is also a "pilot" condition to assess the development of the experimental vignette.	Cognitive Flexibility Scale (CFI) found in Appendix I and the self-report measure found on the instrument provided in Appendix H	10 groups of 6-10 (with 1-3 con-federates in each group)	Participants will be given a vignette to read and then discuss with the group. Following the discussion, participants will render a written decision on an "exit survey." This information will be assessed against their scores in the Cognitive Flexibility Inventory and the self-report measure of commitment level in the instrument found in Appendix H.

(continued)

	Variables Tested	Instruments	Number of Subjects	Procedure
Phase 2.	Socio-psychological: Leader influence (bias verses impartial) and the impact of decision-making protocol (Appendix L). Neurobiological: Changes in neuro-electrical activity related to a conformity task, as measured by qEEG.	qEEG equipment including software and skull caps.	5 subjects to each of the six conditions (approx. 30)	Experimental (qEEG) Groups: 1. Biased Leader with decision-making protocol. 2. Biased leader without decision-making protocol. 3. Impartial leader with decision-making protocol. 4. Impartial leader without decision-making protocol. 5. No leader (confederates only) with decision-making protocol. 6. No leader (confederates only) without decision-making protocol.

Summary

The present chapter outlines a two-phase approach to empirically testing a construct of groupthink for six stated research questions. In the first phase, which also serves as a pilot study to test the vignette, the interactional matrix was assessed in an attempt to determine if there was a correlation between rigidity and ideological commitment in relationship to conformity. Participants in this study self-selected one of two conditions (groups voting "no" or groups voting "yes") based on the day and time they selected to participate. They were administered a demographic and ideological survey, as well as the CFI. They were then asked to participate in a group decision-making activity where they read and discussed the vignette before recording their responses on an exit survey.

In phase two, the neurobiological correlates and moderation effects were assessed in six different treatment groups. The design for study two was similar to study one but in lieu of paper instruments (the survey and CFI) pretest and posttest data was collected through the use of qEEG, which was digitally analyzed in both Neuroguide (brain mapping software) and LORETA. Because a modicum of deception was used, the methodological approach concluded with a full debriefing to all participants.

Chapter Four: Results

Introduction

The purpose of chapter four is to provide a detailed description of the procedures for data analysis and a complete overview of the research results. This chapter will first review the participant characteristics, analytic process, and research findings for study one. Then, the participant characteristics, analytic procedures and research results for study two will be explained. Finally, this chapter will conclude with a summary.

Study One

The original purpose of study one was to pilot the vignette. However, an opportunity was seen to use the pilot study to test out an interactional matrix to determine whether or not cognitive rigidity or ideological commitment had any impact on conformity with regard to group think. Research question one was developed specifically to explore this possibility. Research question one asks the following: To what extent, if any, might groups higher in rigidity and commitment demonstrate higher levels of groupthink? The outcome is described below.

Participants. The first study consisted of 35 participants, all recruited from undergraduate courses at a mid-sized private university. Of the 35 participants, five were male and 30 were female; three spoke English as a second language and were in the U.S. on student visas from China. Age of participants ranged from 18 to 22, where the mode was 19, and the mean age 19.67. Although the frequencies of ethnic backgrounds for the participants are illustrated in Table 3, they are as follows: 54% Caucasian, 23% Hispanic, 11% Asian and 9% African-American/Black.

Table 3.

Study One Ethnicity of Participant

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Asian	4	11.4	11.8	11.8
	Black/African American	3	8.6	8.8	20.6
	White/Caucasian	19	54.3	55.9	76.5
	Hispanic/Latino(a)	8	22.9	23.5	100.0
	Total	34	97.1	100.0	
Missing	99.00	1	2.9		
Total		35	100.0		

Analytical Techniques. Totals for the demographic and ideological survey as well as the CFI were totaled and entered for data analysis. Data were analyzed using the Statistical Package for the Social Sciences (SPSS).

Results. Of the 35 participants that participated in the study, only three did not conform to the group position (two were in the same group, arrived together, and appeared to be friends). The conformity rate for this study, therefore, was 91.4%. Because of the high level of conformity, no significant statistical differences were found with regard to the interactional matrix. The makeup of the participants with regard to religious, political, and ideological commitment as reported on the ideological survey is interesting to note. Specifically, although the sample was drawn from a Christian school, participants reported higher levels of political

commitment (Figure 1) than religious commitment (Figure 2). Levels of ideological commitment can be seen in Figure 3. The overall level of commitment (the average of the three types) demonstrates a fairly well shaped bell curve (Figure 4).

Overall, there was not enough information, likely due to small sample size and high levels of conformity to truly address research question one.

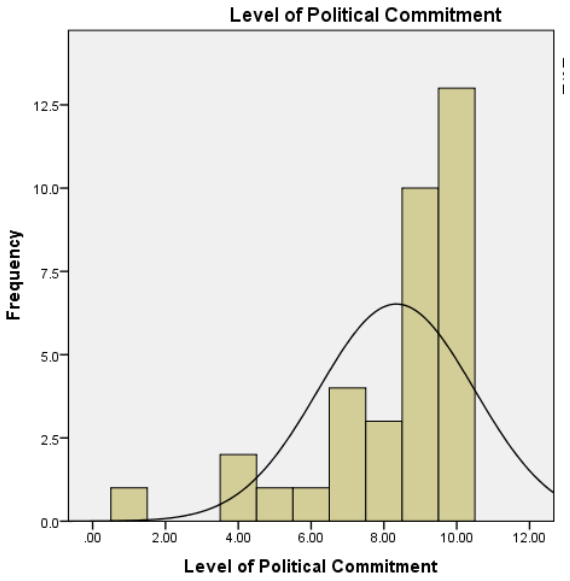

Figure 2. Level of political commitment. This figure shows the level of political commitment as reported by the participants in the sample. Note the distribution is negatively skewed (Mean = 8.34, $S = 2.141$, $N = 35$).

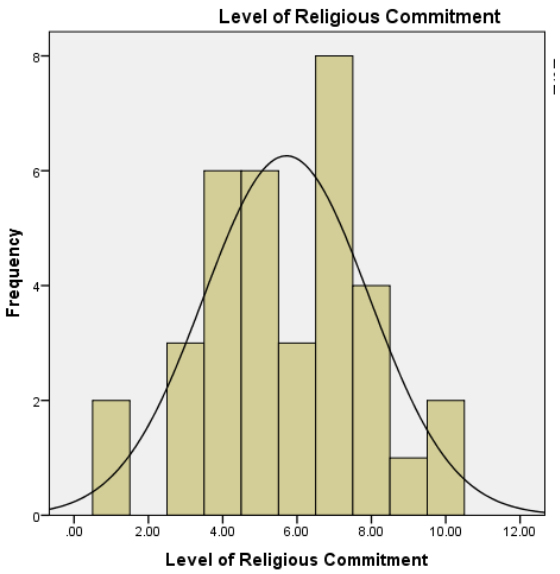

Figure 3. Level of religious commitment. This figure shows the level of religious commitment as reported by the participants in the sample (Mean = 5.71, *S* = 2.23, *N* = 35). Note the sample does not report the same level of commitment here as it does with regard to political views.

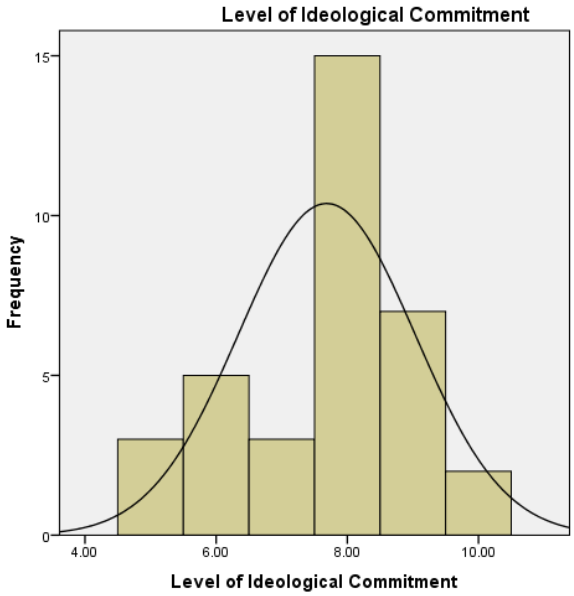

Figure 4. Level of ideological commitment. This figure illustrates the level of ideological commitment as reported by the sample (Mean = 7.69, *S* = 1.345, *N* = 35).

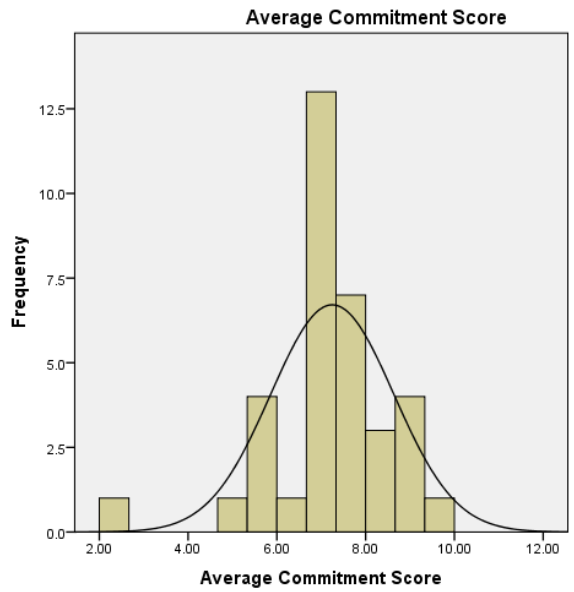

Figure 5. Average commitment score. This figure provides a visual of the overall averaged levels of commitment (the three dimensions averaged together) reported by the sample (Mean = 7.25, $S = 1.387$, $N = 35$).

Study Two

Study two was designed to explore the possible neurobiological correlates of conformity in the form of groupthink. Out the outset, five research questions were designed:

- What difference, if any, does the implementation of decision-making protocols make in the final outcome?
- How does the presence of a leader impact the final decisional outcome with regard to groupthink?
- To what extent, if any, does the presence of a perceived leader moderate the neurobiological dimensions of conformity?
- To what extent, if any, does the partiality of the leader impact the final outcome?
- To what extent, if any, does the partiality of a perceived leader moderate the neurobiological dimensions of conformity?

Participants. Study two consisted of 22 participants; all recruited from the same undergraduate courses at a mid-sized private university as in study one. Of the 22 participants, two were male and 20 were female. Ages ranged from 18 to 24, with a mode of 18 and a mean age of 19.32. A frequency table, identified below as Table 4, provides as overview of the ethnic backgrounds of the 22 participants. However, a summary of the data is as follows: 54.5% Caucasian, 32% Hispanic, 4.5% Asian, and 4.5% Other (self identified as Middle Eastern).

Table 4.

Study Two Ethnicity of Participant

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Asian	1	4.5	4.8	4.8
	White/Caucasian	12	54.5	57.1	61.9
	Hispanic/Latino(a)	7	31.8	33.3	95.2
	Other	1	4.5	4.8	100.0
	Total	21	95.5	100.0	
Missing	99.00	1	4.5		
Total		22	100.0		

Analytical Techniques. As was the case in study one, data that was not neurobiological in nature (e.g. group assignment, minutes to deliberate, whether or not the participant conformed) was input and analyzed in SPSS. The data analysis for the neurobiological information, however, was much more complex.

From each of the 22 participants, five qEEG recordings were taken (three as baseline pretest measures, and two as posttests). All 110 recordings were visually inspected and analyzed in Neuroguide and all artifact possible was removed. Data was selected for analysis from the recording based on both test-retest reliability and split-half reliability. Data was not selected out for further analysis until the test-retest reliability measures for the selected, artifact free data were above 0.90 and the split-half reliability was above 0.95, consistent with the standard of practice in qEEG analysis (Gunkleman & Lubar, 2013). Tables demonstrating all the test-retest and split-half reliability for each recording, each montage, and each electrode site can be seen in Appendix N.

Data were then analyzed in Neuroguide, using all three prescribed montages (linked ears, average reference, and LaPlacian). Each montage was then mapped. The Neuroguide generates brain maps based on a large normative database, providing a visual comparison of the subject based on z scores. An example can be seen in Figure 6. The best data maps were then selected for comparison. The eyes closed baseline was compared to the eyes closed posttest, and the eyes open baseline was compared to the eyes open posttest. In both comparisons, the mental activity baseline (where participants were asked to perform serial sevens) was used as a reference point in an attempt to control for changes that were cognitively related, rather than as a result of the experiment itself.

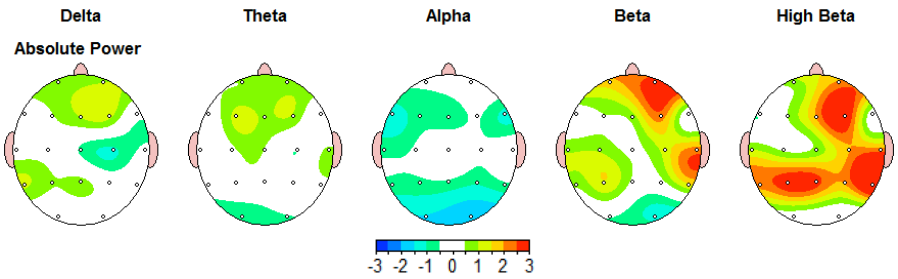

Figure 6. Brain map sample. An example of a Neuroguide generated set of brain maps for a single recording based on a normative distribution and z scored.

A table was created with all 110 sets of brain maps in order to perform a side-by-side comparison as described above and to notate important changes. That table can be seen in Appendix O. From there, those changes were then transposed into an additional table that provided space for the subcortical analysis. Specifically, the researcher imported the artifact free posttest qEEG data for both eyes closed and eyes open from Neuroguide into the LORETA software. This allowed the researcher to identify which brain structures might be associated with the change. That table can be seen in Appendix P.

Once patterns (changes in associated brain structures) were identified, categories were created in SPSS for further comparison across groups. A summary of those patterns and how they were coded into SPSS is provided in Table 5.

Table 5.

Summary of Associated Changes in Subcortical Structures and Corresponding Coding Labels

Frontal lobe change	1.Generalized frontal decrease 2.Generalized frontal increase 3.Right side decrease 4.Left side increase 5.Right side decrease with left side increase 6.Left side decrease 7.Right side increase 8.Change in the medial frontal gyrus only 9.No change noted
Medial frontal gyrus change	1.Yes, increase in activity 2.Yes, decrease in activity 3.No change noted
Activation of anterior cingulate gyrus	1.Yes 2.No
Activation of precuneus or cuneus in the occipital-parietal network	1.Yes 2.No

Results. Of the 22 participants in study two, only one did not conform. The conformity rate for this study is, therefore, 95.5%. As was the case in study one, the level of conformity was so high that it was not statistically possible to look for differences based on whether or not participants conformed to the thinking of the group.

Initially, one-way ANOVA metrics were applied to look for significant group differences. No significant differences, however, were found. It was determined that because the sample size was small, and because data were ordinal in value, that a Spearman correlation coefficient could be applied to determine the relationship, if any, between the described independent variables and the outcome. Using the Spearman correlation coefficient, the researcher attempted to see if there was a significant relationship between the behavioral outcome (measured by minutes to deliberate) and other experimental variables including the presence or absence of a leader, the biased or impartial approach of the leader, and the presence or absence of decision-making protocol. When examined individually, no significant relationships were found. However, when the researcher examined the relationship between group assignment (those three experimental variables taken as whole) $r = 0.575$, $p > 0.01$. A visual summary of that relationship is represented in Figure 7.

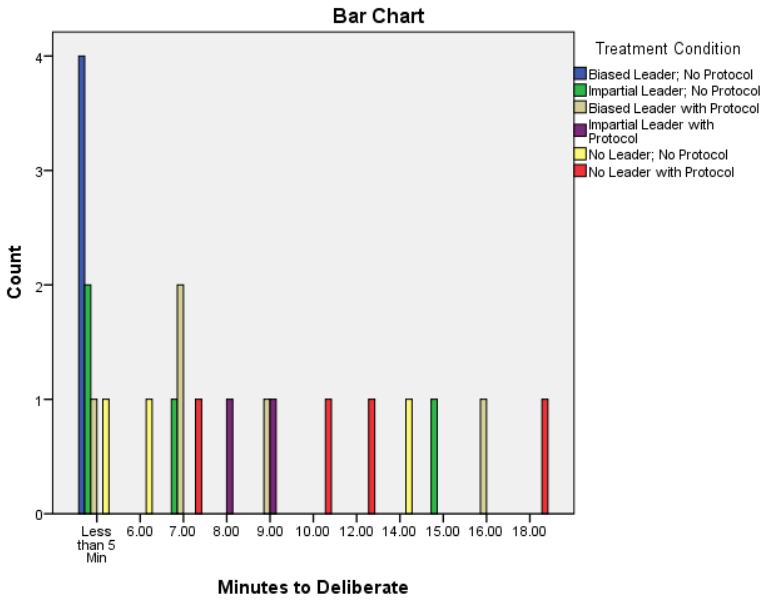

Figure 7. Statistically significant relationship between treatment condition and time to conform. This bar chart illustrates the relationship between treatment conditions with regard to the amount of time in minutes required before participant and group decided they were ready to vote, based on consensus.

The researcher then set out to analyze the neurobiological data. Of the 22 participants, only 20 had brain data that could be used in data analysis. One participant's data could not be analyzed because in the last three of the five recordings, there seems to have been some signal interference that showed up as high amplitude impedance. The researcher suspects that the cap's electrodes were still wet from the previous sanitization between participants. Another participant's data could not be used because in all five recordings there was no connection at the central parietal electrode and the researcher unfortunately did not catch it at the time of data acquisition. Of the twenty that could be used, one participant's data could not be analyzed in the

eyes closed condition because of a bad baseline recording. Another participant had a recent head injury that seemed to be impacting brain function in her eyes open condition. Therefore her eyes open data was not included in the analysis. Notes detailing inclusion and exclusion of data in analysis are found in Appendix P.

No significant relationships were found between changes in the brain and any of the experimental variables (i.e. presence or absence of a stated leader, availability of decision making protocol, or biased or impartial approach of the leader). However, several trends were identified. They are outlined in the subsections below.

Frontal lobe change. In the eyes closed condition, of records analyzed for 19 participants, five demonstrated generalized decreased activity in the pre-frontal cortex (PFC). Three demonstrated generalized increased activity in the PFC. Two participants showed decreased activity only on the right; while only one showed an increase on that side. However, three demonstrated a decrease on the left, while only one showed an increase on that side. Three participants showed a right side decrease with a left side increase. One individual had no change in frontal activity. A summary of the changes is illustrated in Table 6.

In the eyes open analysis, fewer frontal cortex changes were noted. However, four participants demonstrated a generalized decrease in PFC activity, while three demonstrated a generalized increase. Two participants had a right side decrease while six showed an increase on the left. A summary of frontal cortex changes can be seen in Table 7. A side-by-side comparison between the two measures (eyes closed and eyes open) can be viewed in Figure 8.

Table 6

Frontal Change in Eyes Closed

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Generalized Decrease	5	22.7	26.3	26.3
	Generalized Increase	3	13.6	15.8	42.1
	Right Side Decrease	2	9.1	10.5	52.6
	Left Side Increase	3	13.6	15.8	68.4
	Right Side Decrease with Left Side Increase	3	13.6	15.8	84.2
	Left Side Decrease	1	4.5	5.3	89.5
	Right Side Increase	1	4.5	5.3	94.7
	No Change Noted	1	4.5	5.3	100.0
	Total	19	86.4	100.0	
Missing	Missing	3	13.6		
Total		22	100.0		

Table 7

Frontal Change in Eyes Open

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Generalized Decrease	4	18.2	21.1	21.1
	Generalized Increase	3	13.6	15.8	36.8
	Right Side Decrease	2	9.1	10.5	47.4
	Left Side Increase	6	27.3	31.6	78.9
	Right Side Decrease with Left Side Increase	1	4.5	5.3	84.2
	Left Side Decrease	1	4.5	5.3	89.5
	Right Side Increase	1	4.5	5.3	94.7
	No Change Noted	1	4.5	5.3	100.0
	Total	19	86.4	100.0	
Missing	Missing	3	13.6		
Total		22	100.0		

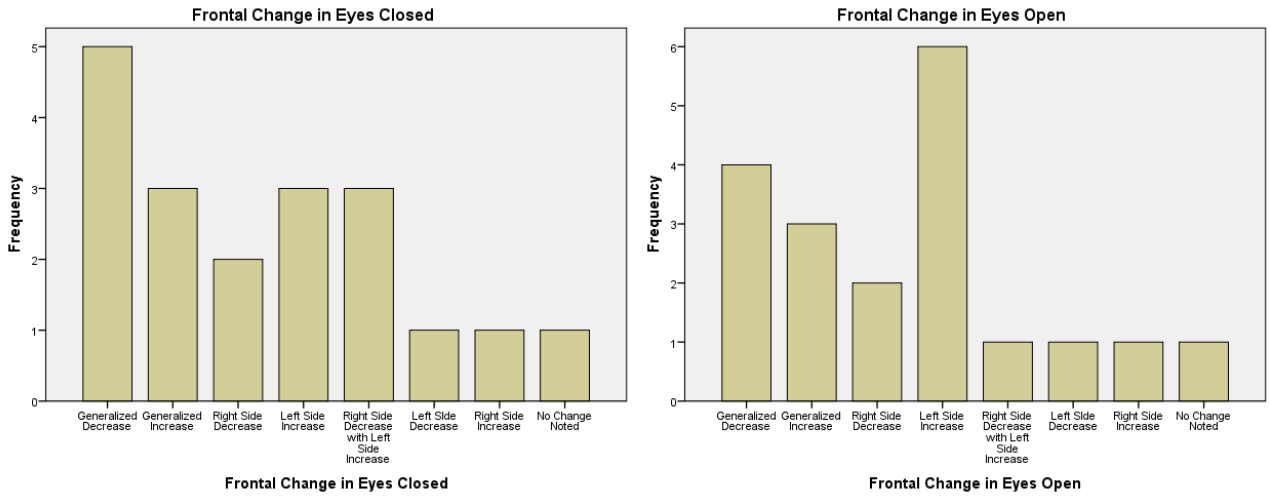

Figure 8. Side by side comparison of frontal cortex changes. This figures provides a comparison of differences between eyes closed posttest measures and posttest data taken during eyes open.

Medial frontal gyrus change. In the eyes closed condition, the medial frontal gyrus in the PFC showed a marked increase in activity in 11 of the 19 records analyzed. Of those 19, seven participant records showed no significant change in the region. These data are summarized in Table 8. However, in the eyes open measures, five participants showed an increase in the medial frontal gyrus, one showed a decrease, and seven records demonstrated no significant change in this region. These numbers are displayed in Table 9.

Table 8

Medial Frontal Gyrus Change in Eyes Closed

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes, Medial activity is increased	11	50.0	57.9	57.9
	Yes, Medial activity is decreased	1	4.5	5.3	63.2
	No Change	7	31.8	36.8	100.0
	Total	19	86.4	100.0	
Missing	Missing	3	13.6		
Total		22	100.0		

Activation of anterior cingulate gyrus. There were very mixed results with regard to increased or decreased activation of the anterior cingulate in this study. Specifically, of the 19 eyes closed comparisons, 10 participants demonstrated increased activation, while nine did not. Comparatively, in the eyes open measure, only six of 19 records showed increased activation of the anterior cingulate. These differences are reported in Tables 10 (eyes closed) and 11 (eyes open).

Table 9

Medial Frontal Gyrus Change in Eyes Open

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes, Medial activity is increased	5	22.7	26.3	26.3
	Yes, Medial activity is decreased	2	9.1	10.5	36.8
	No Change	12	54.5	63.2	100.0
	Total	19	86.4	100.0	
Missing	Missing	3	13.6		
Total		22	100.0		

Table 10

Activation of Anterior Cingulate in Eyes Closed

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	10	45.5	52.6	52.6
	No	9	40.9	47.4	100.0
	Total	19	86.4	100.0	
Missing	Missing	3	13.6		
Total		22	100.0		

Table 11

Activation of Anterior Cingulate in Eyes Open

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	6	27.3	31.6	31.6
	No	13	59.1	68.4	100.0
	Total	19	86.4	100.0	
Missing	Missing	3	13.6		
Total		22	100.0		

Activation of precuneus or cuneus in the occipital-parietal network. Differences here with regard to increased activation were also mixed. Of the 19 records analyzed from the eyes closed measure, 10 participants demonstrated increased activity in either the precuneus or the cuneus of the occipital-parietal network. Nine participants, however, did not. In the eyes open measure, only five of the 14 records demonstrate the same kind of increase. These differences are reported in Table 12 (eyes closed) and Table 13 (eyes open).

Table 12

Activation of the Precuneus or Cuneus in Eyes Closed

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	10	45.5	52.6	52.6
	No	9	40.9	47.4	100.0
	Total	19	86.4	100.0	
Missing	Missing	3	13.6		
Total		22	100.0		

Table 13

Activation of the Precuneus or Cuneus in Eyes Open

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	5	22.7	26.3	26.3
	No	14	63.6	73.7	100.0
	Total	19	86.4	100.0	
Missing	Missing	3	13.6		
Total		22	100.0		

Summary

The present chapter presented the findings for both study one and study two. Very little inferential data was gleaned as a result of small sample size coupled with extreme rates of conformity. Overall, there were no real significant findings in study one. In study two, statistically significant results were extremely limited. In point of fact, the only statistically significant relationship was between treatment condition and the length of time for participants to decide they were ready to vote as indicated by joining a consensus. This statistic is only indirectly related to the research questions, specifically, research questions two, three, and five. A summary of the research questions with a corresponding summary explanation of the results can be found in Table 14.

That said, some interesting potential trends were identified in this study. In particular, most of the participants experienced marked change (increase and/or decrease) in the prefrontal cortex. Only one participant in the eyes closed measure, and one participant in the eyes open measure did not. Further, almost 53% of the sample experienced increased activation of the anterior cingulate in the limbic system during the eyes closed measure while, the same number of participants experienced activation of the occipital-parietal network (specifically in the precuneus and cuneus) also in the eyes closed measure. A discussion of these findings will be provided in the following chapter.

Table 14

Summary of Research Questions with Corresponding Results

1. To what extent, if any, might groups higher in rigidity and commitment demonstrate high levels of groupthink?	No significant differences found. This may be due to the extreme level of conformity coupled with the small sample size.
2. What difference, if any, does the implementation of decision-making protocols make in the final outcome?	No significant relationship except when taken into account with the presence of a leader. In this instance, it seemed to have slowed down the rate of consensus or conformity in the form of groupthink.
3. How does the presence of a leader impact the final decisional outcome with regard to groupthink?	It did not seem to impact the final outcome, in large part because, as is generally true with regard to group dynamics, someone almost always assumed a leadership role.
4. To what extent, if any, does the presence of a perceived leader moderate the neurobiological dimensions of conformity?	No significant relationships were found.
5. To what extent, if any, does the partiality of the leader impact the final outcome?	The only significant relationship here was found when this was taken into account with the other experimental variables.
6. To what extent, if any, does the partiality of a perceived leader moderate the neurobiological dimensions of conformity?	No significant relationships were found.

Chapter Five: Discussion

Introduction

There is a saying in research circles: Data can be significant but not meaningful and data can be meaningful but not significant. There was little statistically significant data in this study. However, the present researcher believes that there is meaning to be found in the results. The purpose of this chapter is to discuss the results of both studies, any meaning in those results, and potential real world implications.

Study One

The purpose of study one was to pilot the vignette for use in study two and to test the possible interaction of cognitive rigidity and ideological commitment on group think. Because the conformity rate was so high, there was too little data to be used as a point of comparison. However, study one did provide some helpful information for future research.

Problems with the design and sample. To begin, and perhaps most important to the study at hand, the pilot study identified a typographical error on the exit survey that, in essence, change the meaning of the question. Specifically, the original exit survey asked, "should Chad accept the bribe?" However, the intended question was "should Chad pay the bribe?" This identification allowed for the researcher to make the adjustment for the remaining groups in study one as well as study two.

An additional problem that was encountered in study one was assuming that the average college student would know what the researcher meant by the word "ideological." Many participants in study one, when completing the demographic and commitment survey, had to ask what that word meant. When participants asked, a cursory definition was provided, but there is no way to account for participants who did not truly know what the word meant and did not ask.

An unforeseen confounding variable in the study was the inclusion of international students who speak English as a second language. Three students from China signed up to participate in the research. The present writer is unclear how strong their command of the English language was. However, at least one student appeared to have some confusion around language nuance in English. This might have been less of a problem in an experiment that was more task-oriented and less social in design. However, here it remains an unknown variable with regard to how it may have impacted the overall outcome.

Study Two

The purpose of study two was to examine social drivers of conformity, such as the presence or absence of a leader, the availability of decision-making protocol, and the relative bias or impartiality of the leader, as well as possible neurobiological correlates of conformity. Study two was clearly much more complex than study one, creating, therefore, much more material for discussion.

To begin, it is clear that while the presence of decision-making protocol did not prevent conformity, it does seem to have slowed it down, particularly in the biased leader group. This may add some empirical validation to the notion that groups can protect themselves, at least in part, from groupthink by adding such protocols to their decision-making procedures. This was the only statistically significant finding in the study. However, there were also many unexpected dynamics. For example, it is difficult to decide, apart from how the present researcher intended the groups to function, which groups were truly leaderless. Specifically, in groups assigned as "non-leader groups," when no clear leader was established, someone typically assumed the role of leader. In most cases it was a confederate but one participant, the sole non-conformist, took that role upon herself at the outset of the experiment. This is likely consistent with how group

dynamics unfold in real day-to-day environments. There were some particular problems with the sample and design however.

Problems with the design and sample. The present researcher tried to control for as many possible variables in advance, especially for variables that could impact the actual EEG recording. To that end, participants were given very specific instructions about not consuming caffeine on the day of the study, how and when to eat, and about getting eight hours of sleep the night before. However, in a sample of college students, it seems reasonable to predict that participants might be over-caffeinated, sleep deprived, and not properly nourished. In point of fact, several participants in the study consumed caffeine on that day. Some of the participants had not read or remembered the instructions, while some participants seemed ignorant of what beverages actually contain caffeine (e.g. black tea and Dr. Pepper). The researcher did her best to try and control for caffeine effects in the analysis of the records, but that is difficult to do when you do not have a non-caffeinated baseline to compare to, as caffeine affects different brains in different ways.

As mentioned earlier, this was a sleep-deprived sample. Sleep deprivation has a significant impact on both baseline data as well as posttest data as response rates in the brain vary between individuals and across various sleep conditions, especially in instances of long-term mild to moderate sleep deprivation (common in the college demographic). Further, these participants seemed truly uneducated about appropriate sleep hygiene and its impact on the brain and body. Specifically, while most participants reported a good night's sleep, they consistently reported six hours or less a night of sleep. This is at least 2 hours less per night of the amount of sleep typically required for a brain at this age (Carlson, 2010).

A difficulty that was encountered relates to participant histories of head injuries. Three participants reported significant histories of impact or trauma to the head. For each of those participants, the visual analysis of their brain maps, particularly in LORETA corresponded with the nature and narrative of their injuries as reported. However, one participant, who denied any history of head trauma, presented, particularly with regard to findings in LORETA, consistent with either a head injury or some form of serious neurological dysregulation that was pronounced in the right hemisphere, in the frontal, parietal, and temporal lobes. Personal histories of head injuries are commonly very underreported (Gunkleman & Lubar, 2013). As reported in chapter four, that individual's data was not used in analysis.

It is also important to note, at this point, that there were no real observable changes in eyes open measures for any of the subjects who reported histories of head injuries. For one participant reporting a head injury within approximately the last 12 months, there was marked dysregulation on the right side, that was especially pronounced all along the frontal gyri and at the frontal-temporal junction. This lack of response for participants with head injuries is likely to have affected the overall findings.

A couple of problems arose in this study related to the equipment that was selected for data acquisition. While a visual inspection of signal strength and impedance can be made, a digital impedance check devise is preferred. However, this was not included due to additional costs associated with adding an additional piece of equipment. While, overall, the data collected was good data, an impedance check device could have negated a couple of problems related to poor connectivity. Specifically, records for two separate participants could not be analyzed because of poor signal quality that was not discovered until after data collection in the data analysis stage. Additionally, there was some signal interference related to the type of cap used

to perform data acquisition. Specifically, the Comby caps use what is known as a mastoid reference in place of an auricular reference. Both the mastoid (the bone behind the ear) and the auricular points (i.e. the ear lobes) are thought to be neutral points, free of electrical potential. However, because the mastoid reference is so close to the temporal electrode sites, they can, and sometimes do, pick up extra noise (signal, muscle tension, etc.). Therefore, auricular references are generally preferred in the industry (Gunkleman & Lubar, 2013). While most of the data appeared to be fairly noise free, there are a couple of recordings where the researcher suspects there may have been some interference from the mastoid references.

With regard to testing condition, it is important to note that participant expectation and arousal related to both pretest and posttest dynamics may have influenced neurological responses in both the baseline set of recordings and in the posttest recordings. Specifically, pretest measures may have been influenced by any anxiety or arousal the participant might have been experiencing due to the unknown or unfamiliar circumstances of sitting down with a faculty researcher to have an EEG performed. Additionally, participants second-guessing their own decisions, if this even happened, may have influenced some of the posttest data. More extensive debriefing procedures would be important in studies going forward in an attempt to capture this extraneous phenomenon.

Tying it Together

The purpose of this study was to investigate the neurobiological basis of groupthink as a dimension of conformity, a component of followership, in order to advance the understanding of effective leadership strategies and the development of healthy organizations. This section will review the findings and where appropriate, make connections to the research. The sections that follow will provide possible applications to organizations.

Social drivers. As mentioned earlier, there were not many significant findings with regard to social drivers or influences (positive or negative) on conformity or groupthink in either study. The one real interesting find was with regard to the presence of decision-making protocol, which did not prevent groupthink, but it did seem to have slowed it down, particularly in the biased leader group. Consistent with Janis' suggestion and the collective work of many who have researched groupthink, adding such a protocol may not completely insulate an organization from groupthink but it may stave it off long enough for a different mind to prevail, when necessary.

An interesting dynamic that emerged from this study is that, despite all the researcher's efforts to the contrary, there was never any truly "leaderless" group. Someone, usually a confederate but on one occasion a participant, always stepped into that role. This may be indicative of a human need to have a leader in a group; it may help mediate feelings of uncertainty or feelings of chaos for example. This is also a likely reason no significant difference with regard to social or neurobiological drivers, were found in groups with leaders by design or self-appointed leaders. Further, when you look at this dynamic, the apparent need to have a leader in the group, coupled with the fact that a leader's position (biased or impartial) seemed to have no influence on groupthink outcomes, the use of decision-making protocols seems even more important. In other words, if we are attempting to protect our organizations from groupthink, and if we know groups will self appoint leaders and that an impartial leader is not likely to be any different in preventing groupthink than a biased leader, we need such protocols as a first line of defense.

While this project has not discussed much about various types of non-conformists, or what we might call potential challengers to groupthink, three different approaches to non-

conformist behavior were noted between the two studies. In study one, one participant who decided to vote "yes" during a "no" condition, was very vocal and outspoken about her choice and the reasons for it. So much so that the other group members (confederates and participants alike) experienced her as abrasive. That did not seem to deter her however. It is likely, at least in this researcher's observation, that this individual is accustomed to not conforming, has an abundance of interpersonal difficulty as a result, and probably experiences very little distress over it. The other two non-conformists in study one were quite the opposite. They were very quiet about their decisions, one giving no real indication how she would vote and the other feigning that she would vote with the consensus but not actually doing so. They were likely either the individual who feigns conformity (Hewlin, 2003) or the tempered radical who chooses when they will openly dissent (Zemke, 2010). The fourth non-conformist came from study two. Her approach was somewhere in the middle. She was respectful in her discourse but certain of her position. During the debriefing part of this study, that participant confided in the researcher that she too experiences a lot of interpersonal difficulty, which distresses her, over being such a non-conformist. She stated that she often feels misunderstood by her peers as someone who seeks conflict when in her mind she is simply being honest and transparent about her positions. Her sincere approach to non-conformity is akin to what Chaleff refers to as courageous followership (2009).

Neurobiological drivers. As stated earlier in this chapter and in chapter four, there were no significant findings with regard to neurobiological correlates. However, patterns in posttest data do seem to be consistent with the existing literature and may add meaning in further studies on groupthink.

Medial frontal cortex. The medial frontal gyrus has been implicated in previous studies as a region of interest in conformity studies (Klucharev, Munneke, Smidts, & Fernandez, 2011). Specifically, it has been associated with the adjustment of one's behavior based on social expectations. Medial increases were seen in 50 % of all participants in the eyes closed measure and 23% of participants in the eyes open measure. However, this does not account for any upregulation in the medial frontal gyrus that may have been present in the pretest condition as a result of a participant monitoring their own behavior, being seated and fitted with a funny electrode equipped cap, in an unfamiliar faculty member's office, and under some what uncertain (or at least unfamiliar) circumstances. In other words, there may have been a bit of a performance expectation causing participants to self monitor and adjust based on what they perceived was being expected of them. This fact may also be augmented by the relatively young age of the sample.

Prefrontal cortex. The right prefrontal cortex (PFC) has been associated with situations where expulsion from the group is threatened. However, studies (e.g. Klucharev, Munneke, Smidts, & Fernandez, 2011) show upregulation in the right PFC tends to mediate the distress associated with an expulsion threat. The sole non-conformist in the group did not demonstrate any medial frontal cortical change but did demonstrate a significant increase in activity in the right PFC, suggesting possibly, that her brain was trying to help her negotiate the pain of choosing to not conform.

Orbital-frontal cortex. The orbital-frontal cortex is the most ventral-medial region of the frontal lobe. Previous researchers have identified the importance of the orbital-frontal cortex function in distinguishing true conformity from feigned conformity (Klucharev, Munneke, Smidts, & Fernandez, 2011). Specifically, upregulation in this region is associated with true

groupthink rather than a pretense of it. While LORETA analysis did not show this region of the brain to be a significant source generator for electrical potential, it is important to note that this area was active in about 50% of all posttest data.

Anterior cingulate. The anterior cingulate located in the limbic system is well documented to play a role in conformity (Eisenberger, Lieberman, & Williams, 2003). The present researcher did note a pattern of upregulation in the anterior cingulate in more than half the cases during eyes closed measures and about a third of the cases during eyes opened. It is difficult to say, but perhaps upregulation in the anterior cingulate would occur at higher frequencies in instances where individuals were more personally or emotionally invested in the group dynamics (for example, with peers or coworkers, or in a institution of worship such as a church). Additionally, as has been mentioned throughout this chapter, it is difficult to determine how much of the emotional brain (the limbic system in which the anterior cingulate is located) was already activated or activating during the pretest baseline conditions, making posttest comparisons more difficult.

Occipital-parietal network. Changes in the occipital-parietal network, seen in this research in the relay between the precuneus and the cuneus, are also associated with research on conformity (Berns, et al., 2003). There is a pattern in this present research to perhaps support that, at least anecdotally. However, this network is responsible for visual processing. In the posttest conditions, participants were asked to sit quietly and recall as much of the experiment as they could to his or herself while the last two qEEG recordings were taken. It is possible that any pattern or upregulation the present research observed was more a function of recalling visual memory of the experiment, than a function of conformity itself.

Overall comparison to the literature. Of the four most notable key neurobiological drivers identified in the literature review as potential factors in groupthink, patterns identified in the present research suggest possible evidence for three of them. Specifically patterns related to the prefrontal cortex in a broad sense, including upregulation of the medial frontal gyrus, and activation of the anterior cingulate. Additionally, the orbital-frontal cortex may also play a role but it is difficult to identify if what is being seen is related to conformity or visual processing. No evidence was found to support the nucleus accumbens as playing a role in conformity in the present study. However, this is a deep brain structure that is generally only measured through the use of MRI or fMRI. Additionally the nucleus accumbens is associated with a pretense of conformity, rather than true conformity itself.

Implications for Organizations. Part of the purpose in studying the neurobiological drivers of conformity was to expand an understanding of followership that would in turn help to identify possible strategies for creating healthy organizations as well as more effective leadership practices. Suggestions for both are outlined below.

Developing healthy organizations. Conformity in the workplace has been positively correlated with higher levels of workplace satisfaction (Boleman & Deal, 2008). Conversely, non-conformists typically report greater levels of disengagement and/or disenchantment in the workplace (Blanchard, Welbourne, Gilmore, & Bullock, 2009). That said it stands to reason that if we want our organizations to be healthy and that if we want to help protect ourselves from the type of groupthink that could lead to poor organizational health or decision-making down the road, then we should work to identify talented non-conformists that have the potential of strengthening our organizations. These non-conformists might be given a special role as "devil's advocate" for example (Janis, 1972). In valuing their non-conformists identity, organizations

may be able to help prevent burnout or disenchantment in the workplace for these individuals, possibly keeping them engaged in the organization. In essence, organizations might consider reaching out to such associates by valuing their non-conformity and giving them a space to do so that is appropriate and healthy for the organization. Additionally, organizations might consider creating incentives for employees and associates to "think outside the box" by creating solutions or alternatives to the ways in which an organization typically thinks or functions.

Leadership strategies. Moving forward, organizations wishing to promote organizational health, might consider developing and implementing trainings on groupthink. Specifically, trainings might include the neurobiological aspects of groupthink, the pros and cons of such conformity, and protocols for preventing pronounced groupthink within the organization. Additionally, training should be considered to help leaders identify non-conformists, how to utilize them in decision-making and planning, and how to value their strengths while effectively managing them so that the non-conformist stays invested in the organization and wards off burnout or disenchantment.

Implications for the Christian Church. While both studies were conducted at a private Christian university, the application to religious, and specifically Christian settings is much more intentional. Part of the author's intent with this work is to understand, and possibly illuminate, the neurobiological drivers of conformity in all organizations, and perhaps particularly in faith-based organizations.

As Christians, we are called to not be conformed to this world (or to one another) but to be transformed by the renewing of our mind in Christ Jesus (Romans 12:2, Philippians 2:5, New King James Version). In his book *The Pursuit of God*, A.W. Tozer uses the example of 100 pianos all in tune with one another, not because they were tuned to one another but because they

were each tuned to a separate, higher standard (Tozer, 2013). The present researcher would add that if they were in fact tuned to one another, rather than that higher standard, the result might not be music, but noise.

The danger for institutions of faith in general, and the Christian church in particular, is that our like-mindedness might be the result of group-mindedness rather than Christ-mindedness. Conformity in the church left unchecked can, and will, have the same devastating effects as it has had in other types of organizations. However, often, non-conformity in such institutions is akin to "sin" or heresy (Zemke, 2010). Church leaders might consider following some of the same suggestions provided above for organizations and their leaders in protecting the group from insidious forms of groupthink. Further still, church leaders can edify their parishioners by fostering a faith that is Christ-centric rather than church-centric. In doing so, leaders might foster a like-mindedness that is the result of Christ-mindedness, like 100 pianos tuned to one higher standard. This, in turn, is likely to have the widespread impact the gospel was intended to have, for "Social religion is perfected when private religion is purified" (Tozer, 2013, p. 88).

Protecting the nonconformist. Mention has been made for organizations and churches to identify non-conforming thinkers in their institutions and to consider leveraging those individuals and their gifts for the greater corporate good. It is important for leaders to remember that such employees and parishioners may feel vulnerable, or misunderstood. Like the sole non-conformist in study two, he or she may feel they are seen as a source of conflict rather than as a source of reason. In valuing their contributions, organizations may be able to retain talented individuals that might otherwise become disengaged from the workplace, and churches can keep insightful parishioners from falling out of fellowship with the congregation out of the pain of

being stigmatized as different. In both instances, such measures are likely to help prevent pervasive and systemic groupthink in these institutions.

Implications for future research. One of the major drawbacks to any kind of brain study is that they require a lot of time and money. For this reason, brain studies tend to use smaller samples. However, as the present study shows, it is difficult to really gain any inferential data using such small numbers of participants. Future studies might consider larger samples. Additionally, the use of more than one researcher would allow for some sort of measure of inter-rater reliability with regard to the visual analysis portion of such a study.

Another drawback to the present study relates to the limits set by the researcher on the length of each qEEG recording. Initially it was determined that shorter recordings for this sample would be better. The researcher wanted to avoid the participant getting drowsy during recordings and thereby contaminating the EEG record with rhythms associated with fatigue. However, the records really ended up being too short. In several records, there was so much artifact that the researcher only ended up with 10 seconds or so of useable data. Future designs should consider increasing the recording time as follows: five minutes baseline eyes closed, five minutes baseline eyes open, two minutes (minimum) for mental activity such as serial sevens, followed by five minutes eyes open and five minutes eyes closed posttest recordings.

It would be interesting to see if there is any empirical support for any of the suggestions mentions earlier in this chapter for leaders and their organizations. For example, one might propose a study on the mentoring of non-conformists in the workplace. If an organization identifies these employees or associates, mentors them, gives them a space for their ideas and a platform that is appropriate, does it change the way in which the employee or associate is engaged in the organization? This might make a great pretest-posttest design.

A criticism of the literature review for this work was the exclusion of the Milgram Studies. The now famous Milgram studies conducted by Stanley Milgram were designed to explore the phenomenon of obedience to authority (Baars & Gage, 2010). For the present author, conformity, in the form of groupthink, and obedience are two separate constructs. However, future studies may wish to explore any possible correlation as well as any potential impact obedience has on groupthink outcomes.

Finally, more research is needed on the types of non-conformists and how they respond to the pain of not conforming. The present researcher is particularly interested in how certain types of non-conformists, specifically those that are tenderhearted in nature (like the sole non-conformist in study two), mediate the pain of not conforming. Martin Luther King Jr., Nelson Mandela, and Mahatma Gandhi are all examples of tenderhearted non-conformists. Are there neurobiological mechanisms that allow them to cope? Moreover, do they engage in coping strategies that trigger neurobiological functions that allow them to mediate the pain of non-conformity? Further study would not only enhance our understanding of followership, but our constructs of effective leaders as well.

Summary

The purpose of this study was to investigate the neurobiological basis of groupthink as a dimension of conformity, a component of followership, in order to advance the understanding of effective leadership strategies and the development of healthy organizations. To that end, a review of the existing literature was performed and two studies designed to capture such phenomenon. Results were mixed.

Study one sought to answer the following research question: To what extent, if any, might groups higher in rigidity and commitment demonstrate higher levels of groupthink?

However, no significant findings were found, in part because conformity rates in this study were so high, there were no points of comparison. Study two conversely, sought to answer five research questions. However, results yielded very little empirical evidence for any of them with a single exception: When variables were taken as a whole (the relative presence or absence of a leader, the leader's biased or impartial position, and the presence or absence of decision making protocols), the amount of time before participants conformed was slowed. This finding was most pronounced in the biased leader conditions where protocols were available, suggesting that such guidelines may help prevent, or at least stave off conformity for a time.

While there were no statistically significant findings with regards to neurobiological correlates and conformity, some interesting patterns were noted. Specifically, changes in posttest conditions from the groupthink experiment in study two reveal marked changes in the pre-frontal cortex, including the medial frontal gyrus, as well as the anterior cingulate and the occipital-parietal network. These changes are consistent with the existing body of scientific literature. Interestingly, those correlates did not seem to be impacted by group assignment, in part because there were no truly leaderless groups and the position of the leader did not seem to impact the outcome.

Conformity seems to be a natural response for most people. As discussed it is a survival mechanism that allows people to live and work well in groups. To some extent, groupthink may help us preserve our traditions and values. However, as seen in certain US policy decisions and corporate scandals, too much groupthink can be the beginning of the end, or at least a long road that leads to consequences for not just the thinkers, but all that are impacted by those decisional ripples. Perhaps by learning to both honor appropriate conformity and appropriate challengers

(non-conformists) to the status, we can create healthier organizations and more effective leadership strategies.

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APPENDIX A

Request for Participation and Participant Instructions
Study 1

January 16, 2014

Dear Participant,

Thank you for considering participating in this study on the neurobiology of decision-making. In this study you will first be asked to complete a brief survey, which includes demographic items, as well as questions about cognition and beliefs. Then you will be given a short case study to read and discuss with a group of other participants. Following the discussion, you will be asked to render a written decision on an "exit survey" about the case you just read.

Should you decide that you wish to participate in this study, please visit the following link to complete informed consent materials, access the Participant Bill of Rights, and to sign-up for a time-slot to participate in the study based on your schedule.

Thank you in advance for your participation in this study.
Study Dates: 10/1/14 – 10/3/14

Study Link: http://www.surveymonkey.com/s/GDM1

APPENDIX B

Request for Participation and Participant Instructions
Study 2

January 16, 2014

Dear Participant,

Thank you for considering participating in this study on the neurobiology of decision-making. In this study your brain will be measured using electroencephalography (EEG). This is a safe and painless procedure administered by a licensed clinician trained in EEG.

A special EEG cap to make the process quicker and easier will be used. The cap will be placed on your head to measure the electrical activity along your scalp. A baseline EEG will be taken, and then you will be asked to participate in a group decision-making activity. Following the activity, another EEG will be taken to look for any changes in the brain's electrical activity. Your participation will take about 90 minutes.

Participant Requirements:
The following is a description of the requirements to participate in this study.

- Not taking any prescription medication
- No over the counter medication for 24 hours prior to the study
- No caffeine on the day of the study
- Please get a good night's rest the night before the study
- Eat a substantial (but not over-filling) meal 1 ½ to 2 hours before your appointment time
- Wash your hair with a basic shampoo (please avoid a conditioning shampoo such as a 2-in-1 formula) and do not condition your hair. Please also abstain from using hair products such as gel, hairspray, leave-in conditioner, wax, etc. as these will impede the electrical signals along the scalp. A free sample of clarifying shampoo is available to you by dropping by James 117.

Should you decide that you wish to participate in this study, please visit the following link to complete informed consent materials, access the Participant Bill of Rights, and to sign-up for a time-slot to participate in the study based on your schedule.

Thank you in advance for your participation in this study.
Study Dates: 10/8/14 – 10/17/14

Study Link: http://www.surveymonkey.com/s/GDM2

APPENDIX C

Consent Form (Study 1)

CONSENT TO ACT AS A HUMAN RESEARCH SUBJECT/PARTICIPANT
(Study 1)

Date: January 16, 2014
Principal Investigator: Angela Deulen, M.S. Doctoral Candidate in the Graduate School of Education and Psychology at Pepperdine University under the supervision of Dr. Kent Rhodes, Dissertation chair.

Research Project Title: The Neurobiology of Group Decision Making (Study 1)

1. By clicking "I do consent to participate at the bottom of this page, I agree to participate in the research study being conducted by Angela Deulen under the direction of Dr. Kent Rhodes.
2. **Study Purpose:** The purpose of this study is to examine the role cognition and belief play in a group decision-making activity.
3. **Procedures:** I understand that I will be asked to complete a brief survey then participate in a group activity where **I** will read a short case summary and then discuss it as a group. Afterward, **I** will make a decision about the case privately on a confidential form (exit survey).
4. My participation in the study will require approximately 30 minutes of my time. The study shall be conducted in Research Center in the School of Behavioral Sciences at California Baptist University.
5. **Benefits:** I understand that the possible benefits to participation in this study include the potential contribution to the body of literature by broadening our understanding of the role of cognition and belief in-group decision-making.
6. **Compensation:** No compensation for participation in this study will be offered.
7. **Potential Risks:** While I understand that there might be certain risks or discomforts associated with this study, **any risks associated with participation in this study are no *greater in and of themselves than those ordinarily encountered in daily life or during the performance of routine physical or psychological examinations or tests*. Any discomfort experienced would be consistent with the type encountered when working in groups of different people addressing fairly routine content. The risk of physical injury is very unlikely.**
8. Because the risk is minimal, I understand that that no recovery period will likely be needed.
9. I understand that I may choose not to participate in this research.
10. I understand that my participation is voluntary and that I may refuse to participate and/or withdraw my consent and discontinue participation in the project or activity at any time without penalty or loss of benefits to which I am otherwise entitled.

11. I understand that the investigator(s) will take all reasonable measures to protect the confidentiality of my records and my identity will not be revealed in any publication that may result from this project. The confidentiality of my records will be maintained in accordance with applicable state and federal laws. Under California law, there are exceptions to confidentiality, including suspicion that a child, elder, or dependent adult is being abused, or if an individual discloses an intent to harm him/herself or others. I understand there is a possibility that my medical record, including identifying information, may be inspected and/or photocopied by officials of the Food and Drug Administration or other federal or state government agencies during the ordinary course of carrying out their functions. If I participate in a sponsored research project, a representative of the sponsor may inspect my research records.
12. I understand that the investigator is willing to answer any inquiries I may have concerning the research herein described. I understand that I may contact Dr. Kent Rhodes, Dissertation Chair, if I have other questions or concerns about this research. If I have questions about my rights as a research participant, I understand that I can contact Dr. Thema Bryant-Davis, Chairperson of the Graduate and Professional Schools IRB, Pepperdine University.
13. I will be informed of any significant new findings developed during the course of my participation in this research, which may have a bearing on my willingness to continue in the study.
14. I understand that in the event of physical injury resulting from the research procedures in which I am to participate, no form of compensation is available. Medical treatment may be provided at my own expense or at the expense of my health care insurer, which may or may not provide coverage. If I have questions, I should contact my insurer.
15. I also understand to my satisfaction the information regarding participation in the research project. All my questions have been answered to my satisfaction. I have received a copy of this informed consent form, which I have read and understand. I hereby consent to participate in the research described above.

APPENDIX D

Consent Form (Study 2)

CONSENT TO ACT AS A HUMAN RESEARCH SUBJECT/PARTICIPANT
(Study 2)

Date: January 16, 2014
Principal Investigator: Angela Deulen, M.S. Doctoral Candidate in the Graduate School of Education and Psychology at Pepperdine University under the supervision of Dr. Kent Rhodes, Dissertation chair.

Research Project Title: The Neurobiology of Group Decision Making (Study 2)

1. By clicking "I do consent to participate at the bottom of this page, I agree to participate in the research study being conducted by Angela Deulen under the direction of Dr. Kent Rhodes.
2. **Study Purpose:** The purpose of this study is to examine the neurobiological changes that take place in the brain during a group decision-making activity as measured by quantitative electroencephalography (EEG) also known as brain mapping.
3. **Procedures:** I understand I will be asked to complete a brief demographic survey, then 20 minutes of baseline data will be taken on the electrical activity of the brain's cortex using quantitative EEG measures. I will then read a brief case study and participate in a group discussion on the reading. My cortical activity will then again be measured on the EEG.

   Participant Requirements:
   The following is a description of the requirements to participate in this study.

   - **Not taking any prescription medication**
   - **No over the counter medication for 24 hours prior to the study**
   - **No caffeine on the day of the study**
   - **Please get a good night's rest the night before the study**
   - **Eat a substantial (but not over-filling) meal 1 ½ to 2 hours before your appointment time**
   - **Wash hair with a basic shampoo (please avoid a conditioning shampoo such as a 2-in-1 formula) and do not condition hair. Please also abstain from using hair products such as gel, hairspray, leave-in conditioner, wax, etc. as these will impede the electrical signals along the scalp. A free sample of clarifying shampoo is available by dropping by James 117, if I choose.**

4. My participation in the study will require approximately 90 minutes of my time. The study shall be conducted in Research Center in the School of Behavioral Sciences at California Baptist University.
5. **Benefits:** I understand that the possible benefits to participation in this study include the potential contribution to the body of literature by broadening our understanding of the role of cognition and belief in-group decision-making.

6. **Compensation:** No compensation for participation in this study will be offered.
7. **Potential Risks:** While I understand that there might be certain risks or discomforts associated with this study, any risks associated with participation in this study are no more than one would encounter in everyday routine events. EEG is a non-invasive procedure routinely practiced and will be administered by a trained, licensed clinician. Risks associated with EEG recordings are minimal and are typically more of an inconvenience (e.g. slightly damp or **messed-up hair** following the procedure). **The risk of physical injury is very unlikely.**
8. Because the risk is minimal, I understand that that no recovery period will likely be needed. **I may choose to wash my hair** if it feels damp or sticky.
9. I understand that I may choose not to participate in this research.
10. I understand that my participation is voluntary and that I may refuse to participate and/or withdraw my consent and discontinue participation in the project or activity at any time without penalty or loss of benefits to which I am otherwise entitled.
11. I understand that the investigator(s) will take all reasonable measures to protect the confidentiality of my records and my identity will not be revealed in any publication that may result from this project. The confidentiality of my records will be maintained in accordance with applicable state and federal laws. Under California law, there are exceptions to confidentiality, including suspicion that a child, elder, or dependent adult is being abused, or if an individual discloses an intent to harm him/herself or others. I understand there is a possibility that my medical record, including identifying information, may be inspected and/or photocopied by officials of the Food and Drug Administration or other federal or state government agencies during the ordinary course of carrying out their functions. If I participate in a sponsored research project, a representative of the sponsor may inspect my research records.
12. I understand that the investigator is willing to answer any inquiries I may have concerning the research herein described. I understand that I may contact Dr. Kent Rhodes, Dissertation Chair, if I have other questions or concerns about this research. If I have questions about my rights as a research participant, I understand that I can contact Dr. Thema Bryant-Davis, Chairperson of the Graduate and Professional Schools IRB, Pepperdine University.
13. I will be informed of any significant new findings developed during the course of my participation in this research, which may have a bearing on my willingness to continue in the study.
14. I understand that in the event of physical injury resulting from the research procedures in which I am to participate, no form of compensation is available. Medical treatment may be provided at my own expense or at the expense of my health care insurer, which may or may not provide coverage. If I have questions, I should contact my insurer.
15. I also understand to my satisfaction the information regarding participation in the research project. All my questions have been answered to my satisfaction. I have received a copy of this informed consent form, which I have read and understand. I hereby consent to participate in the research described above.

APPENDIX E

Participant Bill of Rights

BILL OF RIGHTS for RESEARCH PARTICIPANTS

All persons asked to participate as a subject in a research project, before deciding whether or not to participate, have the right to:

1. Be informed about the nature and purpose of the research.
2. Be given an explanation of the procedures used in the research and, if appropriate, any drug or medical device utilized.
3. Be given a description of any attendant discomforts and risks reasonably expected from or during the research.
4. Be given an explanation of any benefits to subjects potentially resulting from research, if applicable.
5. Be given a disclosure of any appropriate alternative procedures, drugs, or devices that might be advantageous to subjects, and the potential related risks and benefits.
6. Be informed about medical or psychological treatment, if any, available to the subject if complications arise during or after the research.
7. Be given an opportunity to ask any questions concerning the research purposes and procedures.
8. Be told that consent to participate in the research may be withdrawn at any time and subjects may discontinue participation in the research without prejudice.
9. Be given a copy of any signed and dated written consent form related to the research.
10. Be given the opportunity to decide to consent or not consent to participate in the research without the any element of force, fraud, deceit, duress, coercion or undue influence on the decision.

I carefully read this Bill of Rights and fully understand my rights as a potential subject in a research project involving people as subjects.

APPENDIX F

Email Debriefing Participants

Dear research participants,

I want to thank you again for your participation in both of my studies on group decision-making. I know you most likely heard me debrief participants on the results of both studies when I came to your class. However, I wanted to take the opportunity to provide you with the results in writing.

To begin, this study did use a modicum of deception. You were originally told that you were participating in a study on group decision-making, and that is true. However, the variable that was specifically being studied is that of conformity. I apologize for this use of deception; it was important to keep the true variable hidden so as to not compromise the study. If any of you feel distressed by this, please feel free to contact me personally. I would be more than happy to speak to you about it.

I would also like to share the results of the studies. They are outlined below:

Study 1: I was looking to see if there was any relationship between cognitive rigidity and ideological commitment with regard to conformity. The data were not significant. Thirty-five subjects (mean age of 19.67, and 86% female) participated in this study with a conformity rate of 91.4%.

Study 2: I was looking to see how the brain responded in different group dynamics (with a designated leader or without, with decision-making protocol or without, and with a biased leader or an impartial one). No significant differences in the brain were found with regard to the groups. However, some patterns and trends in general were identified, in particularly related to the brain's frontal lobe and anterior cingulate found in the limbic system. Twenty-two participants took part in this study (average age of 19.32, and 91% female). The conformity rate was 95.5%.

I want to take this opportunity to remind participants that they have the right to ask for their data to be removed from the study. Further, again, if you would like to discuss any portion of the study with me, please feel free to contact me at any time.

Thank you again. This work would not have been possible without your contributions.

Kind regards,
Angela Deulen, LPCC, LMFT
Assistant Professor
School of the Behavioral Sciences

APPENDIX G

Participant Questionnaire

Instructions: Please indicate your responses below by checking the appropriate boxes or filling in the blanks.

Are you: □ Male □Female What is your age: _____

Please check your primary ethnicity:

□Asian

□Hispanic/Latino(a)

□Black/African American

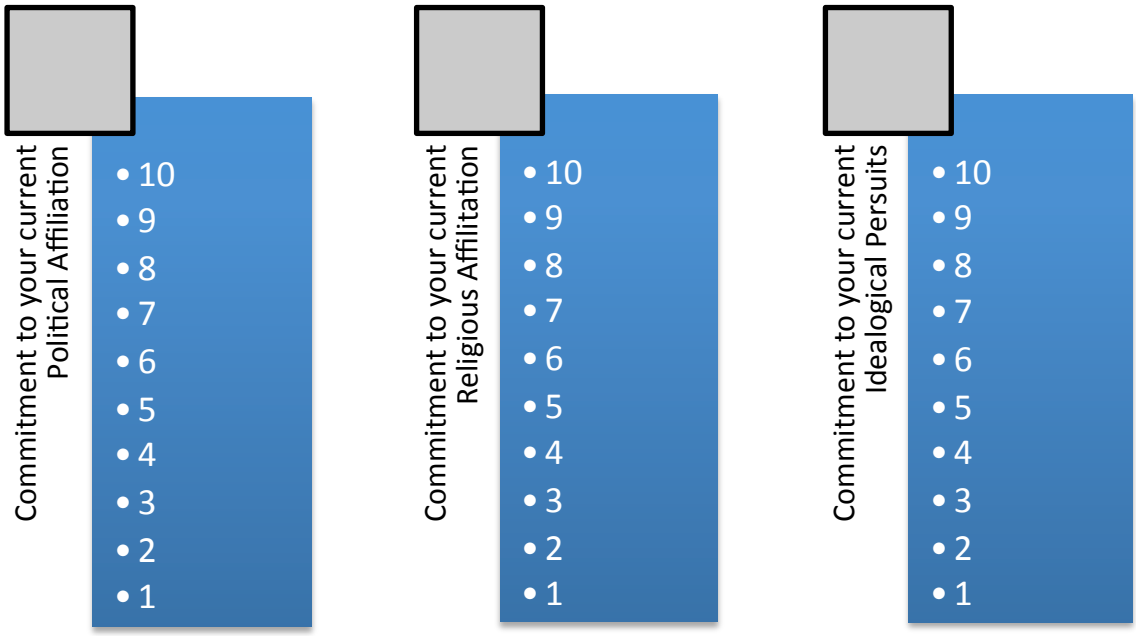
□Native American

□White/Caucasian

□Other: Please Specify: _____

Ideological Commitment Scale

Rate your level of commitment in each of the three areas below on a scale of 1 (being the lowest) to 10 (being the highest). Circle the number in each category that best represents your rated level of commitment.



APPENDIX H

20-Item Cognitive Flexibility Inventory (CFI)

Please use the scale below to indicate the extent to which you agree or disagree with the following statements.

Strongly Disagree	Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Agree	Strongly Agree
1	2	3	4	5	6	7

1. I am good at ‘‘sizing up’’ situations.
2. I have a hard time making decisions when faced with difficult situations.
3. I consider multiple options before making a decision.
4. When I encounter difficult situations, I feel like I am losing control.
5. I like to look at difficult situations from many different angles.
6. I seek additional information not immediately available before attributing causes to behavior.
7. When encountering difficult situations, I become so stressed that I cannot think of a way to resolve the situation.
8. I try to think about things from another person’s point of view.
9. I find it troublesome that there are so many different ways to deal with difficult situations.
10. I am good at putting myself in others’ shoes.
11. When I encounter difficult situations, I just don’t know what to do.
12. It is important to look at difficult situations from many angles.
13. When in difficult situations, I consider multiple options before deciding how to behave.
14. I often look at a situation from different viewpoints.
15. I am capable of overcoming the difficulties in life that I face.
16. I consider all the available facts and information when attributing causes to behavior.
17. I feel I have no power to change things in difficult situations.
18. When I encounter difficult situations, I stop and try to think of several ways to resolve it.
19. I can think of more than one way to resolve a difficult situation I’m confronted with.
20. I consider multiple options before responding to difficult situations.

APPENDIX I

Permission to use CFI

Confirmation Number: 11112913 Order Date: 08/05/2013

Customer Information
Customer: Angela Deulen **Account Number:** 3000683016 **Organization:** Angela Deulen **Email:** adeulen@calbaptist.edu
Payment Method: Invoice

Order Details
Cognitive therapy and research

Billing Status:
N/A

Order detail ID: 63878860
Article Title: The Cognitive Flexibility Inventory: Instrument Development and Estimates of Reliability and Validity
Author(s): Dennis, John P. ; Vander Wal, Jillon S.
DOI: 10.1007/S10608-009-9276-4
Date: Jan 01, 2010
ISSN: 0147-5916
Publication Type: Journal
Volume: 34
Issue: 3
Start page: 241
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APPENDIX J

Vignette

Please use read the following vignette and then discuss with the other participants in your group.

Chad is an international corporate executive. Because his area of expertise is economic practices in the Chinese marketplace, his American company has decided to transfer him (as well as his wife, Ling, and their 2 children) to Beijing to oversee the development of a new enterprise in that region. Chad understands that financials exchanges, what Americans typically refer to as bribes, are deeply woven into the fabric of business practices in China, so much so that to him, it is a cultural and historical norm.

Once in China, at the outset of the project, these financial exchanges are small by American standards (under $10,000.00 per transaction). However, Chad hits a roadblock toward the end of building completion; the local permitting office has indirectly demanded $750,000.00 to grant his final permit. Chad can pay the "bribe" and still come in under budget, but he needs to make a decision quickly as he is close to the deadline set by international trade agreements. Because the budget is derived in part from American tax dollars, Chad is struggling with this final decision.

What do you think Chad should do?

APPENDIX K

Exit Survey

Please answer the following question by circling your response.

What is your conclusion about this case; should Chad pay the bribe?

Yes **No**

Comments (optional):

APPENDIX L

Study Two Data Collection Worksheet

For Researcher Use:

Have you had any caffeine today? Yes No
Notes:

When was your last meal/food eaten?

Are you taking any medication? Yes No
Notes:

Have you ever had a seizure? Yes No
Notes:

Have you ever had a head injury or concussion? Yes No
Notes:

Measurement:
Circumference of Head: _____cm
Length from Naison to Inion: _____cm
Preauriculars (ear to ear) _____cm

Cap size: SM MED LG

Notes:

APPENDIX M

Decision Making Guidelines

Instructions: Please follow these steps in coming to a "verdict" on the case study you have been assigned.

Step 1: As a group, assign someone to play the "devil's advocate." This person will present opposing viewpoints to whatever idea has been presented for the purpose of generating broader thinking on the topic. The devil's advocate does not have to agree with his/her own statements, just advocate for the opposite viewpoint.

Step 2: Discuss the case study as a group as well as possible outcomes.

Step 3: Start to identify emerging patterns/tendencies. For example, someone might say "it sounds like many of us are leaning toward…"

Step 4: Identify those who disagree and give them an opportunity to discuss their reasons.

Step 5: Continue to discuss, assessing the support for each possible outcome. Repeat steps 2-4 as necessary.

Step 6: Finalize your decisions.

APPENDIX N

Reliability Tables for Test-Retest and Split-Half Reliability for

Artifact Free qEEG Data Selections

Participant ID 10 qEEG Record: Pretest Eyes Closed								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.96	0.91	Average	0.97	0.91	Average	0.97	0.91
FP1	0.99	0.99	FP1	0.99	0.97	FP1	1.0	0.91
FP2	0.97	1.0	FP2	0.94	0.99	FP2	0.97	0.92
F3	0.99	0.97	F3	0.99	0.99	F3	0.98	0.68
F4	0.98	0.92	F4	0.96	0.92	F4	0.96	0.96
C3	0.96	0.89	C3	0.98	0.9	C3	1.0	0.98
C4	0.95	0.88	C4	1.0	0.95	C4	0.99	0.99
P3	0.91	0.81	P3	0.9	0.82	P3	0.9	0.77
P4	0.97	0.85	P4	0.97	0.84	P4	0.99	0.88
O1	0.96	0.84	O1	0.98	0.87	O1	0.99	0.88
O2	0.96	0.83	O2	0.96	0.84	O2	0.92	0.84
F7	0.99	0.97	F7	0.97	0.95	F7	0.95	0.98
F8	0.96	0.96	F8	0.96	0.94	F8	0.95	0.97
T3	0.96	0.97	T3	1.0	0.98	T3	0.97	0.9
T4	0.94	0.93	T4	0.97	0.95	T4	0.98	1.0
T5	0.98	0.87	T5	1.0	0.88	T5	1.0	1.0
T6	0.97	0.91	T6	0.99	0.91	T6	0.95	0.98
Fz	1.0	0.9	Fz	1.0	0.87	Fz	1.0	0.94
Cz	0.94	0.87	Cz	0.96	0.89	Cz	0.98	0.93
Pz	0.94	0.84	Pz	0.96	0.84	Pz	0.98	0.87

Participant ID 10 qEEG Record: Pretest Eyes Open								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.98	0.97	Average	0.97	0.97	Average	0.98	0.97
FP1	0.94	0.9	FP1	0.95	0.91	FP1	0.97	0.93
FP2	0.98	0.92	FP2	0.98	0.92	FP2	0.96	0.93
F3	0.97	0.99	F3	0.98	0.99	F3	1.0	0.96
F4	0.98	0.97	F4	0.99	0.98	F4	0.98	1.0
C3	0.97	0.97	C3	0.98	0.96	C3	0.99	0.95
C4	0.98	0.95	C4	0.99	0.99	C4	0.99	0.99
P3	1.0	0.98	P3	0.99	0.98	P3	0.99	1.0
P4	0.95	0.94	P4	0.9	0.93	P4	0.94	0.96
O1	1.0	0.99	O1	0.99	0.98	O1	0.99	0.99
O2	0.97	0.98	O2	0.94	0.99	O2	0.94	1.0
F7	0.96	0.99	F7	0.99	0.99	F7	0.98	0.99
F8	0.99	0.98	F8	0.97	1.0	F8	0.99	0.99
T3	0.96	0.97	T3	0.98	0.93	T3	0.99	0.91
T4	0.99	0.99	T4	0.98	0.98	T4	0.99	0.95
T5	0.98	0.98	T5	0.97	0.95	T5	0.98	0.97
T6	0.98	1.0	T6	0.95	0.98	T6	0.99	0.95
Fz	0.99	0.96	Fz	0.99	1.0	Fz	0.98	0.98
Cz	0.98	0.95	Cz	0.99	0.98	Cz	1.0	0.97
Pz	0.98	0.98	Pz	0.98	1.0	Pz	1.0	0.96

Participant ID 10 qEEG Record: Pretest Serial Sevens								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.97	0.96	Average	0.97	0.94	Average	0.98	0.94
FP1	0.95	0.92	FP1	0.93	0.96	FP1	0.95	0.98
FP2	0.97	0.94	FP2	0.99	0.89	FP2	0.95	0.84
F3	1.0	0.94	F3	1.0	0.99	F3	1.0	0.98
F4	0.99	0.99	F4	0.99	0.94	F4	0.99	0.91
C3	0.98	0.99	C3	0.98	0.88	C3	0.98	0.87
C4	0.98	0.96	C4	0.96	0.93	C4	1.0	0.94
P3	0.96	0.99	P3	0.93	0.99	P3	0.98	0.92
P4	0.97	0.93	P4	0.95	0.96	P4	0.95	0.96
O1	0.97	0.96	O1	0.96	0.97	O1	0.97	0.99
O2	0.97	0.96	O2	0.98	0.99	O2	0.97	0.98
F7	0.95	0.99	F7	1.0	0.88	F7	0.99	0.93
F8	0.97	0.93	F8	0.96	0.92	F8	0.99	0.86
T3	0.96	0.95	T3	0.96	0.93	T3	0.98	0.97
T4	1.0	0.95	T4	0.97	0.98	T4	0.99	0.97
T5	0.98	0.97	T5	1.0	0.98	T5	0.97	0.96
T6	0.98	0.92	T6	0.98	0.93	T6	0.95	0.99
Fz	0.99	0.95	Fz	0.98	0.96	Fz	0.96	0.96
Cz	0.96	0.97	Cz	0.95	0.91	Cz	0.99	0.91
Pz	0.97	0.95	Pz	0.99	0.94	Pz	0.99	0.95

Participant ID 10 qEEG Record: Posttest Eyes Open								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.98	0.95	Average	0.97	0.93	Average	0.96	0.96
FP1	0.96	0.84	FP1	0.99	0.76	FP1	0.98	0.85
FP2	0.96	0.97	FP2	1.0	0.92	FP2	0.99	0.98
F3	0.98	1.0	F3	0.99	0.95	F3	0.95	0.99
F4	0.91	0.87	F4	0.89	0.89	F4	0.85	0.9
C3	0.97	0.92	C3	0.95	0.91	C3	0.92	0.97
C4	0.99	0.92	C4	0.97	0.95	C4	0.92	0.99
P3	0.97	0.98	P3	0.96	0.98	P3	0.99	1.0
P4	0.99	0.99	P4	0.99	0.92	P4	0.97	0.98
O1	0.98	0.96	O1	0.99	1.0	O1	0.98	0.97
O2	0.95	1.0	O2	0.99	0.99	O2	1.0	0.97
F7	0.98	0.89	F7	0.94	0.88	F7	0.95	0.99
F8	0.99	0.98	F8	0.91	0.93	F8	0.91	0.99
T3	1.0	0.94	T3	0.95	0.94	T3	0.98	0.97
T4	0.95	0.95	T4	0.99	0.98	T4	0.98	0.93
T5	1.0	0.97	T5	0.96	0.93	T5	0.93	0.96
T6	0.99	0.95	T6	0.99	0.92	T6	1.0	0.96
Fz	0.99	0.94	Fz	0.99	0.98	Fz	1.0	0.98
Cz	1.0	0.92	Cz	1.0	0.99	Cz	0.99	0.93
Pz	0.99	0.98	Pz	1.0	0.94	Pz	0.94	0.98

Participant ID 10 qEEG Record: Posttest Eyes Closed								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.97	0.91	Average	0.95	0.9	Average	0.94	0.94
FP1	0.94	0.8	FP1	0.98	0.78	FP1	0.9	0.99
FP2	0.98	0.8	FP2	0.99	0.78	FP2	0.95	0.96
F3	0.98	0.93	F3	0.93	0.92	F3	0.99	0.92
F4	0.99	0.96	F4	0.95	0.95	F4	0.97	0.98
C3	0.97	0.95	C3	0.87	0.94	C3	0.93	0.96
C4	0.95	0.98	C4	1.0	0.92	C4	0.94	0.99
P3	1.0	0.91	P3	0.93	0.93	P3	0.96	0.99
P4	0.95	0.91	P4	0.86	0.82	P4	0.9	0.91
O1	0.93	0.87	O1	0.96	0.91	O1	0.97	0.87
O2	0.92	0.88	O2	0.94	0.84	O2	0.99	0.86
F7	1.0	0.89	F7	0.99	0.88	F7	0.94	0.95
F8	0.95	0.97	F8	0.98	0.94	F8	0.94	0.93
T3	0.95	0.89	T3	0.94	0.99	T3	0.92	0.97
T4	0.98	0.94	T4	0.97	0.91	T4	0.95	0.91
T5	0.99	0.96	T5	0.97	0.99	T5	0.93	0.94
T6	0.94	0.89	T6	0.98	0.82	T6	0.95	0.95
Fz	0.98	0.93	Fz	0.89	0.91	Fz	0.92	0.95
Cz	0.95	0.99	Cz	0.98	0.95	Cz	0.91	0.95
Pz	0.99	0.91	Pz	0.92	0.86	Pz	0.92	0.9

Participant ID 11 qEEG Record: Pretest Eyes Closed								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.91	0.85	Average	0.87	0.82	Average	0.9	0.75
FP1	0.81	0.66	FP1	0.92	0.62	FP1	0.87	0.63
FP2	0.91	0.69	FP2	0.91	0.75	FP2	0.94	0.73
F3	0.96	0.98	F3	0.88	0.99	F3	0.97	0.92
F4	0.92	0.79	F4	0.89	0.76	F4	0.91	0.65
C3	0.9	0.55	C3	0.8	0.42	C3	0.8	0.38
C4	0.99	0.52	C4	0.9	0.46	C4	0.81	0.39
P3	0.9	0.92	P3	0.87	0.83	P3	0.91	0.84
P4	0.88	0.95	P4	0.86	0.92	P4	0.87	0.71
O1	0.98	0.96	O1	0.96	0.88	O1	0.98	0.84
O2	0.99	1.0	O2	0.96	0.91	O2	0.86	0.79
F7	0.96	1.0	F7	0.81	0.8	F7	0.82	0.97
F8	0.98	0.99	F8	0.86	0.82	F8	0.92	0.77
T3	0.93	0.86	T3	0.82	0.95	T3	0.94	0.83
T4	0.92	0.85	T4	0.94	0.97	T4	0.98	0.84
T5	0.82	0.95	T5	0.65	0.97	T5	0.77	0.81
T6	0.77	0.79	T6	0.86	0.95	T6	1.0	0.98
Fz	0.91	0.87	Fz	0.93	0.8	Fz	0.96	0.84
Cz	0.88	0.92	Cz	0.94	0.87	Cz	0.79	0.45
Pz	0.86	0.99	Pz	0.83	0.99	Pz	0.98	0.94

Participant ID 11 qEEG Record: Pretest Eyes Open								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.96	0.93	Average	0.97	0.93	Average	0.96	0.93
FP1	0.94	0.91	FP1	0.93	0.97	FP1	0.97	0.98
FP2	0.96	0.89	FP2	0.99	0.99	FP2	0.94	0.97
F3	0.94	0.85	F3	0.96	0.87	F3	0.98	0.95
F4	0.93	0.86	F4	0.97	0.91	F4	0.93	0.88
C3	0.93	0.88	C3	0.94	0.84	C3	0.93	0.89
C4	0.9	0.88	C4	0.9	0.87	C4	0.9	0.9
P3	0.99	0.99	P3	0.99	0.98	P3	0.95	0.94
P4	0.96	0.99	P4	0.96	0.92	P4	0.98	0.94
O1	0.99	0.9	O1	1.0	0.83	O1	0.98	0.89
O2	1.0	0.9	O2	1.0	0.84	O2	0.97	0.91
F7	0.99	0.92	F7	0.97	0.98	F7	1.0	1.0
F8	0.99	0.9	F8	0.97	0.97	F8	0.99	0.96
T3	0.93	1.0	T3	0.95	0.96	T3	0.93	0.94
T4	0.95	0.99	T4	1.0	0.97	T4	0.99	0.93
T5	0.95	1.0	T5	0.97	0.97	T5	0.96	1.0
T6	0.94	0.89	T6	1.0	0.82	T6	0.98	0.84
Fz	0.96	0.92	Fz	0.99	0.94	Fz	1.0	0.96
Cz	0.96	0.96	Cz	0.93	0.96	Cz	0.9	0.95
Pz	0.97	0.98	Pz	0.94	0.99	Pz	1.0	0.91

Participant ID 11 qEEG Record: Pretest Serial Sevens								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.92	0.94	Average	0.9	0.92	Average	0.88	0.92
FP1	1.0	0.93	FP1	0.93	0.9	FP1	0.94	0.95
FP2	0.94	0.94	FP2	0.89	0.9	FP2	0.93	0.99
F3	0.98	0.95	F3	0.97	0.86	F3	0.96	0.87
F4	0.92	0.96	F4	0.9	0.85	F4	0.88	0.92
C3	0.68	0.87	C3	0.64	0.84	C3	0.64	0.83
C4	0.62	0.88	C4	0.63	0.82	C4	0.62	0.82
P3	0.96	0.83	P3	0.99	0.86	P3	0.92	0.86
P4	0.95	0.95	P4	0.99	0.97	P4	0.85	0.99
O1	0.95	0.99	O1	0.92	0.95	O1	0.88	0.99
O2	0.98	0.96	O2	0.97	0.98	O2	0.93	0.95
F7	0.87	0.89	F7	0.96	1.0	F7	0.97	0.96
F8	0.94	0.92	F8	0.94	0.9	F8	0.95	0.89
T3	0.98	0.89	T3	0.92	0.95	T3	0.95	0.96
T4	0.99	0.94	T4	0.99	0.97	T4	0.97	0.94
T5	0.98	0.96	T5	0.93	0.93	T5	0.98	0.94
T6	0.88	1.0	T6	0.87	0.95	T6	0.92	0.89
Fz	0.97	1.0	Fz	0.95	0.9	Fz	0.94	0.92
Cz	0.95	0.97	Cz	0.92	0.96	Cz	0.71	0.78
Pz	0.89	0.95	Pz	0.87	0.98	Pz	0.87	0.99

Participant ID 11 qEEG Record: Posttest Eyes Open								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.93	0.9	Average	0.96	0.88	Average	0.93	0.89
FP1	0.91	0.85	FP1	0.97	0.84	FP1	0.98	1.0
FP2	0.89	0.79	FP2	0.91	0.8	FP2	0.9	0.89
F3	0.92	0.88	F3	0.99	0.94	F3	0.92	0.97
F4	0.96	0.97	F4	1.0	0.91	F4	0.97	0.85
C3	0.95	0.84	C3	0.95	0.81	C3	0.95	0.81
C4	0.89	0.84	C4	0.92	0.82	C4	0.91	0.77
P3	0.89	0.94	P3	0.98	0.97	P3	0.92	0.98
P4	0.94	0.91	P4	0.94	0.83	P4	0.96	0.89
O1	0.93	1.0	O1	0.97	0.98	O1	0.96	0.98
O2	0.92	0.89	O2	0.97	0.91	O2	0.99	1.0
F7	0.98	0.92	F7	0.98	0.9	F7	0.92	0.97
F8	0.99	0.97	F8	0.9	0.92	F8	0.85	0.8
T3	0.93	0.82	T3	0.99	0.73	T3	0.81	0.69
T4	0.95	0.94	T4	0.94	0.87	T4	0.98	0.9
T5	0.94	0.98	T5	0.95	0.95	T5	0.9	0.85
T6	0.98	0.94	T6	0.94	0.91	T6	0.98	0.95
Fz	0.94	0.85	Fz	1.0	0.9	Fz	0.97	0.94
Cz	0.9	0.86	Cz	0.96	0.85	Cz	0.89	0.82
Pz	0.9	0.92	Pz	1.0	0.89	Pz	0.93	0.91

Participant ID 11 qEEG Record: Posttest Eyes Closed								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.93	0.9	Average	0.96	0.88	Average	0.93	0.89
FP1	0.91	0.85	FP1	0.97	0.84	FP1	0.98	1.0
FP2	0.89	0.79	FP2	0.91	0.8	FP2	0.9	0.89
F3	0.92	0.88	F3	0.99	0.94	F3	0.92	0.97
F4	0.96	0.97	F4	1.0	0.91	F4	0.97	0.85
C3	0.95	0.84	C3	0.95	0.81	C3	0.95	0.81
C4	0.89	0.84	C4	0.92	0.82	C4	0.91	0.77
P3	0.89	0.94	P3	0.98	0.97	P3	0.92	0.98
P4	0.94	0.91	P4	0.94	0.83	P4	0.96	0.89
O1	0.93	1.0	O1	0.97	0.98	O1	0.96	0.98
O2	0.92	0.89	O2	0.97	0.91	O2	0.99	1.0
F7	0.98	0.92	F7	0.98	0.9	F7	0.92	0.97
F8	0.99	0.97	F8	0.9	0.92	F8	0.85	0.8
T3	0.93	0.82	T3	0.99	0.73	T3	0.81	0.69
T4	0.95	0.94	T4	0.94	0.87	T4	0.98	0.9
T5	0.94	0.98	T5	0.95	0.95	T5	0.9	0.85
T6	0.98	0.94	T6	0.94	0.91	T6	0.98	0.95
Fz	0.94	0.85	Fz	1.0	0.9	Fz	0.97	0.94
Cz	0.9	0.86	Cz	0.96	0.85	Cz	0.89	0.82
Pz	0.9	0.92	Pz	1.0	0.89	Pz	0.93	0.91

Participant ID 13 qEEG Record: Pretest Eyes Closed								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.97	0.97	Average	0.97	0.96	Average	0.97	0.97
FP1	0.93	0.98	FP1	0.93	0.98	FP1	0.99	0.98
FP2	0.95	0.92	FP2	0.95	0.92	FP2	0.99	0.96
F3	0.99	0.94	F3	0.99	0.94	F3	0.93	0.97
F4	0.99	0.97	F4	0.99	0.97	F4	0.98	0.91
C3	0.96	0.96	C3	0.96	0.96	C3	0.97	1.0
C4	0.98	0.97	C4	0.98	0.97	C4	0.99	0.98
P3	0.98	0.98	P3	0.98	0.98	P3	0.96	0.97
P4	0.99	0.93	P4	0.99	0.93	P4	1.0	0.97
O1	0.97	0.98	O1	0.97	0.98	O1	0.99	0.97
O2	0.98	0.95	O2	0.98	0.95	O2	0.94	0.95
F7	0.93	0.97	F7	0.93	0.97	F7	0.96	0.99
F8	0.99	0.95	F8	0.99	0.95	F8	0.92	0.97
T3	0.96	1.0	T3	0.96	1.0	T3	0.99	0.95
T4	0.99	1.0	T4	0.99	1.0	T4	0.99	0.98
T5	0.99	0.99	T5	0.99	0.99	T5	0.97	0.97
T6	0.98	0.98	T6	0.98	0.98	T6	0.97	0.97
Fz	0.97	0.98	Fz	0.97	0.98	Fz	0.97	0.97
Cz	0.98	0.94	Cz	0.98	0.94	Cz	0.95	0.97
Pz	0.96	0.93	Pz	0.96	0.93	Pz	0.96	1.0

Participant ID 13 qEEG Record: Pretest Eyes Open								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.97	0.97	Average	0.97	0.96	Average	0.98	0.96
FP1	0.92	1.0	FP1	0.95	0.98	FP1	0.99	0.99
FP2	0.91	1.0	FP2	0.97	0.98	FP2	0.96	1.0
F3	0.98	0.94	F3	0.99	0.94	F3	0.9	0.94
F4	0.98	0.96	F4	0.98	0.91	F4	0.98	0.93
C3	1.0	0.98	C3	0.98	0.99	C3	0.98	0.97
C4	0.97	0.98	C4	0.97	0.99	C4	1.0	0.95
P3	0.99	0.98	P3	0.98	0.96	P3	0.99	0.99
P4	0.99	0.98	P4	1.0	0.99	P4	0.99	0.95
O1	0.99	0.97	O1	0.99	0.93	O1	1.0	0.96
O2	0.99	0.98	O2	0.99	0.98	O2	0.96	0.99
F7	0.95	1.0	F7	0.95	0.94	F7	0.99	0.96
F8	0.95	0.94	F8	0.98	0.97	F8	0.97	0.96
T3	0.99	0.99	T3	0.96	0.95	T3	0.99	0.98
T4	0.99	0.96	T4	0.93	0.95	T4	0.97	0.94
T5	0.99	0.97	T5	0.97	0.95	T5	0.98	0.96
T6	0.94	0.91	T6	0.99	0.97	T6	0.98	0.97
Fz	0.98	0.95	Fz	0.99	0.95	Fz	0.96	0.95
Cz	0.99	0.95	Cz	0.96	0.95	Cz	0.99	0.94
Pz	0.94	0.99	Pz	0.93	0.98	Pz	0.97	0.95

Participant ID 13 qEEG Record: Pretest Serial Sevens								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.98	0.96	Average	0.96	0.92	Average	0.96	0.93
FP1	0.99	0.99	FP1	0.97	0.98	FP1	0.97	0.9
FP2	0.96	1.0	FP2	1.0	0.87	FP2	0.96	0.91
F3	0.9	0.94	F3	0.94	0.83	F3	0.94	0.84
F4	0.98	0.93	F4	0.97	0.9	F4	0.89	1.0
C3	0.98	0.97	C3	0.99	0.92	C3	0.97	0.91
C4	1.0	0.95	C4	0.95	0.94	C4	0.97	0.99
P3	0.99	0.99	P3	0.96	0.96	P3	0.98	1.0
P4	0.99	0.95	P4	0.99	0.94	P4	1.0	0.98
O1	1.0	0.96	O1	0.95	0.91	O1	0.92	0.92
O2	0.96	0.99	O2	0.9	0.97	O2	0.9	0.98
F7	0.99	0.96	F7	0.88	0.99	F7	0.99	0.83
F8	0.97	0.96	F8	0.9	0.72	F8	0.89	0.91
T3	0.99	0.98	T3	0.97	0.94	T3	0.99	0.9
T4	0.97	0.94	T4	0.92	0.96	T4	0.99	0.88
T5	0.98	0.96	T5	0.97	0.95	T5	0.99	0.93
T6	0.98	0.97	T6	0.99	0.95	T6	0.96	0.87
Fz	0.96	0.95	Fz	0.99	0.93	Fz	0.99	0.95
Cz	0.99	0.94	Cz	0.94	0.96	Cz	0.98	0.96
Pz	0.97	0.95	Pz	0.98	0.91	Pz	1.0	0.99

Participant ID 13 qEEG Record: Posttest Eyes Open								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.97	0.94	Average	0.96	0.95	Average	0.96	0.94
FP1	0.99	0.97	FP1	0.99	0.97	FP1	0.93	1.0
FP2	0.96	0.94	FP2	0.96	0.95	FP2	0.99	0.98
F3	0.97	0.88	F3	0.93	0.96	F3	0.99	0.94
F4	0.99	0.96	F4	0.98	0.98	F4	0.97	0.98
C3	0.96	0.87	C3	0.94	0.86	C3	0.93	0.96
C4	0.96	0.98	C4	0.96	0.91	C4	0.97	0.9
P3	0.98	0.94	P3	0.97	0.95	P3	0.98	0.96
P4	0.99	0.99	P4	0.95	0.93	P4	1.0	0.98
O1	0.98	0.96	O1	0.99	0.99	O1	0.93	0.97
O2	0.97	0.99	O2	0.95	0.99	O2	0.98	0.98
F7	0.97	1.0	F7	0.99	0.99	F7	0.96	0.91
F8	0.94	0.98	F8	1.0	0.99	F8	0.94	0.91
T3	0.94	0.9	T3	0.96	0.99	T3	0.92	0.93
T4	0.98	0.91	T4	0.94	0.96	T4	0.9	0.87
T5	0.92	0.82	T5	0.89	0.82	T5	0.9	0.79
T6	0.92	1.0	T6	0.9	0.97	T6	0.91	0.95
Fz	0.99	0.9	Fz	0.94	0.92	Fz	0.97	0.97
Cz	0.98	0.94	Cz	0.98	0.93	Cz	0.99	0.95
Pz	0.99	0.98	Pz	1.0	0.98	Pz	1.0	0.99

Participant ID 13 qEEG Record: Posttest Eyes Closed								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.97	0.92	Average	0.96	0.94	Average	0.96	0.91
FP1	0.98	0.95	FP1	1.0	0.99	FP1	0.91	1.0
FP2	0.99	0.83	FP2	0.95	0.84	FP2	0.96	0.82
F3	0.99	0.9	F3	0.99	0.95	F3	0.96	0.88
F4	0.94	0.91	F4	0.99	0.93	F4	0.99	0.86
C3	0.99	0.89	C3	0.94	0.92	C3	0.97	0.97
C4	0.96	0.88	C4	0.98	1.0	C4	0.99	0.9
P3	0.97	0.92	P3	0.94	0.99	P3	0.97	0.91
P4	0.97	0.92	P4	0.92	0.97	P4	0.97	0.93
O1	0.96	0.94	O1	0.96	0.92	O1	0.99	0.95
O2	0.99	0.82	O2	0.92	0.83	O2	0.99	0.84
F7	0.95	0.97	F7	0.99	0.94	F7	0.9	0.84
F8	0.98	0.97	F8	0.98	0.97	F8	0.95	0.91
T3	0.92	0.97	T3	0.97	0.98	T3	0.98	0.98
T4	0.95	0.92	T4	0.88	0.97	T4	0.79	0.9
T5	0.95	0.93	T5	0.99	0.99	T5	0.99	0.94
T6	0.99	0.88	T6	0.91	0.99	T6	0.99	0.91
Fz	0.99	0.91	Fz	0.97	0.99	Fz	0.94	0.96
Cz	0.98	0.9	Cz	0.98	0.93	Cz	0.97	0.9
Pz	0.98	1.0	Pz	0.98	0.86	Pz	0.93	0.94

Participant ID 14 qEEG Record: Pretest Eyes Closed								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.96	0.94	Average	0.92	0.89	Average	0.92	0.9
FP1	0.93	0.97	FP1	0.89	0.88	FP1	0.89	0.81
FP2	0.89	0.83	FP2	0.83	0.73	FP2	0.89	0.96
F3	0.99	0.96	F3	0.99	0.91	F3	0.59	0.56
F4	0.94	0.97	F4	0.91	0.95	F4	0.95	0.93
C3	0.98	0.88	C3	0.97	0.73	C3	0.92	0.92
C4	1.0	0.99	C4	1.0	0.96	C4	0.95	0.89
P3	0.87	0.86	P3	0.82	0.85	P3	0.95	0.91
P4	0.99	0.99	P4	1.0	0.97	P4	0.99	0.91
O1	0.96	1.0	O1	0.93	0.96	O1	1.0	0.98
O2	0.97	0.96	O2	0.93	0.85	O2	0.95	1.0
F7	0.99	0.93	F7	0.92	0.87	F7	0.78	0.94
F8	0.98	0.93	F8	0.96	0.9	F8	1.0	0.79
T3	0.97	0.92	T3	0.92	0.93	T3	0.96	0.92
T4	0.97	0.99	T4	0.94	0.93	T4	0.97	0.9
T5	0.99	0.98	T5	1.0	0.96	T5	0.97	0.93
T6	0.97	0.93	T6	0.84	0.89	T6	0.94	0.99
Fz	0.94	0.95	Fz	0.94	0.87	Fz	1.0	0.87
Cz	0.91	0.97	Cz	0.85	0.95	Cz	0.92	0.98
Pz	0.91	0.89	Pz	0.85	0.83	Pz	0.91	0.84

Participant ID 14 qEEG Record: Pretest Eyes Open								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.96	0.98	Average	0.95	0.95	Average	0.95	0.94
FP1	0.96	0.96	FP1	0.95	0.9	FP1	0.94	0.93
FP2	0.91	0.99	FP2	0.93	0.99	FP2	0.97	0.97
F3	1.0	0.96	F3	0.88	0.91	F3	0.89	0.88
F4	0.93	0.97	F4	0.94	0.95	F4	0.98	0.93
C3	0.96	0.99	C3	0.97	0.99	C3	0.98	0.99
C4	0.99	1.0	C4	0.9	0.97	C4	1.0	0.92
P3	0.96	1.0	P3	0.92	0.99	P3	1.0	0.95
P4	0.96	0.97	P4	0.96	0.93	P4	0.93	1.0
O1	0.99	0.96	O1	0.99	0.97	O1	0.94	0.94
O2	0.98	1.0	O2	0.94	0.93	O2	0.9	0.85
F7	0.97	0.97	F7	0.99	0.87	F7	0.98	0.85
F8	0.93	0.98	F8	0.96	0.97	F8	0.93	0.96
T3	0.96	1.0	T3	0.97	0.92	T3	0.98	0.89
T4	0.96	0.98	T4	1.0	0.95	T4	0.99	0.98
T5	0.99	0.99	T5	0.94	0.94	T5	0.95	0.96
T6	0.96	0.96	T6	1.0	0.96	T6	0.91	0.94
Fz	0.95	0.99	Fz	0.96	0.97	Fz	0.96	0.97
Cz	0.97	0.99	Cz	0.97	1.0	Cz	0.96	0.96
Pz	0.97	0.96	Pz	0.92	0.99	Pz	0.93	0.91

Participant ID 14 qEEG Record: Pretest Serial Sevens								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.96	0.97	Average	0.95	0.95	Average	0.96	0.93
FP1	0.89	0.97	FP1	0.94	0.99	FP1	1.0	0.97
FP2	0.91	0.98	FP2	0.92	0.94	FP2	0.98	0.92
F3	1.0	0.99	F3	0.99	0.9	F3	0.96	0.9
F4	1.0	0.94	F4	0.98	0.93	F4	0.99	0.99
C3	0.97	0.98	C3	0.91	0.95	C3	0.97	0.93
C4	0.96	0.98	C4	0.99	0.97	C4	0.94	0.99
P3	0.97	0.96	P3	1.0	0.87	P3	0.96	0.91
P4	1.0	0.99	P4	0.99	0.98	P4	0.98	0.92
O1	0.96	0.97	O1	0.91	0.83	O1	0.93	0.64
O2	0.97	0.94	O2	0.97	0.98	O2	0.97	0.95
F7	0.94	0.95	F7	0.91	0.99	F7	0.86	0.94
F8	0.94	0.95	F8	0.9	1.0	F8	0.95	0.94
T3	0.98	0.99	T3	0.99	1.0	T3	0.98	0.92
T4	0.96	0.99	T4	0.93	0.94	T4	0.99	0.98
T5	0.99	0.94	T5	0.98	0.91	T5	0.98	0.93
T6	0.95	0.98	T6	0.94	0.94	T6	0.92	0.98
Fz	0.98	0.95	Fz	0.99	0.95	Fz	0.99	0.92
Cz	0.97	0.98	Cz	0.95	0.99	Cz	0.95	1.0
Pz	0.95	0.98	Pz	0.94	0.99	Pz	0.87	0.95

Participant ID 14 qEEG Record: Posttest Eyes Open								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.96	0.91	Average	0.94	0.91	Average	0.96	0.91
FP1	0.92	0.9	FP1	0.92	0.93	FP1	0.99	0.95
FP2	0.95	0.93	FP2	0.98	0.95	FP2	0.99	0.85
F3	0.98	0.86	F3	0.95	0.82	F3	0.96	0.91
F4	0.99	0.93	F4	0.96	0.98	F4	0.97	0.99
C3	1.0	0.84	C3	0.97	0.73	C3	0.99	0.87
C4	0.93	0.9	C4	0.83	0.85	C4	0.92	0.84
P3	0.94	0.98	P3	0.95	0.96	P3	0.95	0.98
P4	0.89	0.99	P4	0.9	0.97	P4	1.0	0.96
O1	0.98	0.9	O1	0.94	0.95	O1	0.99	0.91
O2	0.94	0.86	O2	0.97	0.84	O2	0.98	0.84
F7	0.97	0.84	F7	0.99	0.96	F7	0.95	0.97
F8	1.0	0.92	F8	0.86	0.97	F8	0.92	0.94
T3	1.0	0.88	T3	0.92	1.0	T3	0.93	0.96
T4	0.98	0.88	T4	0.93	0.93	T4	0.93	0.82
T5	0.99	0.91	T5	1.0	0.83	T5	0.91	0.96
T6	0.92	0.93	T6	0.9	0.78	T6	0.93	0.76
Fz	0.98	0.9	Fz	0.99	0.93	Fz	0.98	0.95
Cz	0.98	0.92	Cz	0.87	0.98	Cz	0.88	0.93
Pz	0.97	0.99	Pz	0.97	0.91	Pz	0.97	0.92

Participant ID 14 qEEG Record: Posttest Eyes Closed								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.96	0.91	Average	0.93	0.85	Average	0.92	0.9
FP1	0.96	0.88	FP1	0.97	0.82	FP1	0.89	0.81
FP2	0.94	0.92	FP2	0.96	0.93	FP2	0.89	0.96
F3	0.88	0.82	F3	0.74	0.72	F3	0.59	0.56
F4	0.95	0.87	F4	0.99	0.8	F4	0.95	0.93
C3	0.98	0.82	C3	0.84	0.77	C3	0.92	0.92
C4	0.97	0.88	C4	0.97	0.84	C4	0.95	0.89
P3	0.95	0.87	P3	0.96	0.85	P3	0.95	0.91
P4	0.98	0.97	P4	0.89	0.89	P4	0.99	0.91
O1	0.98	0.96	O1	0.96	0.83	O1	1.0	0.98
O2	0.96	0.97	O2	0.94	0.8	O2	0.95	1.0
F7	0.96	0.94	F7	0.92	0.91	F7	0.78	0.94
F8	0.98	0.81	F8	0.92	0.68	F8	1.0	0.79
T3	0.98	0.89	T3	0.96	0.97	T3	0.96	0.92
T4	1.0	0.89	T4	0.92	0.81	T4	0.97	0.9
T5	0.96	0.95	T5	0.98	0.89	T5	0.97	0.93
T6	0.98	1.0	T6	0.91	0.86	T6	0.94	0.99
Fz	0.97	0.92	Fz	1.0	0.92	Fz	1.0	0.87
Cz	0.97	0.86	Cz	0.95	0.86	Cz	0.92	0.98
Pz	0.93	0.98	Pz	0.93	0.96	Pz	0.91	0.84

Participant ID 15 qEEG Record: Pretest Eyes Closed								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.96	0.91	Average	0.96	0.9	Average	0.95	0.78
FP1	0.93	0.89	FP1	0.96	0.87	FP1	0.99	0.61
FP2	0.98	0.93	FP2	1.0	0.79	FP2	0.97	0.41
F3	0.97	0.86	F3	0.99	0.84	F3	0.99	0.94
F4	0.97	0.96	F4	0.97	0.92	F4	0.93	0.7
C3	0.98	0.99	C3	0.99	0.97	C3	0.95	0.99
C4	0.91	0.96	C4	0.86	0.93	C4	0.87	0.52
P3	0.99	0.98	P3	0.99	0.96	P3	1.0	0.89
P4	0.98	0.64	P4	0.98	0.73	P4	0.99	0.61
O1	0.97	0.91	O1	0.99	0.87	O1	0.92	0.82
O2	0.98	0.85	O2	0.98	0.84	O2	0.98	0.83
F7	0.97	0.89	F7	0.95	0.95	F7	0.95	0.86
F8	0.97	0.82	F8	0.97	0.85	F8	0.97	0.49
T3	0.98	0.87	T3	0.98	0.96	T3	0.97	0.86
T4	1.0	0.96	T4	0.91	0.88	T4	0.85	0.77
T5	0.96	0.96	T5	0.92	0.96	T5	0.97	0.87
T6	0.95	0.92	T6	0.99	0.95	T6	0.92	0.99
Fz	0.96	0.88	Fz	0.98	0.84	Fz	0.97	0.88
Cz	0.94	0.98	Cz	0.91	0.95	Cz	0.94	0.92
Pz	0.92	0.96	Pz	0.9	0.99	Pz	0.95	0.79

Participant ID 15 qEEG Record: Pretest Eyes Open								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.98	0.94	Average	0.97	0.92	Average	0.97	0.89
FP1	0.99	0.96	FP1	0.95	0.93	FP1	0.94	0.91
FP2	0.98	0.98	FP2	0.95	0.93	FP2	0.93	0.98
F3	0.98	0.99	F3	0.99	0.96	F3	0.95	0.95
F4	0.99	0.94	F4	0.98	0.91	F4	0.98	0.91
C3	0.97	1.0	C3	0.96	0.93	C3	0.97	0.93
C4	0.98	0.96	C4	0.95	0.96	C4	0.97	0.78
P3	0.99	0.91	P3	0.96	0.9	P3	0.93	0.96
P4	0.98	0.92	P4	0.98	0.77	P4	0.99	0.45
O1	0.99	0.9	O1	0.98	0.91	O1	1.0	0.92
O2	0.99	0.92	O2	0.99	0.94	O2	0.99	0.98
F7	0.99	0.99	F7	0.95	0.97	F7	0.93	0.98
F8	0.99	0.93	F8	0.98	0.95	F8	0.97	0.93
T3	0.95	0.94	T3	0.98	0.95	T3	0.97	0.91
T4	0.98	0.84	T4	0.95	0.87	T4	0.95	0.85
T5	0.99	0.9	T5	0.97	0.91	T5	0.97	0.85
T6	1.0	0.89	T6	0.99	0.95	T6	0.98	0.95
Fz	1.0	1.0	Fz	0.97	0.98	Fz	0.98	0.94
Cz	0.98	1.0	Cz	0.95	0.98	Cz	0.96	0.98
Pz	0.99	0.91	Pz	0.98	0.88	Pz	0.99	0.69

Participant ID 15 qEEG Record: Pretest Serial Sevens								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.95	0.91	Average	0.92	0.93	Average	0.92	0.92
FP1	0.93	0.97	FP1	0.92	0.98	FP1	0.88	0.95
FP2	0.99	0.97	FP2	0.94	0.99	FP2	0.94	0.9
F3	0.99	0.91	F3	0.99	0.97	F3	0.88	0.94
F4	1.0	0.96	F4	0.93	0.99	F4	0.98	0.9
C3	0.94	0.79	C3	0.98	0.9	C3	1.0	0.96
C4	0.93	0.89	C4	0.85	0.93	C4	0.88	0.94
P3	1.0	0.88	P3	0.97	0.88	P3	0.96	0.96
P4	0.92	0.96	P4	0.91	0.99	P4	0.95	0.93
O1	0.91	0.94	O1	0.89	0.84	O1	0.93	0.9
O2	0.95	0.95	O2	0.97	0.97	O2	0.87	0.98
F7	0.98	1.0	F7	0.85	0.94	F7	0.8	0.98
F8	0.98	0.69	F8	0.94	0.7	F8	0.99	0.79
T3	0.91	0.96	T3	0.84	0.99	T3	0.81	0.92
T4	0.93	0.88	T4	0.95	0.91	T4	0.94	0.88
T5	0.97	0.97	T5	0.94	0.9	T5	0.97	0.88
T6	0.77	0.8	T6	0.76	0.99	T6	0.89	0.97
Fz	0.98	0.9	Fz	0.95	0.97	Fz	1.0	0.97
Cz	0.99	0.85	Cz	0.98	0.87	Cz	0.97	0.88
Pz	0.93	0.95	Pz	0.92	0.97	Pz	0.92	0.9

Participant ID 15 qEEG Record: Posttest Eyes Open								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.95	0.92	Average	0.95	0.91	Average	0.95	0.92
FP1	0.98	0.77	FP1	1.0	0.8	FP1	0.98	0.86
FP2	0.89	0.8	FP2	0.94	0.93	FP2	0.94	0.89
F3	0.99	0.98	F3	0.93	0.91	F3	1.0	0.89
F4	0.9	0.99	F4	0.89	0.92	F4	0.95	1.0
C3	0.99	0.94	C3	0.98	0.98	C3	0.99	0.92
C4	0.99	0.98	C4	0.92	0.98	C4	0.89	0.88
P3	0.95	0.95	P3	0.94	0.87	P3	0.92	1.0
P4	0.94	0.99	P4	0.95	0.97	P4	0.97	0.9
O1	0.94	0.89	O1	0.96	0.89	O1	0.85	0.97
O2	0.96	0.99	O2	0.98	1.0	O2	0.86	0.92
F7	0.92	0.9	F7	0.92	0.93	F7	0.97	1.0
F8	0.87	0.83	F8	0.94	0.82	F8	0.99	0.95
T3	0.9	0.89	T3	0.95	0.95	T3	0.94	0.93
T4	1.0	0.93	T4	0.96	0.92	T4	0.99	0.98
T5	0.84	0.86	T5	0.86	0.75	T5	0.88	0.77
T6	1.0	0.89	T6	0.99	0.97	T6	1.0	0.9
Fz	0.97	1.0	Fz	0.99	0.89	Fz	0.92	0.99
Cz	0.96	0.9	Cz	0.95	0.89	Cz	0.99	0.95
Pz	0.99	0.98	Pz	0.98	0.92	Pz	0.95	0.81

Participant ID 15 qEEG Record: Posttest Eyes Closed								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.95	0.92	Average	0.93	0.9	Average	0.93	0.91
FP1	0.94	0.94	FP1	0.93	0.89	FP1	0.94	0.85
FP2	1.0	0.88	FP2	0.89	0.92	FP2	0.98	0.84
F3	0.92	0.89	F3	0.9	0.84	F3	0.98	0.98
F4	0.95	0.91	F4	0.97	0.93	F4	0.95	0.94
C3	0.91	0.97	C3	0.91	0.94	C3	0.98	0.81
C4	0.91	0.98	C4	0.86	0.97	C4	0.92	0.88
P3	0.93	0.99	P3	0.83	0.97	P3	0.97	0.98
P4	0.99	0.89	P4	0.98	0.88	P4	0.96	0.96
O1	0.92	0.91	O1	0.93	0.8	O1	0.92	0.88
O2	0.96	0.74	O2	0.93	0.71	O2	0.9	0.71
F7	0.88	0.92	F7	1.0	0.93	F7	0.85	0.96
F8	0.98	0.96	F8	1.0	0.97	F8	0.94	0.97
T3	0.99	0.97	T3	0.91	0.96	T3	0.99	0.95
T4	0.9	0.98	T4	0.97	0.95	T4	0.91	0.96
T5	0.97	0.76	T5	0.97	0.82	T5	0.9	0.99
T6	0.95	0.97	T6	0.95	0.99	T6	0.9	0.99
Fz	0.97	0.98	Fz	0.9	0.92	Fz	0.91	0.93
Cz	0.96	0.95	Cz	0.92	0.91	Cz	0.94	0.86
Pz	0.97	0.86	Pz	0.92	0.84	Pz	0.86	0.89

Participant ID 17 qEEG Record: Pretest Eyes Closed								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.98	0.9	Average	0.95	0.83	Average	0.97	0.87
FP1	0.99	0.9	FP1	0.94	0.78	FP1	0.98	0.94
FP2	0.99	0.95	FP2	0.95	0.84	FP2	1.0	0.74
F3	0.97	0.91	F3	0.94	0.82	F3	0.95	0.97
F4	0.99	0.91	F4	0.9	0.78	F4	0.99	0.88
C3	1.0	0.94	C3	1.0	0.87	C3	0.97	0.98
C4	0.96	0.9	C4	0.98	0.84	C4	0.97	0.7
P3	0.98	0.86	P3	0.92	0.81	P3	0.98	0.84
P4	0.97	0.93	P4	0.97	0.93	P4	0.94	0.81
O1	0.99	0.75	O1	0.98	0.72	O1	0.99	0.99
O2	0.98	0.95	O2	0.96	0.93	O2	0.96	0.85
F7	0.99	0.89	F7	0.97	0.8	F7	0.96	0.73
F8	0.99	0.9	F8	0.91	0.81	F8	0.96	0.87
T3	0.97	0.92	T3	0.99	0.88	T3	0.95	0.85
T4	1.0	0.85	T4	0.92	0.75	T4	0.95	0.9
T5	0.97	0.81	T5	0.98	0.76	T5	0.99	0.78
T6	0.96	0.91	T6	0.91	0.86	T6	0.95	0.87
Fz	0.97	0.91	Fz	0.95	0.79	Fz	0.96	0.95
Cz	0.99	0.91	Cz	0.99	0.84	Cz	0.95	0.93
Pz	0.94	0.91	Pz	0.96	0.92	Pz	0.95	0.9

Participant ID 17 qEEG Record: Pretest Eyes Open								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.95	0.93	Average	0.93	0.94	Average	0.95	0.88
FP1	0.85	0.84	FP1	0.8	0.84	FP1	0.89	0.71
FP2	0.85	0.69	FP2	0.84	0.62	FP2	0.94	0.48
F3	1.0	0.89	F3	0.87	0.98	F3	0.95	0.85
F4	0.96	0.92	F4	0.98	0.99	F4	0.98	0.82
C3	0.99	0.94	C3	0.97	0.96	C3	0.99	0.94
C4	0.95	0.93	C4	0.97	0.94	C4	0.89	0.86
P3	0.99	0.97	P3	0.93	0.94	P3	1.0	0.95
P4	0.98	0.96	P4	0.93	0.97	P4	0.99	0.96
O1	0.99	0.97	O1	1.0	0.97	O1	0.99	0.96
O2	0.95	0.98	O2	0.96	0.96	O2	0.94	1.0
F7	0.95	0.98	F7	0.96	0.91	F7	0.8	0.87
F8	0.95	0.98	F8	0.98	0.95	F8	0.92	0.68
T3	0.95	0.96	T3	0.96	0.97	T3	0.97	0.92
T4	0.94	0.97	T4	0.95	0.96	T4	1.0	0.95
T5	0.96	0.98	T5	0.98	0.97	T5	1.0	0.94
T6	0.91	0.94	T6	0.93	0.96	T6	0.93	0.94
Fz	0.97	0.9	Fz	0.87	0.97	Fz	0.96	0.99
Cz	0.95	0.92	Cz	0.95	0.98	Cz	0.93	0.98
Pz	1.0	0.94	Pz	0.95	0.98	Pz	0.97	0.98

Participant ID 18 qEEG Record: Pretest Eyes Closed								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.95	0.92	Average	0.95	0.93	Average	0.95	0.9
FP1	0.91	0.86	FP1	0.91	0.79	FP1	0.92	0.7
FP2	0.96	0.97	FP2	0.93	0.94	FP2	0.95	0.83
F3	0.91	0.85	F3	0.98	0.86	F3	0.96	0.88
F4	0.97	0.94	F4	0.93	0.99	F4	0.99	0.93
C3	0.99	0.85	C3	0.93	0.99	C3	0.95	0.92
C4	1.0	0.93	C4	0.99	0.94	C4	0.94	0.92
P3	0.94	0.92	P3	0.97	0.97	P3	0.98	0.95
P4	0.95	0.99	P4	0.97	0.97	P4	0.96	0.94
O1	0.94	0.98	O1	0.97	0.99	O1	0.99	0.95
O2	0.99	0.94	O2	0.95	0.91	O2	0.99	0.86
F7	0.94	0.91	F7	1.0	0.86	F7	0.96	0.79
F8	0.98	0.87	F8	0.91	0.83	F8	0.85	0.71
T3	0.97	0.91	T3	0.92	0.9	T3	0.96	0.98
T4	0.92	0.96	T4	0.92	0.99	T4	0.91	0.91
T5	0.96	0.98	T5	0.97	0.95	T5	0.99	1.0
T6	0.94	0.99	T6	0.92	0.95	T6	0.92	0.96
Fz	0.92	0.86	Fz	0.99	0.89	Fz	0.95	0.94
Cz	0.97	0.88	Cz	0.99	1.0	Cz	1.0	0.99
Pz	0.94	0.96	Pz	0.94	0.99	Pz	0.97	0.93

Participant ID 18 qEEG Record: Pretest Eyes Open								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.96	0.95	Average	0.96	0.95	Average	0.97	0.96
FP1	0.91	0.98	FP1	0.95	0.94	FP1	0.88	0.94
FP2	0.98	0.96	FP2	0.9	0.95	FP2	0.99	0.9
F3	0.94	0.99	F3	0.97	0.92	F3	0.99	0.96
F4	0.94	0.94	F4	0.98	0.98	F4	0.98	0.98
C3	0.98	0.92	C3	0.98	0.98	C3	0.99	0.99
C4	0.97	0.91	C4	0.97	0.96	C4	0.96	0.94
P3	0.96	1.0	P3	0.93	0.89	P3	0.97	0.93
P4	0.99	0.96	P4	0.97	0.94	P4	1.0	0.93
O1	0.96	0.95	O1	0.99	0.92	O1	0.99	0.99
O2	1.0	0.93	O2	0.97	0.97	O2	0.99	0.98
F7	0.91	0.92	F7	0.9	0.98	F7	0.86	0.96
F8	0.96	0.98	F8	0.98	0.99	F8	0.97	0.99
T3	0.99	0.95	T3	0.99	1.0	T3	0.97	0.98
T4	0.97	0.99	T4	0.97	0.94	T4	0.98	0.93
T5	0.97	0.95	T5	0.99	0.94	T5	0.98	1.0
T6	0.96	0.92	T6	0.99	0.97	T6	0.98	0.9
Fz	0.95	0.95	Fz	0.97	0.97	Fz	0.97	0.95
Cz	0.98	0.92	Cz	0.95	0.98	Cz	0.95	1.0
Pz	0.96	0.99	Pz	0.92	0.89	Pz	0.97	0.96

Participant ID 18 qEEG Record: Pretest Serial Sevens								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.95	0.91	Average	0.94	0.93	Average	0.96	0.94
FP1	0.92	0.8	FP1	0.9	0.86	FP1	0.92	0.88
FP2	0.93	0.8	FP2	0.95	0.96	FP2	0.98	0.95
F3	0.95	0.98	F3	0.94	1.0	F3	0.96	0.98
F4	0.96	0.98	F4	0.93	1.0	F4	0.99	0.9
C3	0.96	0.97	C3	0.96	0.89	C3	0.93	0.95
C4	0.97	0.95	C4	0.95	0.99	C4	0.95	1.0
P3	0.98	0.97	P3	0.89	0.95	P3	0.93	0.95
P4	0.96	0.81	P4	0.9	0.84	P4	0.96	0.92
O1	0.95	0.96	O1	0.99	0.98	O1	0.97	0.89
O2	0.95	0.87	O2	0.99	0.9	O2	0.97	1.0
F7	0.9	0.79	F7	0.81	0.87	F7	0.98	0.91
F8	0.9	0.88	F8	0.93	0.98	F8	0.88	0.89
T3	1.0	0.98	T3	0.98	0.89	T3	1.0	0.89
T4	0.98	0.99	T4	0.95	0.91	T4	0.94	0.98
T5	0.97	0.87	T5	0.96	1.0	T5	0.97	0.98
T6	0.96	0.9	T6	0.97	0.98	T6	0.94	0.87
Fz	0.91	0.97	Fz	0.91	0.94	Fz	0.95	0.97
Cz	0.94	0.94	Cz	0.99	0.88	Cz	0.97	0.93
Pz	0.95	0.89	Pz	0.9	0.9	Pz	0.99	0.97

Participant ID 18 qEEG Record: Posttest Eyes Open								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.97	0.92	Average	0.94	0.9	Average	0.95	0.92
FP1	0.95	0.99	FP1	0.95	0.97	FP1	0.84	0.95
FP2	0.91	0.93	FP2	0.86	0.92	FP2	0.84	0.92
F3	0.98	0.98	F3	1.0	0.98	F3	0.94	0.91
F4	0.97	0.94	F4	0.89	0.91	F4	0.95	0.84
C3	1.0	0.94	C3	0.96	0.84	C3	1.0	0.93
C4	0.99	0.94	C4	0.9	0.89	C4	0.99	0.97
P3	0.93	0.72	P3	0.86	0.68	P3	0.89	0.7
P4	0.96	0.9	P4	0.92	0.88	P4	0.91	0.95
O1	0.97	0.97	O1	0.96	0.98	O1	0.96	0.97
O2	0.98	0.94	O2	0.95	0.96	O2	0.94	0.98
F7	0.93	0.96	F7	0.94	0.99	F7	0.96	0.92
F8	0.96	0.94	F8	0.92	0.97	F8	0.98	0.92
T3	0.99	0.95	T3	0.99	0.93	T3	0.99	0.92
T4	0.94	0.96	T4	0.98	0.91	T4	0.99	0.95
T5	0.99	0.84	T5	0.97	0.85	T5	0.99	0.92
T6	0.98	0.93	T6	0.99	0.92	T6	0.99	0.95
Fz	0.97	0.93	Fz	0.92	0.88	Fz	0.95	0.99
Cz	0.99	0.95	Cz	0.97	0.87	Cz	0.97	0.9
Pz	1.0	0.84	Pz	0.98	0.8	Pz	0.92	0.89

Participant ID 18 qEEG Record: Posttest Eyes Closed								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.97	0.94	Average	0.97	0.93	Average	0.93	0.96
FP1	0.94	0.9	FP1	0.98	0.91	FP1	0.99	0.96
FP2	0.97	0.97	FP2	0.95	0.99	FP2	0.87	0.91
F3	0.98	0.87	F3	1.0	0.91	F3	0.88	0.97
F4	0.96	0.94	F4	0.95	0.91	F4	0.86	0.97
C3	0.97	0.91	C3	0.96	0.89	C3	0.96	0.95
C4	0.98	0.98	C4	0.99	0.94	C4	0.96	1.0
P3	0.95	0.96	P3	0.98	0.98	P3	0.99	0.97
P4	0.93	0.99	P4	0.97	0.9	P4	0.94	0.98
O1	0.97	0.9	O1	0.99	0.94	O1	0.93	0.98
O2	1.0	0.96	O2	1.0	0.85	O2	0.95	0.99
F7	0.94	0.92	F7	0.94	0.96	F7	0.94	0.95
F8	0.97	1.0	F8	0.94	0.99	F8	0.79	0.95
T3	0.98	0.96	T3	1.0	0.96	T3	0.97	1.0
T4	0.99	0.98	T4	0.96	0.93	T4	1.0	0.99
T5	0.97	0.88	T5	0.99	0.95	T5	0.98	0.99
T6	1.0	0.99	T6	0.96	0.87	T6	0.99	0.95
Fz	0.99	0.88	Fz	0.98	0.88	Fz	0.87	0.91
Cz	0.98	0.89	Cz	0.93	0.84	Cz	0.93	0.93
Pz	0.98	0.98	Pz	0.99	1.0	Pz	0.94	0.93

Participant ID 19 qEEG Record: Pretest Eyes Closed								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.97	0.9	Average	0.95	0.88	Average	0.96	0.93
FP1	0.95	0.95	FP1	0.91	0.92	FP1	0.99	0.97
FP2	0.96	0.94	FP2	0.96	0.98	FP2	0.96	0.96
F3	1.0	0.88	F3	0.95	0.93	F3	0.99	0.99
F4	0.99	0.87	F4	0.98	0.91	F4	0.91	0.93
C3	0.96	0.95	C3	1.0	0.99	C3	0.97	0.99
C4	0.99	0.83	C4	1.0	0.83	C4	0.98	0.99
P3	0.94	0.92	P3	0.86	0.88	P3	0.9	0.88
P4	0.96	0.84	P4	0.89	0.77	P4	0.95	0.86
O1	0.98	0.89	O1	0.96	0.81	O1	0.9	0.85
O2	0.99	0.84	O2	0.99	0.74	O2	0.89	0.75
F7	0.97	0.93	F7	0.99	0.88	F7	0.98	0.99
F8	0.99	0.94	F8	0.96	0.99	F8	0.95	0.97
T3	0.94	0.99	T3	0.97	0.91	T3	0.97	0.99
T4	0.98	0.91	T4	0.96	0.96	T4	0.95	0.93
T5	0.99	0.96	T5	0.98	0.81	T5	0.99	0.96
T6	0.97	0.89	T6	0.95	0.87	T6	0.95	0.85
Fz	0.98	0.89	Fz	0.99	0.87	Fz	1.0	0.99
Cz	0.96	0.87	Cz	0.99	0.87	Cz	0.99	0.94
Pz	0.94	0.88	Pz	0.84	0.88	Pz	0.92	0.88

Participant ID 19 qEEG Record: Pretest Eyes Open								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.98	0.94	Average	0.98	0.93	Average	0.97	0.9
FP1	0.99	0.98	FP1	0.98	0.95	FP1	0.93	0.91
FP2	0.98	0.9	FP2	0.98	0.94	FP2	0.96	0.91
F3	0.99	0.98	F3	0.94	0.92	F3	0.94	0.89
F4	0.97	0.99	F4	0.99	0.92	F4	0.98	0.88
C3	0.98	0.99	C3	0.97	0.91	C3	0.96	0.88
C4	0.99	0.95	C4	0.97	0.98	C4	1.0	0.99
P3	0.97	0.95	P3	0.98	0.96	P3	0.98	0.94
P4	0.99	0.98	P4	1.0	0.99	P4	0.99	0.95
O1	0.99	0.98	O1	1.0	0.97	O1	0.98	0.95
O2	1.0	0.99	O2	0.98	0.97	O2	0.96	0.88
F7	1.0	0.96	F7	0.99	0.92	F7	0.97	0.89
F8	0.99	0.71	F8	0.98	0.68	F8	1.0	0.67
T3	0.96	0.99	T3	0.97	0.97	T3	0.97	0.9
T4	0.98	0.93	T4	0.97	0.92	T4	0.99	0.94
T5	0.99	0.9	T5	0.99	0.87	T5	0.99	0.95
T6	0.97	0.83	T6	0.98	0.81	T6	0.94	0.8
Fz	0.95	0.91	Fz	0.98	0.98	Fz	1.0	0.88
Cz	0.95	0.92	Cz	0.98	0.94	Cz	0.99	0.99
Pz	0.98	0.95	Pz	0.96	0.96	Pz	0.97	0.98

Participant ID 19 qEEG Record: Pretest Serial Sevens								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.95	0.92	Average	0.94	0.93	Average	0.97	0.92
FP1	0.93	0.88	FP1	0.97	0.94	FP1	0.95	0.94
FP2	0.9	0.83	FP2	0.93	0.88	FP2	0.93	0.83
F3	0.95	0.94	F3	0.96	0.97	F3	0.99	0.94
F4	0.94	1.0	F4	0.95	0.98	F4	0.98	0.98
C3	0.93	0.91	C3	0.94	0.89	C3	0.98	0.86
C4	0.91	0.92	C4	0.91	0.98	C4	1.0	0.99
P3	0.97	0.95	P3	1.0	0.99	P3	0.95	0.99
P4	0.98	0.94	P4	0.95	0.92	P4	0.98	0.95
O1	0.94	0.99	O1	0.91	0.98	O1	0.93	0.86
O2	0.98	0.98	O2	0.96	0.96	O2	0.97	0.87
F7	0.96	0.9	F7	0.96	0.91	F7	0.98	0.88
F8	0.99	0.92	F8	0.88	0.94	F8	0.92	0.93
T3	0.94	0.87	T3	0.98	0.9	T3	1.0	0.92
T4	0.96	0.98	T4	1.0	0.99	T4	0.98	0.98
T5	0.99	0.95	T5	0.96	0.98	T5	0.97	0.96
T6	0.99	0.89	T6	0.92	0.85	T6	0.97	0.85
Fz	0.92	0.88	Fz	0.91	0.87	Fz	0.97	0.97
Cz	0.89	0.82	Cz	0.86	0.76	Cz	0.97	0.83
Pz	0.95	0.91	Pz	0.93	0.94	Pz	1.0	1.0

Participant ID 19 qEEG Record: Posttest Eyes Open								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.96	0.95	Average	0.94	0.92	Average	0.92	0.93
FP1	0.97	0.97	FP1	0.96	0.91	FP1	0.95	0.97
FP2	0.99	0.98	FP2	0.94	0.94	FP2	0.88	0.94
F3	0.98	0.98	F3	0.96	0.92	F3	0.98	0.99
F4	0.97	0.9	F4	0.99	0.94	F4	1.0	0.95
C3	0.97	0.94	C3	0.99	0.94	C3	0.93	0.86
C4	0.98	0.91	C4	0.98	0.9	C4	0.96	0.97
P3	0.96	0.95	P3	0.98	0.98	P3	0.96	0.97
P4	0.98	0.95	P4	0.94	0.94	P4	0.85	0.96
O1	0.97	0.94	O1	0.91	0.96	O1	0.92	0.94
O2	0.97	1.0	O2	0.94	0.89	O2	0.91	0.93
F7	0.97	1.0	F7	0.97	0.88	F7	0.96	0.98
F8	0.94	0.98	F8	0.99	0.99	F8	0.96	0.83
T3	0.98	0.97	T3	0.91	0.95	T3	0.87	0.95
T4	0.9	0.85	T4	0.84	0.72	T4	0.85	0.71
T5	0.96	0.92	T5	0.97	0.98	T5	0.88	0.93
T6	0.97	0.97	T6	0.89	0.91	T6	0.9	0.91
Fz	0.94	0.97	Fz	0.89	0.91	Fz	0.99	1.0
Cz	0.93	0.9	Cz	0.76	0.9	Cz	0.84	0.89
Pz	0.97	0.94	Pz	1.0	0.96	Pz	0.96	0.98

Participant ID 19 qEEG Record: Posttest Eyes Closed								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.96	0.96	Average	0.93	0.93	Average	0.94	0.92
FP1	0.95	0.97	FP1	0.89	0.9	FP1	0.98	0.93
FP2	0.93	0.92	FP2	0.91	0.91	FP2	0.88	0.92
F3	0.97	0.95	F3	0.87	0.93	F3	0.97	0.98
F4	0.99	0.99	F4	0.96	0.91	F4	0.98	0.94
C3	0.96	0.92	C3	1.0	1.0	C3	0.95	0.91
C4	1.0	0.98	C4	0.93	0.94	C4	0.95	0.89
P3	1.0	0.98	P3	0.91	0.95	P3	0.86	0.95
P4	0.98	0.91	P4	0.96	0.79	P4	0.95	0.86
O1	0.99	0.94	O1	0.93	0.9	O1	0.88	0.83
O2	0.92	0.97	O2	0.96	0.98	O2	0.96	0.96
F7	0.96	0.9	F7	0.95	0.99	F7	0.94	0.92
F8	0.99	0.98	F8	1.0	0.98	F8	0.94	0.99
T3	0.91	0.9	T3	0.9	0.9	T3	0.98	0.94
T4	0.97	0.98	T4	0.95	0.95	T4	0.91	0.86
T5	0.93	0.95	T5	0.94	0.97	T5	0.96	0.99
T6	0.94	0.98	T6	0.9	0.89	T6	0.94	0.81
Fz	0.95	1.0	Fz	0.95	0.94	Fz	1.0	0.9
Cz	0.95	0.97	Cz	0.92	0.96	Cz	0.92	0.93
Pz	0.97	0.95	Pz	0.9	0.83	Pz	0.87	0.99

Participant ID 21 qEEG Record: Pretest Eyes Closed								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.95	0.91	Average	0.94	0.89	Average	0.96	0.91
FP1	0.89	0.92	FP1	0.84	0.94	FP1	0.96	0.93
FP2	0.92	0.94	FP2	1.0	0.99	FP2	1.0	0.95
F3	0.93	0.96	F3	0.83	0.99	F3	0.9	0.99
F4	0.96	0.89	F4	0.99	0.9	F4	1.0	0.99
C3	0.96	0.93	C3	0.99	0.9	C3	0.87	0.82
C4	0.98	0.91	C4	0.97	0.98	C4	0.95	0.92
P3	0.92	0.9	P3	0.91	0.87	P3	0.93	0.85
P4	0.95	0.87	P4	0.99	0.77	P4	0.98	0.77
O1	0.92	0.94	O1	0.95	0.88	O1	1.0	0.99
O2	1.0	0.93	O2	0.91	0.94	O2	1.0	0.96
F7	0.98	0.91	F7	0.96	0.94	F7	0.99	0.98
F8	0.99	0.93	F8	0.84	0.84	F8	0.98	0.84
T3	0.97	0.89	T3	0.98	0.95	T3	0.99	0.95
T4	0.97	0.94	T4	0.93	0.83	T4	0.96	0.89
T5	0.96	0.92	T5	0.95	0.99	T5	0.9	0.94
T6	0.97	0.89	T6	0.98	0.78	T6	0.95	0.87
Fz	0.91	0.86	Fz	0.86	0.8	Fz	0.89	0.9
Cz	0.99	0.85	Cz	0.98	0.82	Cz	0.98	0.84
Pz	0.94	0.94	Pz	0.94	0.86	Pz	0.99	0.88

Participant ID 21 qEEG Record: Pretest Eyes Open								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.95	0.9	Average	0.94	0.9	Average	0.95	0.89
FP1	0.93	0.99	FP1	0.91	0.93	FP1	0.97	0.95
FP2	0.95	0.87	FP2	0.97	0.98	FP2	0.97	0.97
F3	0.93	0.85	F3	0.93	0.95	F3	0.95	0.91
F4	0.89	0.81	F4	0.89	0.88	F4	0.93	0.9
C3	0.96	1.0	C3	0.86	0.98	C3	0.92	0.9
C4	0.96	0.82	C4	0.94	0.82	C4	0.95	0.76
P3	1.0	0.97	P3	0.99	0.95	P3	0.94	0.89
P4	0.89	0.94	P4	0.87	0.96	P4	0.82	0.95
O1	1.0	0.98	O1	0.95	0.85	O1	0.89	0.9
O2	0.92	0.99	O2	0.98	0.9	O2	0.98	0.99
F7	0.98	0.89	F7	1.0	0.98	F7	0.97	0.89
F8	0.95	0.94	F8	0.94	0.96	F8	0.96	0.89
T3	0.99	0.92	T3	0.98	0.98	T3	1.0	0.8
T4	0.98	0.97	T4	0.95	0.97	T4	0.99	0.92
T5	0.99	0.93	T5	0.88	0.73	T5	0.93	0.87
T6	0.9	0.95	T6	0.96	0.98	T6	0.97	0.93
Fz	0.9	0.73	Fz	0.87	0.69	Fz	0.99	0.84
Cz	0.97	0.68	Cz	0.99	0.61	Cz	0.98	0.58
Pz	0.97	0.87	Pz	0.97	0.99	Pz	0.97	0.98

Participant ID 21 qEEG Record: Pretest Serial Sevens								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.95	0.91	Average	0.93	0.9	Average	0.94	0.92
FP1	0.99	0.97	FP1	0.92	0.88	FP1	0.94	0.99
FP2	0.97	0.86	FP2	0.91	0.88	FP2	0.89	0.76
F3	0.91	0.89	F3	0.99	0.94	F3	0.98	0.91
F4	0.99	0.87	F4	0.99	0.87	F4	0.93	0.9
C3	0.96	0.92	C3	0.88	0.92	C3	0.93	0.97
C4	0.94	0.9	C4	0.86	0.94	C4	0.97	0.98
P3	0.88	0.98	P3	0.92	0.9	P3	0.87	0.96
P4	0.99	0.95	P4	0.92	0.93	P4	0.95	0.91
O1	0.96	0.9	O1	0.89	0.91	O1	1.0	0.98
O2	0.99	0.87	O2	0.95	0.93	O2	0.95	0.96
F7	0.91	0.85	F7	0.98	0.77	F7	0.94	1.0
F8	0.98	0.87	F8	0.91	0.79	F8	0.96	0.98
T3	0.98	0.95	T3	0.99	0.94	T3	0.95	0.94
T4	0.91	0.9	T4	0.96	0.92	T4	0.98	0.89
T5	0.98	0.98	T5	0.97	1.0	T5	0.98	0.94
T6	0.94	0.92	T6	0.91	0.91	T6	0.95	0.79
Fz	0.93	0.85	Fz	0.96	0.85	Fz	0.98	0.86
Cz	0.87	0.89	Cz	0.79	0.93	Cz	0.82	1.0
Pz	0.89	0.98	Pz	0.89	0.88	Pz	0.99	0.82

Participant ID 21 qEEG Record: Posttest Eyes Open								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.95	0.93	Average	0.94	0.92	Average	0.94	0.94
FP1	0.98	0.93	FP1	0.98	1.0	FP1	0.99	0.93
FP2	1.0	0.99	FP2	0.98	0.96	FP2	0.96	0.95
F3	0.93	0.94	F3	0.9	0.98	F3	0.93	0.89
F4	0.96	0.97	F4	0.96	1.0	F4	0.96	0.96
C3	0.95	0.98	C3	0.94	0.98	C3	0.96	0.99
C4	0.98	0.8	C4	0.96	0.78	C4	0.96	0.94
P3	0.9	0.89	P3	0.85	0.92	P3	0.86	0.94
P4	0.93	0.98	P4	0.93	0.99	P4	0.95	0.94
O1	0.97	0.93	O1	0.95	0.88	O1	0.94	0.98
O2	0.98	1.0	O2	0.97	0.98	O2	0.99	0.95
F7	0.91	0.87	F7	0.98	0.94	F7	0.89	0.96
F8	0.96	0.9	F8	0.93	0.78	F8	0.92	0.97
T3	0.88	0.91	T3	0.91	0.92	T3	0.92	0.89
T4	0.96	0.92	T4	0.98	0.76	T4	0.96	0.82
T5	0.98	0.91	T5	0.98	0.97	T5	0.91	0.84
T6	0.95	0.98	T6	0.91	0.89	T6	0.98	0.98
Fz	0.99	0.98	Fz	1.0	0.97	Fz	1.0	0.96
Cz	0.98	0.91	Cz	0.95	0.86	Cz	0.9	0.89
Pz	0.88	0.94	Pz	0.86	0.95	Pz	0.92	1.0

Participant ID 21 qEEG Record: Posttest Eyes Closed								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.95	0.93	Average	0.95	0.93	Average	0.93	0.89
FP1	0.98	1.0	FP1	0.96	0.99	FP1	0.96	0.92
FP2	0.95	0.98	FP2	0.99	0.99	FP2	1.0	0.99
F3	0.93	0.94	F3	0.99	0.96	F3	0.91	0.99
F4	0.9	0.9	F4	0.92	0.95	F4	0.89	0.99
C3	0.97	0.99	C3	0.97	0.96	C3	0.9	0.76
C4	1.0	0.91	C4	0.99	0.98	C4	0.91	0.89
P3	0.97	0.87	P3	1.0	0.88	P3	0.98	0.74
P4	0.87	0.84	P4	0.84	0.96	P4	0.91	0.88
O1	0.98	1.0	O1	0.94	0.91	O1	0.93	1.0
O2	0.94	0.93	O2	0.96	0.95	O2	0.95	0.97
F7	0.99	1.0	F7	0.97	0.83	F7	0.98	0.92
F8	0.98	0.97	F8	0.99	0.98	F8	0.97	0.99
T3	1.0	0.99	T3	0.97	0.9	T3	0.88	0.93
T4	0.98	0.99	T4	0.89	0.99	T4	0.91	0.95
T5	0.98	0.95	T5	0.93	0.8	T5	0.94	0.81
T6	0.92	0.86	T6	0.98	0.97	T6	0.99	0.76
Fz	0.89	0.84	Fz	0.9	0.85	Fz	0.96	0.83
Cz	0.92	0.77	Cz	0.91	0.75	Cz	0.84	0.71
Pz	0.97	0.92	Pz	0.94	0.97	Pz	0.95	0.89

Participant ID 22 qEEG Record: Pretest Eyes Closed								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.98	0.95	Average	0.98	0.94	Average	0.97	0.93
FP1	0.98	0.99	FP1	0.97	1.0	FP1	1.0	0.97
FP2	0.97	0.99	FP2	0.96	0.97	FP2	0.96	0.94
F3	0.99	0.98	F3	1.0	0.98	F3	1.0	0.97
F4	0.96	0.95	F4	0.99	0.95	F4	1.0	0.97
C3	0.98	0.96	C3	0.99	0.94	C3	0.99	0.96
C4	0.98	0.94	C4	0.99	0.97	C4	0.97	0.99
P3	0.99	0.94	P3	1.0	0.9	P3	1.0	0.97
P4	0.99	0.91	P4	0.99	0.88	P4	0.99	0.96
O1	0.99	0.91	O1	0.99	0.9	O1	0.97	0.97
O2	0.99	0.9	O2	0.99	0.89	O2	0.97	0.98
F7	0.99	0.99	F7	1.0	0.93	F7	0.99	0.92
F8	0.98	0.96	F8	0.99	1.0	F8	0.96	0.94
T3	0.97	0.95	T3	0.97	0.92	T3	0.99	0.79
T4	0.98	0.98	T4	0.98	0.92	T4	0.93	0.83
T5	0.99	0.89	T5	0.96	0.92	T5	0.94	0.82
T6	0.96	0.95	T6	0.97	0.92	T6	0.9	0.75
Fz	0.96	0.98	Fz	0.99	0.96	Fz	0.99	1.0
Cz	0.95	0.95	Cz	0.96	0.92	Cz	0.97	0.96
Pz	1.0	0.95	Pz	0.99	0.94	Pz	0.99	0.97

Participant ID 22 qEEG Record: Pretest Eyes Open								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.95	0.92	Average	0.96	0.95	Average	0.97	0.95
FP1	0.94	1.0	FP1	0.94	0.96	FP1	0.97	0.96
FP2	0.95	0.91	FP2	0.94	0.86	FP2	1.0	0.88
F3	0.94	0.95	F3	0.96	0.97	F3	0.99	0.97
F4	0.99	0.97	F4	0.99	0.96	F4	1.0	0.9
C3	0.94	0.91	C3	0.96	0.99	C3	0.97	0.97
C4	1.0	0.98	C4	0.97	0.95	C4	0.99	0.96
P3	0.93	0.95	P3	0.95	0.98	P3	0.99	0.95
P4	0.94	0.89	P4	0.96	0.97	P4	0.94	1.0
O1	0.96	0.89	O1	1.0	0.94	O1	0.98	0.99
O2	0.93	0.84	O2	0.96	1.0	O2	0.99	0.99
F7	1.0	0.92	F7	0.99	0.99	F7	0.98	0.92
F8	0.88	0.89	F8	0.98	0.96	F8	0.93	0.98
T3	0.96	0.9	T3	0.97	0.95	T3	0.96	0.99
T4	0.99	0.87	T4	0.96	0.95	T4	0.92	0.92
T5	0.95	0.86	T5	0.95	0.94	T5	0.94	0.87
T6	0.93	0.8	T6	0.94	0.97	T6	0.96	0.93
Fz	0.98	0.93	Fz	0.94	0.88	Fz	0.96	0.95
Cz	0.96	0.99	Cz	0.94	0.92	Cz	0.92	0.99
Pz	0.99	0.98	Pz	1.0	0.96	Pz	0.96	0.98

Participant ID 22 qEEG Record: Pretest Serial Sevens								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.95	0.94	Average	0.94	0.92	Average	0.95	0.95
FP1	0.93	0.86	FP1	1..0	0.93	FP1	0.97	0.94
FP2	0.97	0.92	FP2	0.9	0.96	FP2	0.93	0.98
F3	0.83	0.9	F3	0.86	0.98	F3	0.93	0.98
F4	0.99	0.97	F4	0.93	0.96	F4	0.96	0.98
C3	0.9	0.95	C3	0.98	0.89	C3	0.95	0.96
C4	0.93	0.94	C4	0.91	0.91	C4	0.91	0.91
P3	0.98	0.95	P3	0.93	0.9	P3	0.94	1.0
P4	0.98	0.98	P4	0.94	0.92	P4	0.96	0.97
O1	0.97	0.96	O1	0.96	0.81	O1	1.0	0.89
O2	0.97	0.95	O2	0.99	0.88	O2	0.96	0.97
F7	0.98	0.98	F7	0.88	0.94	F7	0.96	0.98
F8	0.9	0.82	F8	0.87	0.89	F8	0.99	0.95
T3	0.99	1.0	T3	0.99	0.94	T3	0.95	0.94
T4	0.95	0.9	T4	0.98	0.9	T4	0.96	0.9
T5	0.97	0.99	T5	0.97	0.96	T5	0.96	0.91
T6	0.94	0.87	T6	0.98	0.95	T6	0.91	0.92
Fz	0.94	0.98	Fz	0.91	0.89	Fz	0.9	0.93
Cz	0.91	0.99	Cz	0.99	0.97	Cz	0.97	0.93
Pz	0.99	0.96	Pz	0.92	0.84	Pz	0.98	0.98

Participant ID 22 qEEG Record: Posttest Eyes Open								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.93	0.91	Average	0.92	0.89	Average	0.91	0.9
FP1	0.89	0.95	FP1	0.98	0.94	FP1	0.93	0.98
FP2	0.97	0.87	FP2	0.91	0.85	FP2	0.91	0.85
F3	0.8	0.99	F3	0.88	0.91	F3	0.99	0.97
F4	0.79	0.75	F4	0.85	0.79	F4	0.98	0.86
C3	0.95	0.84	C3	0.88	0.8	C3	0.88	0.88
C4	0.97	0.97	C4	0.93	0.99	C4	0.87	0.82
P3	0.96	0.93	P3	0.98	0.97	P3	0.79	0.88
P4	0.99	0.94	P4	0.85	0.92	P4	0.91	0.92
O1	0.94	1.0	O1	0.96	0.96	O1	0.86	0.92
O2	0.95	1.0	O2	0.95	0.96	O2	0.89	0.97
F7	0.94	0.88	F7	0.91	0.89	F7	0.99	0.89
F8	1.0	0.89	F8	0.94	0.81	F8	0.88	0.82
T3	0.88	0.95	T3	0.98	0.83	T3	0.95	0.84
T4	0.99	0.77	T4	0.93	0.73	T4	0.89	0.65
T5	0.83	0.9	T5	0.74	0.85	T5	0.9	1.0
T6	0.95	0.97	T6	0.95	0.93	T6	0.82	0.87
Fz	0.91	0.82	Fz	0.97	0.93	Fz	0.99	0.93
Cz	0.94	0.84	Cz	0.97	0.86	Cz	0.97	0.98
Pz	0.95	0.96	Pz	0.87	0.97	Pz	0.8	0.98

Participant ID 22 qEEG Record: Posttest Eyes Closed								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.98	0.97	Average	0.97	0.94	Average	0.96	0.94
FP1	0.97	0.96	FP1	1.0	0.93	FP1	0.99	0.95
FP2	0.93	0.97	FP2	0.94	1.0	FP2	0.92	0.92
F3	0.99	0.96	F3	0.98	0.96	F3	0.97	0.95
F4	1.0	0.98	F4	0.96	0.99	F4	0.99	0.97
C3	1.0	0.98	C3	0.99	0.97	C3	0.97	0.98
C4	0.97	0.93	C4	0.92	0.91	C4	0.88	0.96
P3	1.0	0.99	P3	0.99	0.95	P3	0.98	0.93
P4	0.99	0.99	P4	0.98	0.96	P4	0.95	0.93
O1	0.94	0.94	O1	0.99	0.93	O1	0.98	0.93
O2	0.95	0.99	O2	0.98	0.87	O2	1.0	0.93
F7	0.98	0.99	F7	0.97	0.93	F7	0.97	0.9
F8	1.0	0.95	F8	0.97	0.98	F8	0.96	0.95
T3	0.98	0.98	T3	0.98	0.98	T3	0.97	0.97
T4	0.97	0.97	T4	0.99	0.92	T4	0.97	0.96
T5	0.99	0.95	T5	0.98	0.93	T5	1.0	0.91
T6	0.93	0.99	T6	0.92	0.91	T6	0.94	0.97
Fz	0.98	0.98	Fz	0.98	0.99	Fz	1.0	0.96
Cz	1.0	0.91	Cz	0.96	0.88	Cz	0.95	0.95
Pz	1.0	0.96	Pz	0.96	0.94	Pz	0.95	0.83

Participant ID 23 qEEG Record: Pretest Eyes Closed								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.96	0.91	Average	0.95	0.87	Average	0.94	0.81
FP1	0.96	0.83	FP1	0.98	0.83	FP1	0.97	0.89
FP2	0.97	0.84	FP2	0.98	0.81	FP2	0.92	0.7
F3	0.97	0.88	F3	0.96	0.88	F3	0.98	0.93
F4	0.96	0.86	F4	0.94	0.81	F4	0.9	0.79
C3	0.97	0.9	C3	0.9	0.89	C3	0.98	0.92
C4	0.98	0.91	C4	0.99	0.91	C4	0.93	0.92
P3	0.92	0.96	P3	0.95	0.9	P3	0.93	0.91
P4	0.92	1.0	P4	0.99	0.93	P4	0.95	0.9
O1	0.97	0.76	O1	0.97	0.68	O1	0.98	0.45
O2	0.99	0.98	O2	0.89	0.89	O2	0.94	0.65
F7	0.99	0.9	F7	0.93	0.96	F7	0.98	0.9
F8	0.97	0.84	F8	0.99	0.74	F8	0.91	0.49
T3	0.98	0.94	T3	0.93	0.97	T3	0.93	0.97
T4	0.95	0.98	T4	0.93	1.0	T4	0.94	0.69
T5	0.94	0.89	T5	0.99	0.83	T5	0.93	0.7
T6	0.98	0.97	T6	0.88	0.89	T6	0.92	0.86
Fz	0.96	0.88	Fz	0.95	0.87	Fz	0.95	0.95
Cz	0.96	0.88	Cz	0.91	0.84	Cz	0.92	0.87
Pz	0.92	1.0	Pz	0.97	0.99	Pz	0.98	0.92

Participant ID 23 qEEG Record: Pretest Eyes Open								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.97	0.9	Average	0.94	0.87	Average	0.95	0.88
FP1	0.97	0.85	FP1	0.98	0.9	FP1	0.98	0.97
FP2	0.99	0.86	FP2	0.97	0.83	FP2	0.96	0.91
F3	0.98	0.85	F3	0.98	0.83	F3	0.98	0.99
F4	0.92	0.91	F4	0.89	0.91	F4	0.97	0.96
C3	1.0	0.92	C3	0.89	0.96	C3	0.95	0.97
C4	0.94	0.95	C4	0.96	0.95	C4	0.99	0.88
P3	0.97	0.92	P3	0.98	0.8	P3	0.97	0.75
P4	0.95	0.86	P4	0.99	0.77	P4	1.0	0.71
O1	0.97	0.76	O1	0.95	0.64	O1	0.89	0.54
O2	0.99	0.92	O2	0.87	0.86	O2	0.97	0.75
F7	0.99	0.91	F7	0.94	0.99	F7	0.98	0.97
F8	0.94	0.87	F8	0.92	0.79	F8	0.87	0.89
T3	0.95	0.97	T3	0.97	0.97	T3	0.93	0.98
T4	0.97	0.9	T4	0.97	0.87	T4	0.94	0.99
T5	0.96	0.94	T5	0.98	0.87	T5	0.95	0.82
T6	1.0	0.84	T6	0.87	0.8	T6	0.9	0.74
Fz	0.95	0.9	Fz	0.94	0.89	Fz	0.94	0.99
Cz	0.95	0.91	Cz	0.98	0.91	Cz	1.0	0.98
Pz	0.97	0.98	Pz	0.89	0.93	Pz	0.89	0.9

Participant ID 23 qEEG Record: Pretest Serial Sevens								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.96	0.95	Average	0.93	0.89	Average	0.91	0.86
FP1	0.99	0.92	FP1	0.94	0.82	FP1	0.97	0.76
FP2	0.97	0.98	FP2	1.0	0.88	FP2	0.88	0.9
F3	0.98	0.94	F3	0.96	0.81	F3	0.77	0.55
F4	0.95	0.99	F4	0.96	0.98	F4	1.0	0.86
C3	0.94	0.96	C3	0.92	0.89	C3	0.98	0.97
C4	0.99	0.96	C4	0.94	0.87	C4	0.87	0.94
P3	0.89	0.95	P3	0.87	0.94	P3	0.91	1.0
P4	0.94	0.97	P4	0.94	0.9	P4	0.83	0.84
O1	0.96	0.88	O1	0.93	0.87	O1	0.96	0.79
O2	1.0	0.94	O2	0.94	0.88	O2	0.96	0.97
F7	0.94	0.96	F7	0.91	0.93	F7	0.79	0.65
F8	0.95	0.99	F8	0.96	0.83	F8	0.86	0.92
T3	0.99	0.98	T3	0.99	0.94	T3	0.94	0.81
T4	0.98	0.98	T4	0.92	0.84	T4	0.88	0.97
T5	0.99	0.94	T5	0.97	1.0	T5	0.98	1.0
T6	0.97	0.99	T6	0.85	0.99	T6	0.97	1.0
Fz	0.93	0.99	Fz	0.93	0.95	Fz	0.86	0.81
Cz	0.91	0.93	Cz	0.86	0.86	Cz	0.94	0.82
Pz	0.94	0.86	Pz	0.94	0.79	Pz	0.97	0.84

Participant ID 23 qEEG Record: Posttest Eyes Open								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.95	0.94	Average	0.92	0.91	Average	0.92	0.88
FP1	0.89	0.93	FP1	0.95	0.9	FP1	0.83	0.94
FP2	0.95	0.95	FP2	0.91	0.89	FP2	0.97	0.93
F3	0.91	0.9	F3	0.94	0.83	F3	0.91	0.96
F4	0.99	0.98	F4	0.87	0.97	F4	0.99	0.96
C3	0.89	0.89	C3	0.98	0.79	C3	0.98	0.8
C4	0.98	1.0	C4	0.94	0.92	C4	0.87	0.95
P3	0.99	1.0	P3	0.88	0.96	P3	0.92	0.73
P4	0.94	0.99	P4	0.78	0.92	P4	0.88	0.8
O1	0.96	0.91	O1	0.9	0.93	O1	0.88	0.95
O2	0.99	0.98	O2	0.94	0.99	O2	0.99	0.92
F7	0.98	0.89	F7	0.89	0.94	F7	0.86	0.99
F8	0.93	0.89	F8	0.84	0.82	F8	0.99	0.9
T3	0.98	0.96	T3	0.88	0.99	T3	0.94	0.89
T4	1.0	0.94	T4	0.87	0.99	T4	0.95	0.81
T5	0.98	0.97	T5	0.96	0.92	T5	0.96	0.91
T6	0.96	0.92	T6	0.93	0.89	T6	0.79	0.92
Fz	0.94	0.96	Fz	0.98	0.95	Fz	0.98	0.87
Cz	0.92	0.97	Cz	0.99	0.9	Cz	0.96	0.99
Pz	0.92	0.8	Pz	0.95	0.7	Pz	0.84	0.48

Participant ID 23 qEEG Record: Posttest Eyes Closed								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.95	0.97	Average	0.94	0.94	Average	0.95	0.93
FP1	1.0	0.99	FP1	0.92	0.99	FP1	0.95	0.93
FP2	0.99	1.0	FP2	0.94	1.0	FP2	0.99	0.97
F3	0.98	1.0	F3	0.97	0.99	F3	0.99	0.91
F4	1.0	0.99	F4	0.99	0.95	F4	0.92	0.92
C3	0.99	0.94	C3	0.95	0.86	C3	0.98	0.87
C4	0.96	0.93	C4	0.97	0.96	C4	0.99	0.96
P3	0.91	0.99	P3	0.97	0.96	P3	0.94	0.98
P4	0.88	1.0	P4	0.92	0.97	P4	0.93	0.94
O1	0.94	0.96	O1	0.95	0.93	O1	0.95	0.93
O2	0.92	0.98	O2	0.94	0.94	O2	0.96	0.83
F7	0.96	0.98	F7	0.92	0.87	F7	1.0	0.81
F8	0.95	0.97	F8	0.86	0.86	F8	0.88	0.92
T3	0.96	0.98	T3	0.96	0.86	T3	0.92	0.99
T4	0.97	0.97	T4	0.96	0.8	T4	0.97	0.9
T5	0.99	0.93	T5	0.93	0.94	T5	0.93	0.99
T6	0.9	1.0	T6	0.91	1.0	T6	0.93	0.91
Fz	0.97	1.0	Fz	1.0	0.99	Fz	0.87	0.97
Cz	1.0	0.98	Cz	0.97	0.96	Cz	0.96	0.92
Pz	0.88	0.91	Pz	0.9	0.95	Pz	0.99	0.96

Participant ID 24 qEEG Record: Pretest Eyes Closed								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.97	0.98	Average	0.97	0.95	Average	0.97	0.81
FP1	0.96	0.99	FP1	0.98	0.95	FP1	0.97	0.88
FP2	0.98	0.98	FP2	1.0	0.99	FP2	0.94	0.91
F3	0.99	0.98	F3	0.99	0.93	F3	0.99	0.92
F4	0.97	0.98	F4	1.0	0.79	F4	0.99	0.41
C3	1.0	0.99	C3	1.0	0.97	C3	0.99	0.98
C4	0.99	1.0	C4	0.93	0.99	C4	0.91	0.82
P3	0.95	0.93	P3	0.95	0.97	P3	0.97	0.74
P4	0.98	0.93	P4	0.97	0.94	P4	0.98	0.59
O1	0.96	0.99	O1	0.96	0.98	O1	0.95	0.93
O2	0.97	0.96	O2	0.96	0.92	O2	0.97	0.88
F7	0.97	1.0	F7	0.97	0.97	F7	0.96	0.9
F8	0.96	1.0	F8	0.98	0.94	F8	1.0	0.88
T3	0.96	0.95	T3	0.93	0.91	T3	0.99	0.94
T4	0.92	1.0	T4	0.99	0.99	T4	0.99	0.89
T5	0.98	0.98	T5	0.93	0.98	T5	1.0	0.97
T6	0.92	0.95	T6	0.98	0.97	T6	0.99	0.93
Fz	0.98	0.99	Fz	1.0	0.97	Fz	0.94	0.67
Cz	0.99	0.96	Cz	0.99	0.98	Cz	0.95	0.65
Pz	0.99	1.0	Pz	0.99	0.87	Pz	0.95	0.41

Participant ID 24 qEEG Record: Pretest Eyes Open								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.95	0.92	Average	0.95	0.9	Average	0.96	0.93
FP1	0.98	0.88	FP1	0.92	0.89	FP1	0.95	0.92
FP2	0.98	0.89	FP2	0.93	0.91	FP2	0.97	0.9
F3	0.94	0.95	F3	0.99	0.94	F3	0.98	0.99
F4	0.92	0.89	F4	0.93	0.86	F4	0.93	0.89
C3	0.9	0.97	C3	0.95	0.94	C3	0.92	0.91
C4	0.91	0.92	C4	0.9	0.9	C4	0.86	0.99
P3	0.96	0.91	P3	0.99	0.83	P3	0.98	0.92
P4	0.97	0.89	P4	0.98	0.86	P4	0.96	0.91
O1	0.97	0.92	O1	0.98	0.89	O1	1.0	0.99
O2	0.98	0.9	O2	0.97	0.9	O2	0.98	0.94
F7	0.94	0.89	F7	1.0	0.85	F7	0.98	0.99
F8	0.95	0.89	F8	0.9	0.89	F8	1.0	0.98
T3	0.95	0.95	T3	1.0	0.92	T3	0.98	0.89
T4	0.98	0.94	T4	0.94	0.97	T4	0.99	0.7
T5	0.96	0.95	T5	0.97	0.94	T5	0.98	0.93
T6	0.99	0.95	T6	0.92	0.93	T6	0.98	0.97
Fz	0.95	0.98	Fz	0.99	0.95	Fz	0.99	0.9
Cz	0.88	0.93	Cz	0.88	0.95	Cz	0.93	0.93
Pz	0.92	0.87	Pz	0.94	0.8	Pz	0.98	0.96

Participant ID 24 qEEG Record: Pretest Serial Sevens								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.95	0.9	Average	0.91	0.9	Average	0.92	0.9
FP1	0.95	0.85	FP1	0.95	0.8	FP1	0.93	0.94
FP2	0.88	0.97	FP2	0.79	0.93	FP2	0.93	0.83
F3	0.96	0.88	F3	0.97	0.83	F3	0.98	0.8
F4	0.98	0.87	F4	0.81	0.83	F4	0.97	0.9
C3	0.98	0.98	C3	0.82	0.89	C3	0.9	0.95
C4	0.99	0.8	C4	0.84	0.79	C4	0.81	0.77
P3	0.99	0.99	P3	0.88	0.96	P3	0.96	0.92
P4	0.91	0.95	P4	0.97	0.98	P4	0.96	0.92
O1	0.96	0.9	O1	0.96	0.94	O1	0.98	0.94
O2	0.96	0.83	O2	0.96	0.96	O2	0.94	0.89
F7	0.98	0.96	F7	0.99	0.99	F7	0.7	0.86
F8	1.0	0.85	F8	0.89	0.96	F8	0.89	0.78
T3	0.89	0.92	T3	0.84	0.82	T3	0.99	0.96
T4	0.91	0.88	T4	0.99	0.96	T4	0.95	0.98
T5	0.89	0.8	T5	0.88	0.76	T5	0.99	0.85
T6	0.91	0.78	T6	0.95	0.98	T6	0.92	0.98
Fz	0.94	0.99	Fz	0.83	0.96	Fz	0.83	0.93
Cz	0.98	0.95	Cz	0.96	0.96	Cz	0.96	0.96
Pz	0.93	0.98	Pz	1.0	0.87	Pz	0.98	0.99

Participant ID 24 qEEG Record: Posttest Eyes Open								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.96	0.91	Average	0.95	0.93	Average	0.95	0.9
FP1	0.94	1.0	FP1	0.9	0.9	FP1	0.9	0.8
FP2	0.93	0.96	FP2	0.93	1.0	FP2	0.94	0.94
F3	0.95	0.89	F3	0.92	0.93	F3	0.91	0.97
F4	0.97	0.91	F4	0.97	0.91	F4	0.99	0.93
C3	0.98	0.85	C3	0.99	0.9	C3	0.94	1.0
C4	0.99	0.92	C4	0.97	0.95	C4	0.95	0.91
P3	0.99	0.89	P3	0.97	0.96	P3	0.99	0.91
P4	0.99	0.95	P4	0.99	0.99	P4	0.93	0.95
O1	0.93	0.94	O1	0.99	0.97	O1	0.96	0.86
O2	0.97	0.92	O2	0.96	0.98	O2	0.98	0.93
F7	0.94	0.94	F7	0.99	0.87	F7	0.99	0.9
F8	0.99	0.87	F8	0.94	0.9	F8	0.95	0.9
T3	0.91	0.82	T3	0.98	0.84	T3	0.94	0.78
T4	0.94	0.79	T4	0.93	0.82	T4	0.94	0.72
T5	0.97	0.89	T5	0.92	0.89	T5	0.98	0.83
T6	0.98	0.95	T6	0.95	0.91	T6	0.97	0.79
Fz	0.92	0.91	Fz	0.87	0.95	Fz	0.93	0.96
Cz	0.95	0.95	Cz	0.93	1.0	Cz	0.89	0.97
Pz	0.97	0.92	Pz	0.98	0.97	Pz	0.96	0.99

Participant ID 24 qEEG Record: Posttest Eyes Closed								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.96	0.94	Average	0.96	0.92	Average	0.95	0.93
FP1	0.99	0.98	FP1	0.98	0.97	FP1	0.92	0.97
FP2	0.99	0.97	FP2	0.99	0.92	FP2	0.95	0.98
F3	0.96	0.97	F3	0.97	0.96	F3	0.87	0.98
F4	0.96	0.98	F4	0.94	0.93	F4	0.98	0.99
C3	0.98	0.97	C3	0.97	0.87	C3	0.93	0.98
C4	0.92	0.84	C4	0.96	0.74	C4	0.97	0.88
P3	0.94	0.89	P3	0.91	0.88	P3	0.99	0.92
P4	1.0	0.93	P4	0.94	0.94	P4	0.92	0.93
O1	0.98	0.95	O1	0.99	0.96	O1	1.0	0.99
O2	0.98	0.89	O2	0.99	0.93	O2	0.95	0.91
F7	0.9	0.97	F7	0.99	1.0	F7	0.95	0.9
F8	0.97	0.96	F8	0.94	0.95	F8	0.98	0.91
T3	0.98	0.87	T3	0.92	0.88	T3	0.97	0.77
T4	0.99	1.0	T4	0.98	0.89	T4	0.96	0.84
T5	0.98	0.89	T5	0.92	0.93	T5	0.95	0.95
T6	0.95	0.9	T6	0.98	0.93	T6	0.97	0.92
Fz	0.95	0.93	Fz	0.97	0.87	Fz	0.9	0.98
Cz	0.93	0.95	Cz	0.94	0.93	Cz	0.97	0.91
Pz	0.97	0.96	Pz	1.0	0.99	Pz	0.96	0.96

Participant ID 26 qEEG Record: Pretest Eyes Closed								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.95	0.9	Average	0.94	0.91	Average	0.93	0.81
FP1	0.9	0.98	FP1	0.99	0.96	FP1	0.97	0.84
FP2	0.85	0.95	FP2	0.92	0.9	FP2	0.89	0.86
F3	0.99	0.94	F3	0.98	0.91	F3	0.9	0.78
F4	0.97	0.95	F4	0.98	0.97	F4	0.95	0.82
C3	0.94	0.95	C3	0.98	0.99	C3	0.95	0.96
C4	0.98	0.97	C4	0.97	0.97	C4	0.85	0.98
P3	0.98	0.88	P3	0.9	0.92	P3	0.98	0.88
P4	0.92	0.91	P4	0.88	0.97	P4	0.84	0.86
O1	0.92	0.88	O1	0.86	0.93	O1	0.99	0.9
O2	0.94	0.99	O2	0.88	0.98	O2	0.9	0.77
F7	0.97	0.93	F7	0.98	0.99	F7	0.92	0.88
F8	0.93	0.85	F8	0.96	0.85	F8	0.95	0.83
T3	1.0	0.93	T3	0.97	0.99	T3	0.95	0.92
T4	0.95	0.94	T4	0.95	0.99	T4	0.96	0.76
T5	0.93	0.82	T5	0.95	0.76	T5	0.98	0.75
T6	0.99	0.67	T6	0.96	0.67	T6	0.96	0.68
Fz	0.86	0.89	Fz	0.88	0.79	Fz	0.9	0.69
Cz	0.99	0.75	Cz	0.98	0.67	Cz	0.92	0.62
Pz	0.96	0.96	Pz	0.98	0.95	Pz	0.98	0.67

Participant ID 26 qEEG Record: Pretest Eyes Open								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.95	0.93	Average	0.98	0.92	Average	0.98	0.92
FP1	0.96	0.86	FP1	0.99	0.91	FP1	0.99	0.91
FP2	0.97	0.86	FP2	0.95	0.94	FP2	0.95	0.94
F3	0.96	0.91	F3	0.97	0.87	F3	0.97	0.87
F4	0.93	0.98	F4	1.0	0.85	F4	1.0	0.85
C3	0.91	0.87	C3	0.98	0.76	C3	0.98	0.76
C4	0.94	0.99	C4	0.98	0.87	C4	0.98	0.87
P3	0.99	0.95	P3	0.93	0.98	P3	0.93	0.98
P4	0.93	0.94	P4	0.98	0.92	P4	0.98	0.92
O1	0.95	0.95	O1	0.96	0.98	O1	0.96	0.98
O2	0.96	0.99	O2	0.96	0.99	O2	0.96	0.99
F7	0.94	0.92	F7	1.0	0.94	F7	1.0	0.94
F8	0.96	0.91	F8	0.97	0.96	F8	0.97	0.96
T3	0.97	0.89	T3	0.99	0.99	T3	0.99	0.99
T4	0.94	0.96	T4	0.94	0.99	T4	0.94	0.99
T5	0.98	0.95	T5	1.0	0.95	T5	1.0	0.95
T6	0.97	0.96	T6	0.98	0.92	T6	0.98	0.92
Fz	0.85	0.88	Fz	0.98	0.86	Fz	0.98	0.86
Cz	0.95	0.91	Cz	0.98	0.91	Cz	0.98	0.91
Pz	0.95	0.97	Pz	0.99	0.9	Pz	0.99	0.9

Participant ID 26 qEEG Record: Pretest Serial Sevens								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.96	0.9	Average	0.94	0.92	Average	0.91	0.93
FP1	0.99	0.87	FP1	0.92	0.96	FP1	0.87	0.88
FP2	0.98	0.91	FP2	0.95	0.97	FP2	0.97	0.95
F3	0.99	0.88	F3	0.94	0.97	F3	0.98	0.98
F4	0.97	0.88	F4	0.99	0.97	F4	0.78	0.92
C3	0.92	0.72	C3	0.89	0.75	C3	0.92	0.79
C4	0.97	0.81	C4	0.97	0.89	C4	0.92	0.95
P3	0.99	0.99	P3	0.93	0.93	P3	0.98	0.92
P4	0.95	0.89	P4	0.95	0.94	P4	0.95	0.94
O1	1.0	0.93	O1	0.98	0.95	O1	0.92	0.98
O2	0.97	0.94	O2	0.99	0.89	O2	0.95	0.99
F7	0.95	0.87	F7	0.99	0.81	F7	0.89	0.97
F8	0.98	0.89	F8	0.99	0.96	F8	0.94	0.89
T3	0.99	0.92	T3	1.0	0.95	T3	0.97	0.98
T4	1.0	0.93	T4	0.89	0.98	T4	0.91	0.92
T5	0.96	0.94	T5	0.91	0.83	T5	0.96	0.85
T6	0.94	0.91	T6	0.99	0.93	T6	0.97	1.0
Fz	0.96	0.96	Fz	0.83	0.98	Fz	0.73	0.95
Cz	0.86	0.9	Cz	0.82	0.97	Cz	0.99	0.86
Pz	0.98	0.9	Pz	0.91	0.85	Pz	0.78	0.87

Participant ID 26 qEEG Record: Posttest Eyes Open								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.95	0.94	Average	0.94	0.94	Average	0.93	0.91
FP1	0.92	0.86	FP1	0.98	0.79	FP1	0.94	0.85
FP2	0.91	0.97	FP2	0.96	0.98	FP2	0.96	0.93
F3	0.93	1.0	F3	0.91	1.0	F3	0.99	0.94
F4	0.99	0.96	F4	0.97	0.98	F4	0.93	0.97
C3	0.99	0.94	C3	0.98	0.99	C3	0.99	0.91
C4	0.98	0.93	C4	0.96	0.97	C4	0.9	0.92
P3	0.96	0.93	P3	0.93	0.91	P3	0.94	0.92
P4	0.97	0.91	P4	0.98	0.93	P4	1.0	0.87
O1	0.75	0.82	O1	0.8	0.76	O1	0.66	0.69
O2	0.99	0.88	O2	0.96	0.87	O2	0.83	0.72
F7	0.96	0.96	F7	0.95	1.0	F7	0.96	0.98
F8	0.99	0.91	F8	0.94	0.88	F8	0.98	0.92
T3	0.98	0.99	T3	0.98	0.99	T3	0.98	0.96
T4	0.92	0.96	T4	0.92	0.95	T4	0.93	0.87
T5	0.95	0.97	T5	0.96	0.98	T5	0.97	0.94
T6	0.96	0.95	T6	0.91	0.95	T6	0.96	0.99
Fz	0.9	0.99	Fz	0.83	0.99	Fz	0.82	0.96
Cz	0.96	0.93	Cz	0.87	0.96	Cz	0.93	0.94
Pz	0.99	0.96	Pz	0.99	0.97	Pz	0.92	0.93

Participant ID 26 qEEG Record: Posttest Eyes Closed								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.95	0.92	Average	0.93	0.91	Average	0.92	0.89
FP1	0.92	0.86	FP1	0.91	0.7	FP1	0.86	0.93
FP2	1.0	0.99	FP2	0.94	0.95	FP2	0.98	0.81
F3	0.92	0.86	F3	0.98	0.87	F3	0.91	0.79
F4	1.0	0.92	F4	0.96	0.91	F4	0.96	0.83
C3	0.99	0.98	C3	0.94	0.96	C3	0.94	0.89
C4	0.97	0.96	C4	0.85	0.93	C4	0.98	0.96
P3	0.88	0.98	P3	0.98	0.81	P3	0.98	0.96
P4	1.0	0.93	P4	0.92	0.9	P4	0.9	0.92
O1	0.75	0.83	O1	0.94	0.99	O1	0.97	0.92
O2	0.99	0.84	O2	0.94	0.96	O2	0.82	0.86
F7	0.81	0.89	F7	0.78	0.99	F7	0.93	0.78
F8	0.99	0.98	F8	0.87	0.98	F8	0.95	0.96
T3	0.99	0.98	T3	0.91	0.88	T3	0.96	0.9
T4	0.97	1.0	T4	0.96	0.88	T4	0.84	0.88
T5	0.98	0.96	T5	0.93	0.99	T5	0.93	0.95
T6	0.99	0.87	T6	0.99	0.95	T6	0.86	0.95
Fz	0.96	0.81	Fz	0.94	0.82	Fz	0.93	0.83
Cz	1.0	0.85	Cz	0.98	0.86	Cz	0.9	0.87
Pz	0.95	0.98	Pz	0.98	0.96	Pz	0.97	0.94

Participant ID 27 qEEG Record: Pretest Eyes Open								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.98	0.93	Average	0.97	0.93	Average	0.97	0.95
FP1	0.95	0.91	FP1	0.98	0.91	FP1	0.94	0.96
FP2	1.0	0.87	FP2	0.97	0.84	FP2	0.98	0.82
F3	0.98	0.95	F3	0.97	0.99	F3	0.98	0.89
F4	1.0	0.94	F4	1.0	0.95	F4	0.98	0.98
C3	0.99	0.92	C3	1.0	0.95	C3	0.97	0.97
C4	1.0	0.94	C4	0.98	0.97	C4	0.99	0.89
P3	1.0	0.92	P3	0.96	0.93	P3	0.95	0.97
P4	0.94	0.94	P4	0.98	0.92	P4	0.95	1.0
O1	0.99	0.92	O1	0.96	0.89	O1	0.99	0.91
O2	1.0	0.94	O2	0.96	0.92	O2	0.94	0.99
F7	0.98	0.87	F7	0.96	0.84	F7	0.92	0.92
F8	0.99	0.98	F8	0.96	0.98	F8	0.99	0.98
T3	0.96	0.97	T3	0.96	0.97	T3	0.95	1.0
T4	0.97	0.95	T4	1.0	0.88	T4	0.98	0.93
T5	0.96	0.98	T5	0.96	0.98	T5	0.99	0.98
T6	0.99	1.0	T6	0.99	0.98	T6	0.99	0.99
Fz	0.98	0.95	Fz	0.95	0.98	Fz	0.99	0.97
Cz	0.96	0.92	Cz	0.96	0.96	Cz	0.94	0.96
Pz	0.96	0.91	Pz	0.98	0.87	Pz	0.97	1.0

Participant ID 27 qEEG Record: Pretest Serial Sevens								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.95	0.91	Average	0.94	0.94	Average	0.94	0.95
FP1	0.96	0.86	FP1	0.96	0.94	FP1	0.92	0.9
FP2	0.84	0.84	FP2	0.77	0.99	FP2	0.91	0.99
F3	0.98	0.92	F3	0.94	0.93	F3	0.9	0.98
F4	0.94	0.88	F4	0.97	0.94	F4	0.91	0.98
C3	0.9	0.98	C3	0.89	0.94	C3	0.99	0.92
C4	0.96	0.84	C4	1.0	0.98	C4	0.96	1.0
P3	0.94	0.84	P3	0.96	0.9	P3	0.89	0.92
P4	0.99	0.85	P4	0.93	0.97	P4	0.96	0.97
O1	0.97	0.9	O1	0.94	0.96	O1	0.94	0.99
O2	0.97	0.84	O2	0.94	0.98	O2	0.91	0.92
F7	0.97	0.99	F7	0.85	0.9	F7	0.91	0.85
F8	0.95	0.91	F8	0.96	0.88	F8	0.94	0.99
T3	0.97	0.91	T3	0.95	0.94	T3	0.94	0.85
T4	0.97	0.99	T4	0.98	0.96	T4	1.0	0.96
T5	0.96	0.97	T5	0.93	0.95	T5	0.98	0.91
T6	0.93	0.97	T6	0.98	0.89	T6	0.98	0.98
Fz	0.98	0.96	Fz	0.99	0.93	Fz	0.97	0.89
Cz	0.95	0.96	Cz	0.99	0.95	Cz	0.89	0.97
Pz	0.91	0.84	Pz	0.91	0.92	Pz	0.94	0.99

Participant ID 27 qEEG Record: Posttest Eyes Open								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.97	0.96	Average	0.96	0.94	Average	0.94	0.95
FP1	0.98	1.0	FP1	0.97	0.95	FP1	0.95	0.94
FP2	0.93	0.89	FP2	0.89	0.97	FP2	0.93	0.92
F3	0.98	0.98	F3	1.0	0.93	F3	0.96	0.96
F4	0.97	0.99	F4	0.91	0.89	F4	0.94	1.0
C3	1.0	0.99	C3	0.98	0.95	C3	0.99	0.97
C4	0.96	0.99	C4	1.0	0.9	C4	0.94	0.94
P3	1.0	0.98	P3	0.97	0.92	P3	0.96	0.96
P4	0.96	0.95	P4	0.97	0.87	P4	0.91	0.94
O1	0.95	0.98	O1	0.94	0.96	O1	0.99	0.96
O2	0.96	0.97	O2	0.98	0.94	O2	0.89	0.99
F7	0.96	0.97	F7	0.94	0.91	F7	0.89	0.98
F8	0.92	0.92	F8	0.9	0.93	F8	0.86	0.89
T3	0.98	0.99	T3	0.96	0.98	T3	0.97	0.96
T4	0.99	0.9	T4	0.95	0.93	T4	0.93	0.92
T5	0.99	0.98	T5	0.95	0.98	T5	0.97	0.93
T6	0.96	0.95	T6	0.99	0.98	T6	0.93	0.99
Fz	1.0	0.92	Fz	0.97	1.0	Fz	0.94	0.94
Cz	0.99	0.97	Cz	0.97	0.97	Cz	0.98	0.95
Pz	0.99	0.94	Pz	0.97	0.84	Pz	0.95	0.99

Participant ID 27 qEEG Record: Posttest Eyes Closed								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.95	0.95	Average	0.96	0.93	Average	0.95	0.94
FP1	0.94	0.99	FP1	0.95	1.0	FP1	0.92	0.94
FP2	0.95	0.9	FP2	0.97	0.93	FP2	0.87	0.98
F3	0.96	0.95	F3	0.95	0.91	F3	0.98	0.98
F4	0.99	0.91	F4	1.0	0.91	F4	0.99	0.97
C3	0.99	0.97	C3	0.99	0.97	C3	0.94	0.98
C4	0.93	0.96	C4	0.95	0.99	C4	0.98	0.95
P3	0.92	0.91	P3	0.94	0.85	P3	0.94	0.93
P4	0.93	1.0	P4	1.0	0.93	P4	0.94	0.92
O1	0.92	0.86	O1	0.94	0.87	O1	0.93	0.96
O2	0.99	0.95	O2	1.0	0.95	O2	0.97	0.95
F7	0.98	0.94	F7	1.0	0.9	F7	0.99	0.92
F8	0.91	0.98	F8	0.97	0.98	F8	0.95	0.97
T3	0.98	0.99	T3	0.95	0.98	T3	0.97	0.99
T4	0.99	0.95	T4	0.95	0.99	T4	0.92	0.92
T5	0.95	0.94	T5	0.96	0.93	T5	0.98	0.92
T6	0.93	0.94	T6	0.96	0.95	T6	0.94	0.86
Fz	0.98	0.92	Fz	0.98	0.85	Fz	0.96	0.83
Cz	0.96	0.97	Cz	0.95	0.95	Cz	0.98	1.0
Pz	0.89	0.94	Pz	0.91	0.9	Pz	0.91	0.95

Participant ID 28 qEEG Record: Pretest Eyes Closed								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.95	0.93	Average	0.94	0.91	Average	0.93	0.92
FP1	0.98	0.92	FP1	1.0	0.87	FP1	0.99	0.91
FP2	0.95	0.95	FP2	0.94	0.93	FP2	0.93	0.96
F3	0.99	0.99	F3	0.93	0.96	F3	0.99	0.9
F4	0.98	0.93	F4	0.95	0.87	F4	0.9	0.91
C3	0.94	0.9	C3	0.83	0.92	C3	0.84	0.97
C4	0.94	0.95	C4	0.94	0.94	C4	0.98	0.81
P3	0.89	0.98	P3	0.87	0.89	P3	0.83	0.97
P4	0.94	0.97	P4	0.97	0.92	P4	0.98	0.92
O1	0.93	0.88	O1	0.94	0.88	O1	0.94	0.93
O2	0.94	0.91	O2	1.0	0.93	O2	0.94	0.95
F7	0.98	1.0	F7	0.89	0.94	F7	0.92	0.93
F8	0.96	0.9	F8	0.98	0.89	F8	0.92	0.92
T3	0.99	0.92	T3	0.97	0.98	T3	0.91	1.0
T4	0.96	0.96	T4	1.0	1.0	T4	0.9	0.99
T5	0.88	0.92	T5	0.93	0.83	T5	0.89	0.94
T6	0.88	0.85	T6	0.92	0.86	T6	0.9	0.83
Fz	0.98	0.92	Fz	0.96	0.85	Fz	0.96	0.95
Cz	0.96	0.99	Cz	0.97	0.91	Cz	1.0	0.96
Pz	0.9	0.9	Pz	0.94	0.86	Pz	0.95	0.77

Participant ID 28 qEEG Record: Pretest Eyes Open								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.96	0.93	Average	0.96	0.94	Average	0.96	0.95
FP1	0.98	1.0	FP1	0.97	0.96	FP1	0.98	0.94
FP2	0.95	1.0	FP2	0.9	0.97	FP2	0.98	0.95
F3	0.98	0.9	F3	0.96	0.94	F3	0.99	0.9
F4	0.93	0.91	F4	0.93	0.95	F4	0.97	0.96
C3	0.98	0.89	C3	0.99	0.97	C3	0.97	0.96
C4	0.95	0.93	C4	0.98	0.99	C4	0.96	0.95
P3	0.94	0.87	P3	0.89	0.83	P3	0.89	0.85
P4	0.97	0.91	P4	0.98	0.96	P4	0.93	0.92
O1	0.91	0.9	O1	0.89	0.87	O1	0.94	0.96
O2	0.98	0.96	O2	0.99	0.94	O2	0.96	0.97
F7	0.96	0.94	F7	0.98	0.97	F7	1.0	0.97
F8	0.96	0.99	F8	0.98	0.97	F8	0.95	0.95
T3	0.99	0.91	T3	1.0	1.0	T3	0.97	0.96
T4	0.99	0.98	T4	0.92	0.95	T4	0.96	0.98
T5	0.93	0.88	T5	0.9	0.85	T5	0.95	0.93
T6	0.99	0.97	T6	1.0	0.99	T6	0.95	0.96
Fz	0.96	0.89	Fz	0.99	0.92	Fz	0.99	0.97
Cz	0.96	0.88	Cz	0.98	0.95	Cz	0.98	1.0
Pz	0.97	0.9	Pz	0.95	0.94	Pz	0.93	0.93

Participant ID 28 qEEG Record: Pretest Serial Sevens								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.95	0.94	Average	0.96	0.92	Average	0.96	0.93
FP1	0.89	0.92	FP1	0.96	0.94	FP1	0.93	0.78
FP2	0.94	0.98	FP2	0.96	0.91	FP2	0.86	0.92
F3	0.87	0.95	F3	0.94	0.9	F3	0.98	0.92
F4	0.98	0.98	F4	0.98	0.96	F4	1.0	0.99
C3	0.97	0.91	C3	0.99	0.94	C3	1.0	0.98
C4	0.96	0.9	C4	0.88	0.97	C4	0.99	0.93
P3	0.95	0.98	P3	0.97	0.99	P3	0.94	0.93
P4	0.96	0.92	P4	0.95	0.97	P4	0.97	0.95
O1	0.98	0.94	O1	0.93	0.83	O1	0.94	0.98
O2	0.98	0.99	O2	0.97	0.92	O2	0.99	0.99
F7	0.88	0.96	F7	0.97	0.85	F7	0.97	0.91
F8	0.98	0.95	F8	0.97	0.97	F8	0.88	0.96
T3	0.97	0.95	T3	0.96	0.9	T3	0.92	0.97
T4	0.96	0.93	T4	0.94	0.99	T4	0.96	0.98
T5	0.95	0.96	T5	1.0	0.9	T5	0.98	0.9
T6	0.98	0.98	T6	0.91	0.89	T6	0.95	0.98
Fz	0.94	0.93	Fz	0.98	0.96	Fz	0.98	0.98
Cz	0.95	0.96	Cz	0.9	0.94	Cz	0.94	0.95
Pz	0.98	0.81	Pz	0.99	0.78	Pz	0.98	0.73

Participant ID 28 qEEG Record: Posttest Eyes Open								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.96	0.93	Average	0.94	0.9	Average	0.95	0.91
FP1	0.93	0.78	FP1	0.94	0.88	FP1	0.85	0.91
FP2	0.86	0.92	FP2	0.89	0.76	FP2	0.99	0.74
F3	0.98	0.92	F3	0.91	0.96	F3	0.92	0.93
F4	1.0	0.99	F4	0.96	0.92	F4	0.98	0.99
C3	1.0	0.98	C3	0.92	0.84	C3	0.91	0.96
C4	0.99	0.93	C4	0.99	0.85	C4	0.99	0.94
P3	0.94	0.93	P3	0.93	0.94	P3	0.91	0.95
P4	0.97	0.95	P4	0.87	0.89	P4	0.93	0.9
O1	0.94	0.98	O1	0.98	0.8	O1	0.96	0.82
O2	0.99	0.99	O2	0.98	0.91	O2	0.99	0.92
F7	0.97	0.91	F7	1.0	0.91	F7	0.98	0.9
F8	0.88	0.96	F8	0.96	0.93	F8	0.91	0.85
T3	0.92	0.97	T3	0.94	0.88	T3	0.98	0.97
T4	0.96	0.98	T4	0.95	0.92	T4	0.97	1.0
T5	0.98	0.9	T5	0.99	0.94	T5	0.97	0.91
T6	0.95	0.98	T6	0.97	0.98	T6	0.94	0.91
Fz	0.98	0.98	Fz	0.93	0.9	Fz	0.99	0.93
Cz	0.94	0.95	Cz	0.89	0.91	Cz	0.93	0.98
Pz	0.98	0.73	Pz	0.86	0.88	Pz	0.87	0.87

Participant ID 28 qEEG Record: Posttest Eyes Closed								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.96	0.92	Average	0.94	0.9	Average	0.93	0.89
FP1	0.99	0.85	FP1	0.98	0.84	FP1	0.95	0.94
FP2	0.99	0.76	FP2	1.0	0.75	FP2	0.92	0.68
F3	0.96	0.98	F3	0.99	0.99	F3	0.98	0.92
F4	0.96	0.96	F4	0.95	0.9	F4	0.96	0.85
C3	0.9	1.0	C3	0.95	1.0	C3	0.88	0.98
C4	0.95	0.9	C4	0.92	0.84	C4	0.88	0.91
P3	0.99	0.85	P3	0.99	0.82	P3	1.0	0.91
P4	0.98	0.94	P4	0.95	0.99	P4	0.93	0.95
O1	0.95	0.87	O1	0.96	0.88	O1	0.93	0.96
O2	0.97	0.99	O2	0.93	0.93	O2	0.94	0.98
F7	0.93	0.97	F7	0.95	0.91	F7	0.94	0.84
F8	0.98	0.9	F8	0.96	0.86	F8	0.84	0.71
T3	0.9	0.96	T3	0.91	0.93	T3	0.98	0.92
T4	0.96	0.84	T4	0.91	0.88	T4	0.94	0.92
T5	1.0	0.93	T5	0.94	0.89	T5	1.0	0.98
T6	0.97	0.98	T6	0.85	0.88	T6	0.89	0.9
Fz	0.94	1.0	Fz	0.95	0.96	Fz	0.89	0.89
Cz	0.89	0.98	Cz	0.87	0.98	Cz	0.97	0.85
Pz	0.93	0.84	Pz	0.94	0.78	Pz	0.93	0.81

Participant ID 29 qEEG Record: Pretest Eyes Closed								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.97	0.96	Average	0.96	0.94	Average	0.97	0.95
FP1	0.99	0.97	FP1	0.98	0.97	FP1	0.97	0.92
FP2	0.94	0.97	FP2	0.91	0.95	FP2	0.96	0.91
F3	0.96	0.97	F3	0.98	0.98	F3	0.96	0.96
F4	0.99	1.0	F4	0.97	0.99	F4	0.93	0.98
C3	0.96	0.97	C3	0.99	0.97	C3	0.97	0.92
C4	0.97	0.93	C4	0.91	0.88	C4	0.98	0.98
P3	0.98	0.94	P3	0.98	0.91	P3	1.0	0.99
P4	0.94	0.88	P4	0.9	0.88	P4	0.95	0.89
O1	0.97	1.0	O1	0.94	0.96	O1	0.96	0.99
O2	0.99	0.87	O2	0.98	0.89	O2	0.96	0.97
F7	0.97	0.99	F7	0.96	0.94	F7	0.97	0.96
F8	0.92	0.92	F8	0.9	0.86	F8	0.95	0.97
T3	0.98	0.98	T3	0.95	0.88	T3	0.98	0.87
T4	0.94	1.0	T4	0.97	0.96	T4	0.97	0.89
T5	0.99	0.93	T5	0.99	1.0	T5	0.99	0.97
T6	0.94	0.99	T6	1.0	0.96	T6	0.99	1.0
Fz	0.98	1.0	Fz	0.97	0.99	Fz	0.98	0.97
Cz	0.99	0.96	Cz	0.99	0.95	Cz	1.0	0.95
Pz	0.99	1.0	Pz	0.95	0.97	Pz	0.96	0.97

Participant ID 29 qEEG Record: Pretest Eyes Open								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.97	0.95	Average	0.97	0.96	Average	0.97	0.93
FP1	0.95	0.99	FP1	0.96	0.98	FP1	0.99	1.0
FP2	0.95	0.95	FP2	0.96	0.97	FP2	0.99	0.89
F3	0.98	0.99	F3	0.91	0.88	F3	0.83	0.8
F4	0.99	0.97	F4	0.99	0.99	F4	0.97	0.99
C3	0.98	0.94	C3	0.99	0.97	C3	0.94	0.9
C4	1.0	0.92	C4	0.98	0.96	C4	0.99	1.0
P3	0.96	0.94	P3	0.95	0.99	P3	0.98	0.94
P4	1.0	0.95	P4	0.98	0.97	P4	0.97	0.99
O1	0.96	0.94	O1	0.98	0.98	O1	0.98	0.93
O2	0.98	0.97	O2	0.95	0.97	O2	0.99	0.96
F7	0.97	0.98	F7	0.98	0.97	F7	0.97	0.92
F8	0.99	0.91	F8	0.98	0.9	F8	0.98	0.92
T3	0.97	0.94	T3	0.99	0.86	T3	0.97	0.78
T4	0.97	0.99	T4	0.98	0.92	T4	1.0	0.87
T5	0.96	0.97	T5	0.98	0.97	T5	1.0	0.97
T6	0.99	0.95	T6	0.96	0.96	T6	0.97	0.99
Fz	0.96	0.96	Fz	0.96	0.98	Fz	0.94	0.96
Cz	0.97	0.95	Cz	0.96	1.0	Cz	0.99	0.95
Pz	0.98	0.94	Pz	0.96	0.99	Pz	1.0	0.99

Participant ID 29 qEEG Record: Pretest Serial Sevens								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.97	0.97	Average	0.97	0.94	Average	0.96	0.95
FP1	0.94	0.93	FP1	0.92	0.87	FP1	0.97	0.89
FP2	0.97	0.94	FP2	1.0	0.94	FP2	0.98	0.93
F3	0.98	0.95	F3	0.94	0.92	F3	0.9	0.97
F4	0.99	0.99	F4	0.97	0.97	F4	0.97	0.94
C3	0.98	0.97	C3	1.0	0.96	C3	0.92	0.99
C4	0.99	0.99	C4	0.99	0.98	C4	0.95	0.94
P3	0.99	0.92	P3	0.99	0.95	P3	1.0	0.94
P4	0.98	0.98	P4	0.94	0.94	P4	0.98	0.98
O1	0.99	0.99	O1	1.0	0.95	O1	0.96	0.97
O2	0.96	0.98	O2	0.95	0.94	O2	1.0	0.98
F7	0.99	0.96	F7	0.96	0.95	F7	0.98	0.93
F8	0.95	1.0	F8	0.96	0.92	F8	0.98	0.99
T3	0.95	0.99	T3	0.99	0.92	T3	0.94	0.91
T4	1.0	0.92	T4	0.95	0.84	T4	0.96	0.82
T5	0.94	0.99	T5	0.97	0.99	T5	0.94	0.94
T6	0.96	0.99	T6	1..0	0.94	T6	0.99	0.98
Fz	0.96	0.98	Fz	0.96	1.0	Fz	0.92	0.91
Cz	0.98	0.98	Cz	0.98	0.93	Cz	0.99	0.95
Pz	0.99	0.95	Pz	0.98	1.0	Pz	0.98	0.98

Participant ID 29 qEEG Record: Posttest Eyes Open								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.96	0.96	Average	0.95	0.92	Average	0.95	0.92
FP1	0.93	0.94	FP1	0.94	0.92	FP1	0.99	0.94
FP2	0.98	0.93	FP2	0.97	0.9	FP2	1.0	0.94
F3	0.99	0.93	F3	0.97	0.83	F3	0.99	0.77
F4	0.97	0.98	F4	0.92	0.94	F4	0.91	0.9
C3	0.97	0.96	C3	0.92	0.91	C3	0.98	0.98
C4	0.97	0.96	C4	0.95	0.97	C4	0.97	0.99
P3	0.97	0.99	P3	0.97	0.96	P3	0.98	0.93
P4	0.88	0.91	P4	0.79	0.8	P4	0.71	0.66
O1	0.96	0.94	O1	0.96	0.95	O1	0.99	1.0
O2	0.98	0.97	O2	0.99	0.93	O2	0.99	0.98
F7	0.99	0.97	F7	0.96	0.92	F7	0.95	0.92
F8	0.9	0.91	F8	0.95	0.83	F8	0.88	0.87
T3	0.98	0.97	T3	0.99	0.89	T3	0.99	0.89
T4	0.9	0.99	T4	0.92	1.0	T4	0.87	0.97
T5	0.97	0.93	T5	0.96	0.97	T5	0.97	0.97
T6	0.92	0.99	T6	0.95	0.96	T6	0.9	0.94
Fz	1.0	0.98	Fz	0.99	1.0	Fz	0.98	0.94
Cz	0.99	0.96	Cz	0.98	0.93	Cz	0.98	0.97
Pz	0.97	0.99	Pz	0.96	0.94	Pz	1.0	0.92

Participant ID 29 qEEG Record: Posttest Eyes Closed								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.95	0.95	Average	0.96	0.95	Average	0.96	0.94
FP1	0.91	0.97	FP1	0.94	0.9	FP1	0.92	0.99
FP2	1.0	0.98	FP2	0.98	0.95	FP2	0.98	0.92
F3	0.96	0.97	F3	0.91	0.98	F3	0.96	0.97
F4	0.96	0.94	F4	0.98	0.92	F4	0.94	0.93
C3	0.94	0.97	C3	0.95	0.99	C3	0.97	0.89
C4	0.88	0.96	C4	0.91	0.95	C4	0.96	0.98
P3	0.96	0.96	P3	0.95	1.0	P3	0.94	0.99
P4	0.94	0.99	P4	0.94	0.94	P4	0.96	0.98
O1	0.96	0.95	O1	0.93	0.94	O1	0.97	1.0
O2	0.99	0.98	O2	0.99	0.98	O2	0.99	0.91
F7	1.0	0.94	F7	0.9	0.92	F7	0.97	0.87
F8	0.87	0.89	F8	0.96	0.99	F8	1.0	0.88
T3	0.99	0.91	T3	0.95	0.86	T3	0.91	0.87
T4	0.86	0.94	T4	0.93	1.0	T4	0.86	1.0
T5	0.97	0.94	T5	0.99	0.96	T5	0.98	0.82
T6	0.98	0.97	T6	0.99	0.99	T6	0.97	0.96
Fz	0.98	0.94	Fz	0.96	0.97	Fz	0.98	0.99
Cz	0.92	0.94	Cz	1.0	0.94	Cz	0.98	0.91
Pz	0.95	1.0	Pz	0.99	0.92	Pz	1.0	0.97

Participant ID 30 qEEG Record: Pretest Eyes Closed								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.97	0.95	Average	0.97	0.94	Average	0.98	0.96
FP1	0.99	0.9	FP1	0.94	0.87	FP1	0.98	0.94
FP2	0.99	0.99	FP2	0.94	0.96	FP2	1.0	0.97
F3	0.95	0.96	F3	0.97	0.94	F3	0.98	0.92
F4	0.97	1.0	F4	0.99	0.98	F4	0.98	0.98
C3	0.95	0.97	C3	0.97	0.99	C3	0.96	0.95
C4	0.99	0.98	C4	0.97	0.95	C4	0.98	0.99
P3	0.93	0.94	P3	0.97	0.97	P3	0.96	0.98
P4	0.99	0.89	P4	0.98	0.89	P4	0.99	0.94
O1	0.97	0.84	O1	1.0	0.9	O1	0.98	0.91
O2	1.0	0.92	O2	0.97	0.94	O2	0.99	0.97
F7	0.99	0.94	F7	0.95	0.95	F7	0.97	0.99
F8	0.97	0.97	F8	0.98	0.99	F8	0.99	1.0
T3	0.92	0.98	T3	0.99	0.99	T3	0.98	0.97
T4	0.97	0.98	T4	0.94	0.92	T4	0.99	0.96
T5	0.97	0.97	T5	0.99	0.98	T5	0.97	0.99
T6	0.94	0.97	T6	0.94	0.93	T6	0.95	0.96
Fz	0.98	1.0	Fz	0.96	0.98	Fz	0.98	1.0
Cz	0.98	0.98	Cz	1.0	0.98	Cz	0.98	0.95
Pz	0.95	0.85	Pz	1.0	0.8	Pz	0.96	0.85

Participant ID 30 qEEG Record: Pretest Eyes Open								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.97	0.94	Average	0.96	0.94	Average	0.96	0.93
FP1	0.91	0.93	FP1	0.88	0.96	FP1	0.97	0.91
FP2	0.89	0.97	FP2	0.86	0.96	FP2	0.88	0.95
F3	0.95	0.87	F3	0.92	0.92	F3	0.95	0.97
F4	0.97	0.96	F4	0.95	0.99	F4	0.97	0.96
C3	0.94	0.95	C3	0.97	0.99	C3	0.99	0.98
C4	1.0	0.95	C4	0.98	0.97	C4	0.97	0.94
P3	0.94	0.91	P3	0.92	1.0	P3	0.89	0.91
P4	0.98	0.98	P4	0.97	0.95	P4	0.99	0.97
O1	1.0	0.75	O1	0.99	0.82	O1	0.97	0.86
O2	0.99	0.91	O2	0.97	0.97	O2	0.97	0.93
F7	0.94	0.92	F7	0.99	0.94	F7	0.94	0.9
F8	0.96	0.96	F8	0.98	0.94	F8	0.95	0.85
T3	0.99	0.94	T3	0.97	0.87	T3	0.97	0.87
T4	0.96	0.98	T4	0.97	0.96	T4	0.97	0.92
T5	0.96	0.99	T5	0.99	0.94	T5	1.0	0.93
T6	0.99	0.98	T6	0.98	0.99	T6	0.97	0.99
Fz	1.0	0.88	Fz	0.99	0.86	Fz	0.96	0.94
Cz	0.99	1.0	Cz	0.95	0.92	Cz	0.88	0.83
Pz	1.0	1.0	Pz	0.97	0.95	Pz	0.97	0.96

Participant ID 30 qEEG Record: Pretest Serial Sevens								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.96	0.95	Average	0.96	0.94	Average	0.96	0.93
FP1	0.99	0.89	FP1	0.96	0.85	FP1	0.95	0.85
FP2	0.9	0.95	FP2	0.94	0.9	FP2	0.94	0.89
F3	0.98	0.93	F3	0.96	0.91	F3	0.97	0.97
F4	0.95	0.95	F4	0.95	0.95	F4	0.94	0.99
C3	0.96	0.98	C3	0.99	1.0	C3	0.97	0.97
C4	0.99	0.96	C4	0.97	0.99	C4	0.96	1.0
P3	0.98	0.93	P3	0.95	0.84	P3	0.99	0.96
P4	0.98	0.97	P4	0.98	0.99	P4	0.95	0.94
O1	0.94	0.9	O1	0.99	0.91	O1	1.0	0.94
O2	0.97	0.86	O2	0.99	0.89	O2	0.97	0.93
F7	0.97	0.94	F7	0.96	0.94	F7	0.97	0.92
F8	0.97	0.95	F8	0.95	0.97	F8	0.96	0.88
T3	0.97	0.97	T3	0.99	0.95	T3	0.97	0.9
T4	0.95	0.97	T4	0.93	0.94	T4	0.9	0.81
T5	0.93	0.97	T5	0.99	0.87	T5	0.95	0.92
T6	0.97	0.98	T6	0.97	0.99	T6	0.97	0.88
Fz	0.99	0.98	Fz	0.98	0.99	Fz	1.0	0.92
Cz	0.93	0.98	Cz	0.89	0.93	Cz	0.89	1.0
Pz	0.99	0.97	Pz	0.99	1.0	Pz	0.94	0.97

Participant ID 30 qEEG Record: Posttest Eyes Open								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.96	0.95	Average	0.95	0.93	Average	0.93	0.94
FP1	0.86	0.94	FP1	0.84	0.97	FP1	0.96	0.9
FP2	0.92	0.98	FP2	0.91	0.99	FP2	0.9	0.99
F3	0.92	0.93	F3	0.99	0.95	F3	0.99	0.98
F4	0.96	0.95	F4	0.96	0.97	F4	0.94	1.0
C3	0.97	0.98	C3	0.99	0.99	C3	0.92	0.99
C4	1.0	0.93	C4	0.95	0.94	C4	0.96	0.89
P3	0.96	0.91	P3	0.99	0.81	P3	0.97	0.94
P4	0.97	0.91	P4	0.91	0.97	P4	0.92	0.98
O1	0.99	0.86	O1	0.96	0.81	O1	0.95	0.84
O2	0.98	0.91	O2	0.99	0.86	O2	0.93	0.97
F7	0.95	0.96	F7	0.92	0.99	F7	0.89	0.93
F8	0.94	0.97	F8	0.99	0.96	F8	0.93	0.87
T3	0.99	0.99	T3	0.99	0.86	T3	0.98	0.96
T4	1.0	0.98	T4	0.94	0.87	T4	0.86	0.9
T5	0.97	0.94	T5	0.96	0.98	T5	0.94	1.0
T6	0.91	0.98	T6	0.9	0.79	T6	0.78	0.74
Fz	0.93	0.99	Fz	0.99	0.95	Fz	0.9	0.95
Cz	0.95	0.97	Cz	0.96	0.98	Cz	0.98	0.94
Pz	0.98	0.96	Pz	0.93	0.97	Pz	0.98	0.99

Participant ID 30 qEEG Record: Posttest Eyes Closed								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.96	0.92	Average	0.93	0.93	Average	0.96	0.94
FP1	0.86	0.88	FP1	0.93	0.96	FP1	0.98	1.0
FP2	0.94	0.98	FP2	0.86	0.88	FP2	0.87	0.83
F3	0.89	0.86	F3	0.91	0.96	F3	0.91	0.99
F4	0.98	0.89	F4	0.92	1.0	F4	0.96	0.97
C3	0.95	0.87	C3	0.93	0.89	C3	1.0	0.91
C4	0.97	0.88	C4	0.93	0.99	C4	1.0	0.99
P3	0.97	0.92	P3	0.88	0.86	P3	0.92	0.82
P4	0.99	0.99	P4	0.97	0.98	P4	0.98	0.99
O1	0.96	0.97	O1	0.96	0.99	O1	0.92	0.95
O2	0.98	0.92	O2	0.99	0.93	O2	0.99	0.9
F7	0.97	0.91	F7	0.93	0.86	F7	0.96	1.0
F8	0.92	0.94	F8	0.88	0.97	F8	0.95	0.99
T3	0.98	0.95	T3	0.93	0.9	T3	0.98	0.85
T4	0.96	0.95	T4	0.92	0.89	T4	0.99	0.99
T5	0.99	0.98	T5	0.97	0.93	T5	0.97	1.0
T6	0.98	0.97	T6	0.98	0.85	T6	0.97	0.88
Fz	1.0	0.86	Fz	0.97	0.99	Fz	0.96	0.93
Cz	0.98	0.86	Cz	0.96	0.94	Cz	0.89	0.97
Pz	0.96	0.97	Pz	0.93	1.0	Pz	0.94	0.97

Participant ID 31 qEEG Record: Pretest Eyes Closed								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.97	0.9	Average	0.96	0.89	Average	0.94	0.81
FP1	0.95	0.98	FP1	0.94	0.9	FP1	0.98	0.94
FP2	0.99	0.98	FP2	0.99	0.9	FP2	0.97	0.84
F3	0.97	0.98	F3	0.92	0.98	F3	0.96	0.73
F4	1.0	0.96	F4	0.98	0.99	F4	0.98	0.78
C3	0.98	0.91	C3	0.97	0.98	C3	1.0	0.94
C4	0.94	0.79	C4	0.93	0.63	C4	0.88	0.56
P3	0.98	0.8	P3	0.96	0.87	P3	0.9	0.85
P4	0.99	0.87	P4	0.98	0.83	P4	0.9	0.89
O1	0.95	0.88	O1	0.97	0.85	O1	0.93	0.74
O2	0.99	0.87	O2	0.99	0.86	O2	0.92	0.88
F7	0.91	0.9	F7	0.86	0.89	F7	0.87	0.92
F8	0.95	0.88	F8	0.98	0.81	F8	0.91	0.74
T3	0.96	0.9	T3	0.98	0.99	T3	0.96	0.93
T4	0.99	0.75	T4	0.97	0.62	T4	0.89	0.56
T5	0.96	0.88	T5	0.99	0.97	T5	1.0	0.97
T6	0.99	0.89	T6	0.98	0.98	T6	0.93	0.78
Fz	0.97	0.98	Fz	0.96	0.98	Fz	0.97	0.83
Cz	0.99	0.96	Cz	0.98	0.98	Cz	0.96	0.78
Pz	0.97	0.9	Pz	0.97	0.91	Pz	0.93	0.76

Participant ID 31 qEEG Record: Pretest Eyes Open								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.98	0.95	Average	0.97	0.95	Average	0.95	0.94
FP1	0.99	0.97	FP1	0.98	0.99	FP1	0.99	0.92
FP2	0.99	0.98	FP2	1.0	0.92	FP2	0.96	0.94
F3	0.96	0.93	F3	0.99	0.94	F3	0.99	0.93
F4	0.98	1.0	F4	0.99	0.96	F4	0.98	0.99
C3	0.98	0.97	C3	0.96	0.94	C3	0.93	0.97
C4	0.97	0.93	C4	0.9	0.93	C4	0.91	0.9
P3	0.97	0.92	P3	0.95	0.94	P3	0.99	1.0
P4	0.99	0.96	P4	0.97	0.97	P4	0.99	0.94
O1	0.97	0.96	O1	0.99	0.96	O1	0.97	0.99
O2	0.99	0.96	O2	0.99	0.99	O2	0.94	0.98
F7	0.99	0.89	F7	0.98	0.9	F7	1.0	0.88
F8	0.98	0.98	F8	0.96	0.99	F8	0.98	0.97
T3	0.99	0.93	T3	0.97	0.96	T3	0.94	0.9
T4	1.0	0.9	T4	0.95	0.95	T4	0.92	0.89
T5	0.95	0.94	T5	0.98	0.92	T5	0.94	0.98
T6	0.99	0.93	T6	0.95	0.96	T6	0.88	0.82
Fz	1.0	0.95	Fz	0.98	0.92	Fz	1.0	0.91
Cz	0.97	0.95	Cz	0.9	0.97	Cz	0.9	0.98
Pz	1.0	0.94	Pz	0.98	0.99	Pz	0.92	0.98

Participant ID 31 qEEG Record: Pretest Serial Sevens								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.95	0.93	Average	0.95	0.93	Average	0.92	0.93
FP1	0.91	0.99	FP1	0.9	0.95	FP1	0.8	1.0
FP2	0.94	0.98	FP2	0.98	0.95	FP2	0.91	0.89
F3	0.98	0.94	F3	1.0	0.98	F3	0.79	0.88
F4	0.98	0.99	F4	0.99	0.96	F4	0.95	0.98
C3	1.0	0.89	C3	0.96	0.97	C3	0.93	0.85
C4	0.98	0.98	C4	0.98	0.85	C4	1.0	0.84
P3	0.92	0.93	P3	0.9	0.92	P3	0.89	0.92
P4	0.97	0.95	P4	0.98	0.98	P4	0.96	0.98
O1	0.93	0.93	O1	0.98	0.99	O1	0.97	0.93
O2	0.99	0.97	O2	0.87	0.97	O2	0.94	0.99
F7	0.99	0.76	F7	0.92	0.75	F7	0.88	0.82
F8	0.87	0.96	F8	0.97	0.98	F8	0.93	0.96
T3	0.97	0.87	T3	0.95	0.96	T3	0.93	0.97
T4	0.85	0.91	T4	0.86	0.87	T4	0.87	0.91
T5	0.98	0.91	T5	0.94	0.98	T5	0.99	0.98
T6	0.88	1.0	T6	0.93	0.92	T6	0.8	0.96
Fz	0.99	0.96	Fz	0.91	0.86	Fz	0.99	1.0
Cz	0.98	0.91	Cz	0.96	0.93	Cz	0.92	0.94
Pz	0.98	0.94	Pz	0.98	0.98	Pz	0.97	0.92

Participant ID 31 qEEG Record: Posttest Eyes Open								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.95	0.9	Average	0.91	0.88	Average	0.93	0.93
FP1	0.9	0.88	FP1	0.85	0.91	FP1	0.85	0.95
FP2	0.97	0.91	FP2	0.84	0.93	FP2	1.0	0.98
F3	0.98	0.82	F3	0.98	0.8	F3	0.97	0.97
F4	0.96	0.85	F4	0.92	0.81	F4	0.95	0.98
C3	0.99	0.78	C3	0.88	0.7	C3	0.81	0.74
C4	1.0	0.95	C4	0.9	1.0	C4	0.82	0.93
P3	0.96	0.95	P3	0.95	0.9	P3	0.98	0.97
P4	0.94	0.92	P4	0.96	0.79	P4	0.94	0.95
O1	0.89	1.0	O1	0.92	0.91	O1	0.97	0.95
O2	0.99	0.92	O2	0.91	0.82	O2	0.98	0.92
F7	1.0	0.85	F7	0.87	0.92	F7	0.77	0.98
F8	0.95	0.87	F8	0.85	1.0	F8	0.93	0.87
T3	0.92	0.93	T3	0.93	0.97	T3	0.98	0.85
T4	0.97	0.97	T4	0.93	0.85	T4	0.85	0.97
T5	0.96	0.97	T5	0.9	0.96	T5	0.97	0.96
T6	0.86	0.97	T6	0.9	0.81	T6	0.94	0.87
Fz	0.96	0.76	Fz	0.93	0.74	Fz	0.94	0.99
Cz	0.89	0.79	Cz	0.92	0.88	Cz	0.99	0.87
Pz	0.98	0.96	Pz	0.94	0.95	Pz	0.96	0.94

Participant ID 31 qEEG Record: Posttest Eyes Closed								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.95	0.95	Average	0.91	0.93	Average	0.93	0.96
FP1	0.97	0.98	FP1	0.86	0.89	FP1	0.94	0.95
FP2	0.94	0.96	FP2	0.85	0.9	FP2	0.97	0.95
F3	0.99	0.98	F3	0.85	1.0	F3	0.87	0.99
F4	0.9	1.0	F4	0.84	0.95	F4	0.83	0.98
C3	0.98	0.93	C3	0.89	0.86	C3	0.83	0.96
C4	0.94	0.95	C4	0.76	0.99	C4	0.85	0.92
P3	0.97	0.91	P3	0.9	0.98	P3	0.99	1.0
P4	0.97	0.91	P4	0.98	0.96	P4	0.95	1.0
O1	0.99	0.98	O1	0.97	0.9	O1	0.93	1.0
O2	0.95	0.97	O2	0.98	0.89	O2	0.98	0.96
F7	0.93	0.89	F7	0.91	0.94	F7	1.0	0.87
F8	0.9	0.95	F8	0.99	0.91	F8	1.0	0.94
T3	0.98	0.96	T3	0.92	0.95	T3	0.99	0.99
T4	0.91	0.97	T4	0.96	0.91	T4	0.96	0.98
T5	0.96	0.97	T5	0.98	0.95	T5	0.91	0.99
T6	1.0	0.99	T6	0.93	0.82	T6	0.96	0.92
Fz	0.99	0.99	Fz	0.88	1.0	Fz	0.91	0.97
Cz	0.98	0.98	Cz	0.97	0.99	Cz	0.95	0.98
Pz	0.85	0.83	Pz	0.77	0.83	Pz	0.8	0.97

Participant ID 32 qEEG Record: Pretest Eyes Closed								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.97	0.94	Average	0.96	0.93	Average	0.97	0.95
FP1	0.93	0.89	FP1	0.93	0.86	FP1	0.98	0.92
FP2	0.9	0.89	FP2	0.89	0.88	FP2	0.89	0.97
F3	0.98	0.98	F3	0.94	0.97	F3	0.98	0.91
F4	0.97	0.95	F4	0.96	1.0	F4	0.91	0.98
C3	0.97	1.0	C3	1.0	0.98	C3	0.99	0.97
C4	1.0	0.95	C4	0.94	0.89	C4	0.99	0.88
P3	0.98	0.91	P3	0.98	0.93	P3	0.97	0.99
P4	0.96	0.92	P4	0.98	0.91	P4	1.0	0.93
O1	0.99	0.86	O1	1.0	0.89	O1	0.98	0.99
O2	0.99	0.89	O2	0.95	0.94	O2	0.98	0.98
F7	0.98	0.98	F7	0.96	0.91	F7	0.9	0.96
F8	0.96	0.93	F8	0.97	0.92	F8	0.99	0.96
T3	1.0	0.97	T3	1.0	0.97	T3	0.97	1.0
T4	0.98	0.95	T4	0.96	0.93	T4	0.93	0.94
T5	0.95	0.95	T5	1.0	0.96	T5	0.98	0.98
T6	0.99	0.92	T6	0.95	0.92	T6	0.99	0.97
Fz	0.99	0.96	Fz	0.99	0.93	Fz	0.99	0.95
Cz	0.98	0.97	Cz	0.98	1.0	Cz	0.98	0.93
Pz	0.92	0.93	Pz	0.92	0.92	Pz	0.97	0.92

Participant ID 32 qEEG Record: Pretest Eyes Open								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.97	0.97	Average	0.97	0.95	Average	0.97	0.95
FP1	0.97	0.91	FP1	0.95	0.88	FP1	0.98	0.88
FP2	0.98	0.94	FP2	0.97	0.89	FP2	1.0	0.88
F3	0.97	0.98	F3	0.97	0.99	F3	0.97	0.99
F4	0.97	0.98	F4	0.97	0.97	F4	0.95	0.95
C3	0.98	0.98	C3	0.98	0.97	C3	0.98	0.98
C4	0.96	0.87	C4	0.96	0.82	C4	0.95	0.89
P3	0.98	0.98	P3	0.95	0.99	P3	0.99	0.98
P4	0.98	0.97	P4	1.0	0.97	P4	0.98	0.98
O1	0.99	0.99	O1	0.95	0.94	O1	0.99	0.99
O2	0.98	0.94	O2	0.99	0.96	O2	0.99	0.99
F7	0.97	0.94	F7	0.99	0.91	F7	0.97	0.89
F8	0.97	1.0	F8	1.0	0.95	F8	0.97	0.85
T3	0.95	0.99	T3	0.96	0.99	T3	0.98	0.98
T4	0.97	0.98	T4	1.0	0.97	T4	0.97	0.97
T5	0.96	0.97	T5	0.94	0.95	T5	0.97	0.98
T6	0.98	0.99	T6	0.94	0.98	T6	0.97	0.98
Fz	0.97	0.98	Fz	0.99	0.95	Fz	1.0	1.0
Cz	0.97	0.99	Cz	0.98	0.94	Cz	0.94	0.96
Pz	0.96	0.96	Pz	0.92	0.98	Pz	0.95	0.99

Participant ID 32 qEEG Record: Pretest Serial Sevens								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.97	0.96	Average	0.96	0.95	Average	0.96	0.96
FP1	0.98	0.98	FP1	0.97	0.9	FP1	0.98	0.95
FP2	0.99	0.98	FP2	0.97	0.88	FP2	0.98	0.92
F3	0.97	0.98	F3	0.98	0.94	F3	0.99	0.96
F4	0.96	0.92	F4	0.97	0.98	F4	0.95	0.99
C3	0.96	0.97	C3	0.95	0.96	C3	0.96	0.95
C4	0.99	0.94	C4	0.97	0.93	C4	0.94	0.97
P3	0.95	0.95	P3	0.97	0.98	P3	0.95	0.97
P4	0.97	0.91	P4	0.98	0.99	P4	1.0	0.99
O1	0.95	1.0	O1	0.97	0.99	O1	0.99	0.97
O2	0.99	1.0	O2	0.94	0.92	O2	1.0	0.95
F7	0.9	0.94	F7	0.99	0.94	F7	0.99	0.89
F8	0.98	0.97	F8	1.0	0.87	F8	0.97	0.94
T3	0.97	1.0	T3	0.94	0.96	T3	0.96	0.94
T4	0.97	0.99	T4	0.96	0.89	T4	0.97	0.94
T5	1.0	0.94	T5	0.9	0.96	T5	0.93	0.93
T6	0.96	0.95	T6	0.98	0.96	T6	0.93	0.94
Fz	0.98	0.93	Fz	0.94	1.0	Fz	0.92	1.0
Cz	0.98	0.9	Cz	0.92	0.98	Cz	0.92	1.0
Pz	0.92	0.95	Pz	0.93	0.96	Pz	0.97	0.98

Participant ID 32 qEEG Record: Posttest Eyes Open								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.96	0.96	Average	0.94	0.94	Average	0.96	0.96
FP1	0.98	0.9	FP1	0.96	0.94	FP1	0.97	0.96
FP2	0.98	0.96	FP2	0.97	0.91	FP2	0.91	0.99
F3	0.96	0.95	F3	0.92	0.97	F3	0.94	0.94
F4	0.99	0.97	F4	0.96	0.92	F4	0.99	0.95
C3	0.92	0.91	C3	0.91	0.99	C3	0.95	0.98
C4	0.95	0.99	C4	0.94	0.96	C4	0.99	0.95
P3	1.0	1.0	P3	0.98	0.96	P3	0.99	0.97
P4	0.93	0.97	P4	0.93	0.99	P4	0.97	0.99
O1	0.94	0.99	O1	0.99	0.98	O1	0.97	0.98
O2	0.9	0.98	O2	0.93	0.97	O2	0.98	1.0
F7	0.93	0.94	F7	0.9	0.9	F7	0.93	0.99
F8	0.98	0.96	F8	0.89	0.9	F8	0.98	0.98
T3	0.97	0.99	T3	0.96	0.87	T3	0.98	1.0
T4	0.98	0.98	T4	0.9	0.89	T4	0.91	0.88
T5	0.95	0.97	T5	0.95	0.96	T5	0.89	0.95
T6	0.95	0.98	T6	0.91	0.94	T6	0.89	1.0
Fz	0.95	0.96	Fz	0.87	0.96	Fz	0.98	0.96
Cz	0.98	0.99	Cz	0.97	0.99	Cz	0.96	0.93
Pz	0.98	0.91	Pz	0.97	0.83	Pz	1.0	0.87

Participant ID 32 qEEG Record: Posttest Eyes Closed								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.96	0.9	Average	0.92	0.92	Average	0.96	0.91
FP1	0.93	0.77	FP1	0.9	0.75	FP1	0.91	0.81
FP2	0.91	0.9	FP2	0.83	0.84	FP2	0.92	0.85
F3	0.98	0.97	F3	0.94	0.96	F3	0.95	0.95
F4	0.99	0.88	F4	0.93	0.95	F4	0.96	0.83
C3	1.0	0.94	C3	0.95	0.97	C3	0.95	0.94
C4	0.98	0.8	C4	0.95	0.86	C4	1.0	0.89
P3	0.95	0.96	P3	0.94	0.94	P3	1.0	0.98
P4	0.89	0.84	P4	0.85	0.97	P4	0.95	0.95
O1	0.93	0.98	O1	0.92	0.97	O1	0.88	0.98
O2	0.93	0.93	O2	0.93	0.98	O2	0.98	0.99
F7	1.0	0.97	F7	1.0	0.89	F7	0.95	0.8
F8	1.0	0.81	F8	0.97	0.85	F8	0.99	0.83
T3	0.98	0.97	T3	0.92	0.87	T3	1.0	0.96
T4	0.92	0.84	T4	0.91	0.89	T4	1.0	0.96
T5	0.99	0.98	T5	0.96	0.99	T5	0.92	0.91
T6	0.99	0.87	T6	0.92	0.99	T6	0.96	0.98
Fz	0.96	0.96	Fz	0.91	0.94	Fz	0.95	0.89
Cz	1.0	0.97	Cz	0.97	0.91	Cz	1.0	0.93
Pz	0.87	0.84	Pz	0.81	0.94	Pz	0.9	0.94

Participant ID 33 qEEG Record: Pretest Eyes Closed								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.97	0.92	Average	0.97	0.92	Average	0.97	0.94
FP1	0.99	0.96	FP1	0.99	0.96	FP1	0.95	0.89
FP2	0.98	0.93	FP2	0.98	0.93	FP2	0.98	0.97
F3	1.0	0.83	F3	1.0	0.83	F3	0.94	0.9
F4	0.99	0.89	F4	0.99	0.89	F4	0.99	0.95
C3	0.97	0.82	C3	0.97	0.82	C3	0.99	0.79
C4	0.99	0.93	C4	0.99	0.93	C4	0.92	0.94
P3	0.99	0.97	P3	0.99	0.97	P3	0.99	1.0
P4	0.98	0.99	P4	0.98	0.99	P4	0.98	0.98
O1	0.94	0.91	O1	0.94	0.91	O1	0.96	0.93
O2	0.95	0.93	O2	0.95	0.93	O2	0.96	0.96
F7	0.96	0.88	F7	0.96	0.88	F7	0.96	0.96
F8	0.98	0.92	F8	0.98	0.92	F8	0.99	0.98
T3	0.98	0.86	T3	0.98	0.86	T3	0.98	0.78
T4	0.97	0.96	T4	0.97	0.96	T4	0.99	0.94
T5	0.98	0.98	T5	0.98	0.98	T5	1.0	0.95
T6	0.99	0.96	T6	0.99	0.96	T6	0.99	0.96
Fz	0.99	0.89	Fz	0.99	0.89	Fz	0.94	0.99
Cz	0.95	0.9	Cz	0.95	0.9	Cz	0.94	0.97
Pz	0.94	0.95	Pz	0.94	0.95	Pz	0.99	0.99

Participant ID 33 qEEG Record: Pretest Eyes Open								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.97	0.96	Average	0.96	0.96	Average	0.97	0.96
FP1	0.93	0.92	FP1	0.93	0.95	FP1	0.97	0.99
FP2	0.96	0.94	FP2	0.94	0.98	FP2	0.97	0.94
F3	0.98	0.99	F3	0.98	0.94	F3	0.92	0.98
F4	0.98	0.97	F4	0.99	0.98	F4	0.99	0.98
C3	0.99	0.97	C3	0.97	0.92	C3	0.95	0.98
C4	0.96	0.99	C4	0.97	0.98	C4	0.96	0.99
P3	0.99	0.97	P3	0.97	0.94	P3	1.0	0.97
P4	0.97	1.0	P4	0.97	0.99	P4	0.97	0.96
O1	0.97	0.92	O1	0.95	0.92	O1	0.93	0.9
O2	1.0	0.94	O2	0.99	0.93	O2	0.98	0.87
F7	0.98	0.99	F7	1.0	0.97	F7	0.96	0.97
F8	0.97	0.93	F8	0.92	0.99	F8	1.0	1.0
T3	0.93	0.96	T3	0.93	0.91	T3	0.98	0.96
T4	0.97	0.96	T4	0.99	1.0	T4	0.96	1.0
T5	0.92	0.94	T5	0.93	0.94	T5	0.97	0.94
T6	0.94	0.91	T6	0.96	0.94	T6	0.94	0.87
Fz	1.0	0.96	Fz	0.99	0.98	Fz	0.97	0.96
Cz	0.96	0.93	Cz	0.97	0.91	Cz	0.99	0.96
Pz	0.95	1.0	Pz	0.97	0.99	Pz	0.99	0.98

Participant ID 33 qEEG Record: Pretest Serial Sevens								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.95	0.93	Average	0.93	0.9	Average	0.92	0.95
FP1	0.95	1.0	FP1	0.91	0.95	FP1	0.95	0.87
FP2	0.93	0.91	FP2	0.92	0.89	FP2	0.9	0.98
F3	0.98	0.91	F3	0.93	0.93	F3	1.0	1.0
F4	0.91	0.95	F4	0.99	0.96	F4	0.93	0.96
C3	0.91	0.93	C3	0.81	0.88	C3	0.95	0.95
C4	0.97	0.96	C4	0.92	0.93	C4	0.82	0.88
P3	0.99	0.99	P3	0.97	0.87	P3	0.91	0.99
P4	0.9	0.95	P4	0.76	0.86	P4	0.7	0.79
O1	0.92	0.89	O1	0.95	0.83	O1	0.93	0.98
O2	1.0	0.84	O2	0.95	0.89	O2	0.99	0.98
F7	1.0	0.93	F7	0.92	0.98	F7	0.96	0.98
F8	0.89	0.82	F8	0.92	0.77	F8	0.89	1.0
T3	0.98	0.9	T3	0.99	0.83	T3	0.96	0.89
T4	0.97	0.96	T4	0.99	0.95	T4	0.93	0.98
T5	0.89	0.91	T5	0.92	0.84	T5	0.89	0.98
T6	0.98	0.91	T6	0.96	0.96	T6	0.97	0.95
Fz	0.94	0.89	Fz	0.98	0.94	Fz	0.88	0.95
Cz	0.94	0.97	Cz	0.94	0.92	Cz	0.96	0.95
Pz	0.95	0.97	Pz	0.95	0.9	Pz	0.96	0.93

Participant ID 33 qEEG Record: Posttest Eyes Open								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.95	0.94	Average	0.9	0.92	Average	0.94	0.94
FP1	0.96	0.99	FP1	0.93	0.99	FP1	0.87	0.96
FP2	0.99	0.99	FP2	0.94	1.0	FP2	0.94	0.93
F3	0.95	1.0	F3	0.91	0.94	F3	0.94	0.98
F4	0.93	0.96	F4	0.91	0.99	F4	0.86	0.84
C3	0.94	0.91	C3	0.88	0.72	C3	0.9	0.88
C4	0.97	0.91	C4	0.94	0.96	C4	0.98	0.86
P3	0.99	0.88	P3	0.9	0.84	P3	0.99	0.92
P4	0.92	0.84	P4	0.89	0.81	P4	0.98	0.9
O1	0.96	0.92	O1	0.83	0.95	O1	0.95	1.0
O2	0.97	0.89	O2	0.99	0.88	O2	0.93	0.96
F7	1.0	0.94	F7	0.95	0.88	F7	0.98	0.9
F8	0.96	0.97	F8	0.9	0.83	F8	0.95	0.96
T3	0.98	0.96	T3	0.91	0.98	T3	0.99	1.0
T4	0.94	0.95	T4	0.84	0.93	T4	0.9	0.99
T5	0.9	0.93	T5	0.85	0.95	T5	0.95	0.88
T6	0.91	0.93	T6	0.85	0.98	T6	0.86	0.99
Fz	0.85	0.99	Fz	0.75	0.99	Fz	0.98	0.98
Cz	0.98	0.96	Cz	0.97	0.97	Cz	0.91	0.98
Pz	0.97	0.94	Pz	0.88	0.92	Pz	0.96	0.92

Participant ID 33 qEEG Record: Posttest Eyes Closed								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.96	0.92	Average	0.95	0.94	Average	0.96	0.92
FP1	0.96	0.95	FP1	0.99	1.0	FP1	0.97	0.93
FP2	0.96	0.94	FP2	0.99	1.0	FP2	0.95	0.91
F3	1.0	0.86	F3	0.95	0.91	F3	0.99	0.97
F4	0.99	0.87	F4	0.98	0.95	F4	0.98	0.98
C3	0.97	0.85	C3	0.98	0.85	C3	0.93	0.85
C4	0.94	0.96	C4	0.91	0.9	C4	0.97	0.94
P3	0.99	0.89	P3	1.0	0.94	P3	0.96	0.79
P4	0.91	0.98	P4	0.88	0.96	P4	0.93	0.98
O1	0.98	0.91	O1	0.94	0.89	O1	0.98	0.91
O2	0.93	0.93	O2	0.94	0.85	O2	0.98	0.96
F7	0.93	0.89	F7	0.87	0.93	F7	0.93	0.89
F8	0.98	0.91	F8	1.0	0.99	F8	0.97	0.97
T3	0.89	0.91	T3	0.79	0.96	T3	0.93	0.82
T4	0.99	0.95	T4	1.0	0.99	T4	0.96	0.97
T5	0.96	0.95	T5	0.9	0.92	T5	0.97	0.87
T6	0.97	0.98	T6	0.99	0.91	T6	1.0	0.99
Fz	0.99	0.88	Fz	0.98	0.97	Fz	0.97	0.89
Cz	0.96	0.9	Cz	0.96	0.92	Cz	0.9	0.92
Pz	0.96	0.94	Pz	0.94	0.96	Pz	0.97	0.89

Participant ID 34 qEEG Record: Pretest Eyes Closed								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.97	0.94	Average	0.95	0.88	Average	0.97	0.93
FP1	0.98	0.98	FP1	0.95	0.85	FP1	1.0	0.91
FP2	0.97	1.0	FP2	0.95	0.88	FP2	0.95	0.9
F3	0.97	0.99	F3	0.98	0.86	F3	0.96	0.96
F4	0.99	0.99	F4	0.92	0.88	F4	0.96	0.98
C3	0.97	0.98	C3	1.0	0.85	C3	0.97	0.89
C4	0.98	0.99	C4	0.97	0.93	C4	0.99	0.96
P3	0.98	0.86	P3	0.93	0.78	P3	0.94	0.91
P4	0.98	0.86	P4	0.95	0.8	P4	0.99	0.93
O1	0.92	0.83	O1	0.93	0.85	O1	0.98	0.92
O2	0.99	0.83	O2	0.96	0.82	O2	0.95	0.89
F7	1.0	0.99	F7	0.95	0.96	F7	0.91	0.9
F8	1.0	0.94	F8	0.93	0.99	F8	0.94	0.94
T3	0.94	0.98	T3	0.93	0.95	T3	0.98	0.93
T4	0.95	0.97	T4	0.99	0.99	T4	0.96	0.99
T5	0.97	0.96	T5	0.95	0.96	T5	0.96	0.91
T6	0.96	0.93	T6	0.98	0.93	T6	0.95	0.99
Fz	0.99	0.99	Fz	0.95	0.86	Fz	0.96	0.96
Cz	0.98	0.96	Cz	0.99	0.9	Cz	0.99	0.91
Pz	1.0	0.85	Pz	0.94	0.77	Pz	0.98	0.84

Participant ID 34 qEEG Record: Pretest Eyes Open								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.96	0.97	Average	0.97	0.95	Average	0.97	0.95
FP1	0.98	1.0	FP1	0.98	0.97	FP1	0.93	0.95
FP2	1.0	0.98	FP2	0.96	0.97	FP2	0.98	0.97
F3	0.96	0.98	F3	0.99	0.99	F3	1.0	0.99
F4	0.98	0.98	F4	0.99	0.99	F4	0.97	0.97
C3	0.93	1.0	C3	0.99	0.98	C3	0.97	0.96
C4	0.97	0.95	C4	0.98	0.86	C4	0.99	0.85
P3	0.93	0.96	P3	0.95	0.96	P3	1.0	0.96
P4	0.92	0.94	P4	0.95	0.92	P4	0.98	0.95
O1	0.93	0.94	O1	0.96	0.93	O1	0.96	0.92
O2	0.9	0.94	O2	0.98	0.94	O2	0.94	0.95
F7	0.95	0.99	F7	0.99	0.96	F7	0.99	0.95
F8	0.95	0.95	F8	0.96	0.97	F8	0.96	0.94
T3	0.93	0.99	T3	0.92	0.97	T3	0.92	0.97
T4	0.99	0.95	T4	0.96	0.94	T4	1.0	0.93
T5	0.94	0.98	T5	1.0	0.99	T5	0.97	0.94
T6	0.95	0.94	T6	0.95	0.96	T6	0.98	0.96
Fz	0.98	1.0	Fz	1.0	0.95	Fz	1.0	0.95
Cz	0.97	0.97	Cz	0.99	0.94	Cz	0.98	0.93
Pz	0.96	0.96	Pz	0.99	0.95	Pz	1.0	0.98

Participant ID 34 qEEG Record: Pretest Serial Sevens								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.96	0.94	Average	0.93	0.9	Average	0.94	0.93
FP1	0.98	0.93	FP1	0.89	0.83	FP1	0.9	0.99
FP2	0.94	0.98	FP2	0.94	0.92	FP2	0.98	1.0
F3	0.99	0.96	F3	0.97	0.95	F3	0.94	0.94
F4	0.93	0.94	F4	0.93	0.93	F4	0.99	0.97
C3	0.97	0.93	C3	0.97	0.88	C3	1.0	0.97
C4	0.98	0.95	C4	0.89	0.99	C4	0.9	0.98
P3	0.96	0.93	P3	0.93	0.87	P3	0.98	0.86
P4	0.97	0.94	P4	1.0	0.96	P4	0.99	0.88
O1	0.96	0.96	O1	0.99	0.83	O1	0.92	0.85
O2	1.0	0.95	O2	0.97	0.96	O2	0.99	0.97
F7	0.95	0.9	F7	0.92	0.93	F7	0.94	0.93
F8	0.87	0.84	F8	0.77	0.76	F8	0.78	0.82
T3	0.98	0.98	T3	0.88	0.94	T3	0.95	0.97
T4	0.99	0.87	T4	0.93	0.82	T4	0.92	0.93
T5	0.99	0.97	T5	1.0	0.92	T5	0.95	1.0
T6	0.98	0.95	T6	0.93	0.83	T6	0.96	0.97
Fz	0.93	0.98	Fz	1.0	0.98	Fz	0.95	0.92
Cz	0.95	0.95	Cz	0.93	0.9	Cz	0.94	0.89
Pz	0.96	0.9	Pz	0.89	0.81	Pz	0.94	0.86

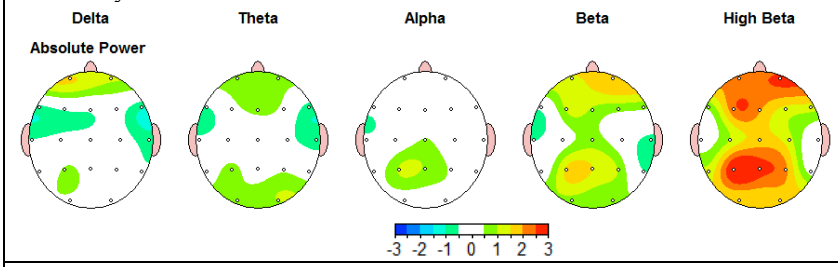
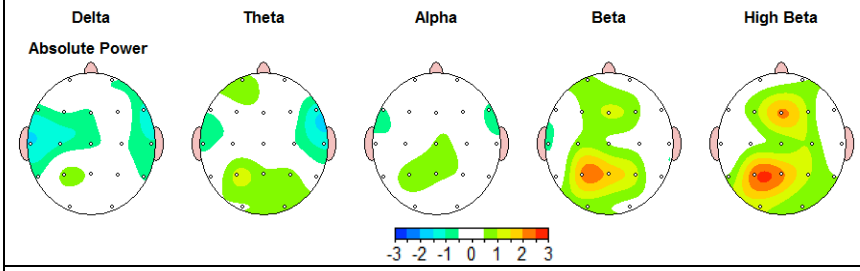
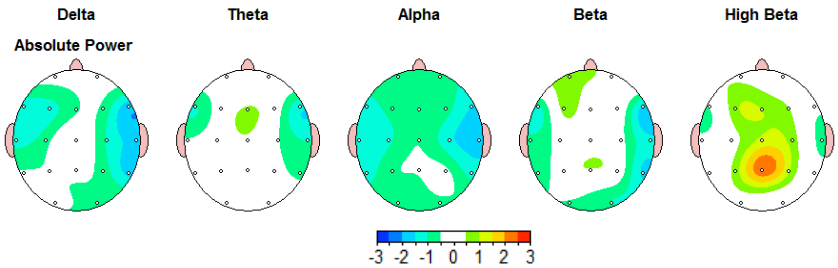
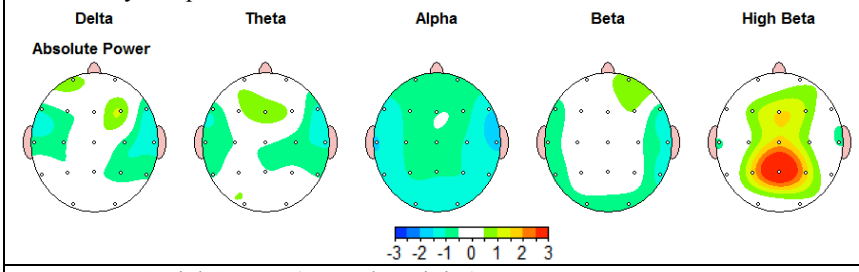
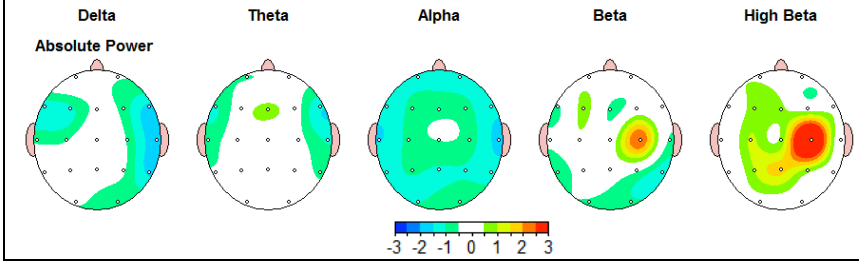
Participant ID 34 qEEG Record: Posttest Eyes Open								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.95	0.9	Average	0.92	0.89	Average	0.92	0.89
FP1	1.0	0.83	FP1	0.97	0.83	FP1	0.82	0.82
FP2	0.98	0.96	FP2	0.97	0.99	FP2	0.91	0.96
F3	1.0	0.89	F3	0.94	0.86	F3	0.87	0.83
F4	0.96	0.99	F4	0.99	0.99	F4	0.99	0.94
C3	0.96	0.86	C3	0.9	0.84	C3	0.93	0.93
C4	1.0	0.88	C4	0.97	0.85	C4	0.93	0.84
P3	0.96	0.84	P3	0.94	0.91	P3	1.0	0.91
P4	0.99	0.93	P4	0.96	0.96	P4	0.99	0.99
O1	0.94	0.97	O1	0.97	0.93	O1	0.96	0.87
O2	0.96	0.91	O2	0.93	0.98	O2	0.93	0.98
F7	0.83	0.77	F7	0.7	0.65	F7	0.67	0.65
F8	0.93	0.88	F8	0.84	0.9	F8	0.95	0.91
T3	0.96	0.9	T3	0.96	0.8	T3	1.0	0.75
T4	0.86	0.94	T4	0.84	0.89	T4	0.96	1.0
T5	0.94	0.92	T5	0.93	0.9	T5	0.94	0.74
T6	0.92	0.99	T6	0.87	0.92	T6	0.87	0.96
Fz	0.94	0.91	Fz	0.88	0.96	Fz	0.93	0.89
Cz	0.97	0.9	Cz	0.93	0.91	Cz	0.9	0.98
Pz	0.99	0.87	Pz	0.97	0.91	Pz	0.98	1.0

Participant ID 34 qEEG Record: Posttest Eyes Closed								
Linked Ears			Average Reference			LaPlacian		
	Split Half	Test/ Retest		Split Half	Test/ Retest		Split Half	Test/ Retest
Average	0.96	0.92	Average	0.96	0.87	Average	0.95	0.92
FP1	0.98	0.95	FP1	0.98	0.89	FP1	0.99	0.98
FP2	0.99	0.95	FP2	0.98	0.86	FP2	0.94	0.93
F3	0.96	0.95	F3	0.94	0.87	F3	0.92	0.94
F4	0.98	0.93	F4	1.0	0.86	F4	0.97	0.86
C3	0.98	0.93	C3	0.9	0.85	C3	0.87	0.94
C4	0.98	0.9	C4	0.96	0.79	C4	0.95	0.79
P3	0.97	0.92	P3	0.99	0.86	P3	0.98	0.98
P4	0.94	0.83	P4	0.89	0.76	P4	0.94	0.9
O1	0.99	0.95	O1	0.98	0.93	O1	0.99	0.99
O2	0.88	0.8	O2	0.89	0.84	O2	0.88	0.84
F7	0.97	0.92	F7	0.99	0.93	F7	0.97	0.99
F8	0.97	0.96	F8	0.93	0.91	F8	0.96	0.84
T3	0.98	0.94	T3	0.95	0.95	T3	0.99	0.86
T4	0.88	0.87	T4	0.98	0.88	T4	0.97	0.97
T5	0.94	0.98	T5	0.99	0.97	T5	0.98	0.87
T6	0.99	0.85	T6	0.98	0.89	T6	0.96	0.97
Fz	0.97	0.93	Fz	0.95	0.87	Fz	0.98	0.96
Cz	0.96	0.93	Cz	0.92	0.87	Cz	0.95	0.94
Pz	0.97	0.9	Pz	0.96	0.83	Pz	0.88	0.93

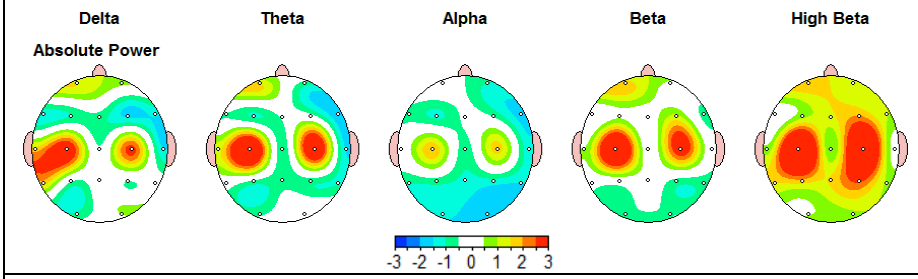
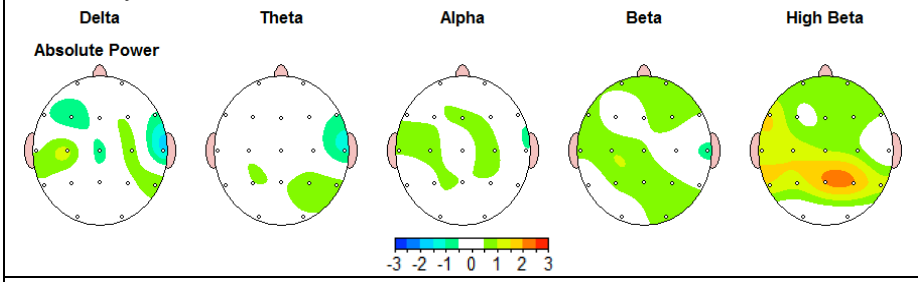
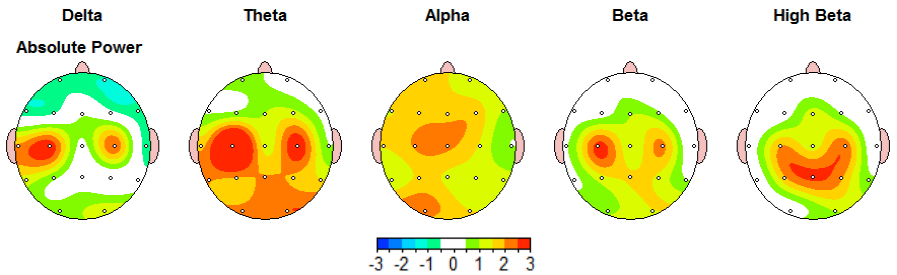
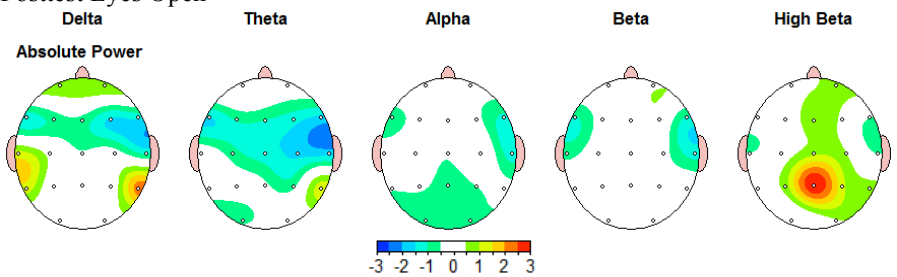
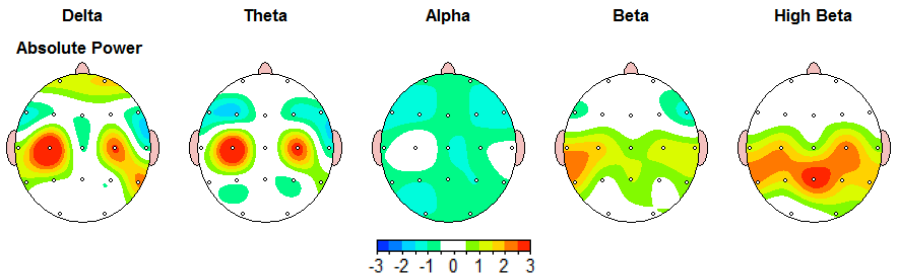
APPENDIX O

Brain Map Comparison Tables (Personal Notes)

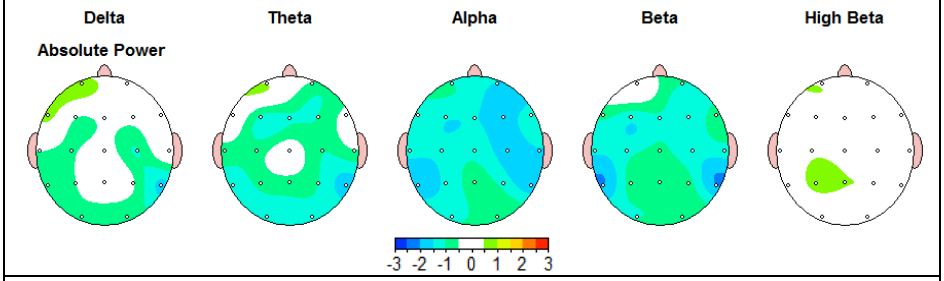
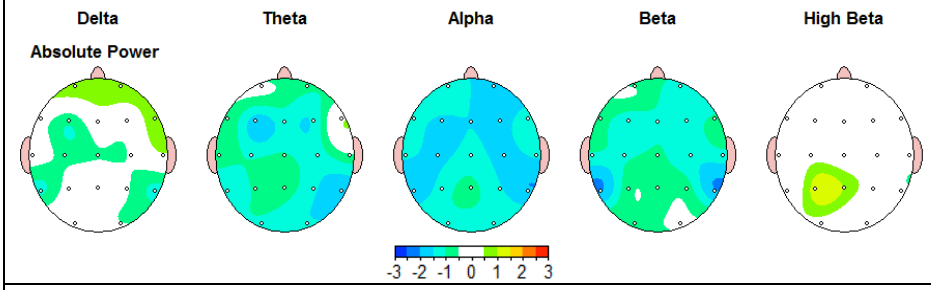
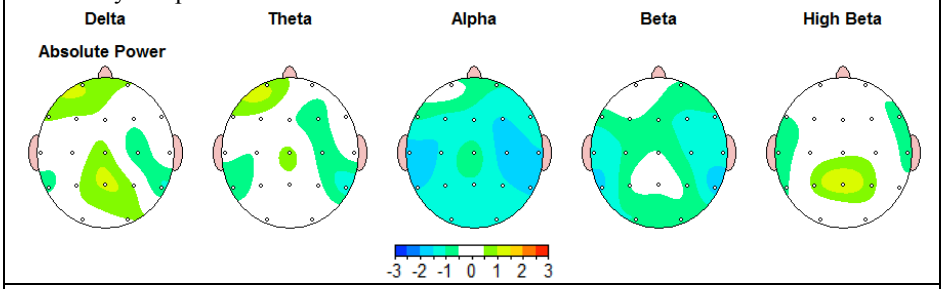
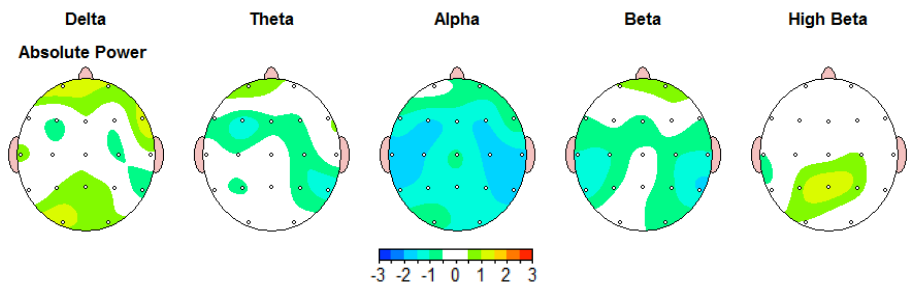
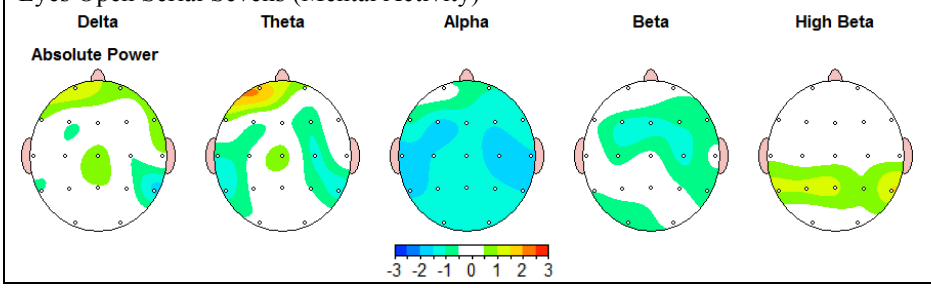
Participant ID 10

Pretest Eyes Closed 	Decrease in all bands, especially right frontal, except up at P3 in theta and beta
Posttest Eyes Closed 	
Pretest Eyes Open 	Marked increase in high beta at PZ (verses C4 in S7)
Posttest Eyes Open 	
Eyes Open Serial Sevens (Mental Activity) 	

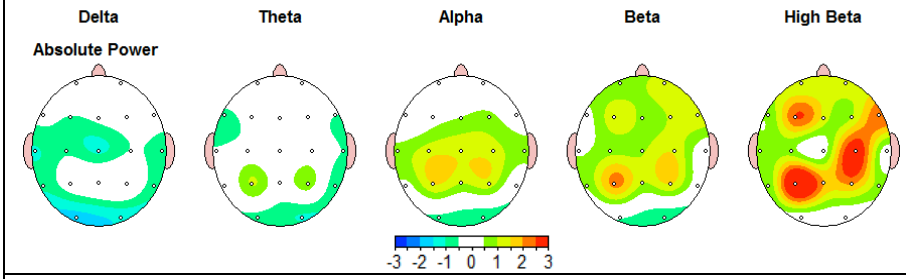
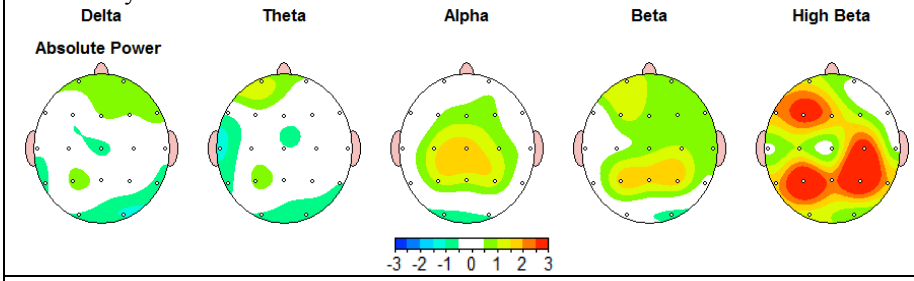
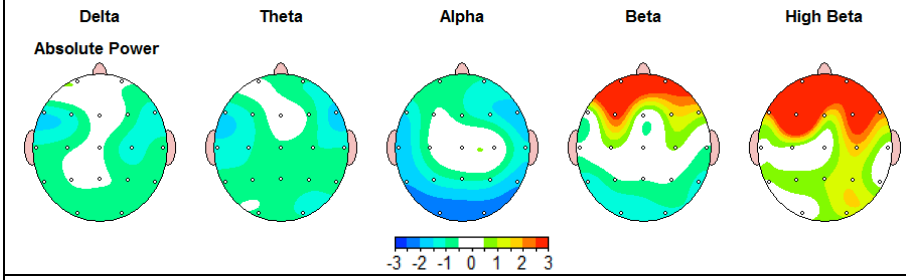
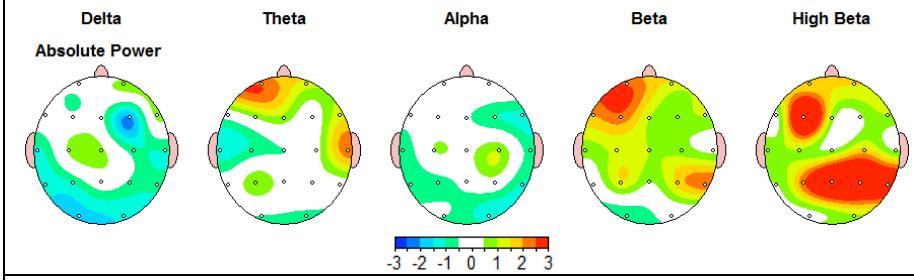
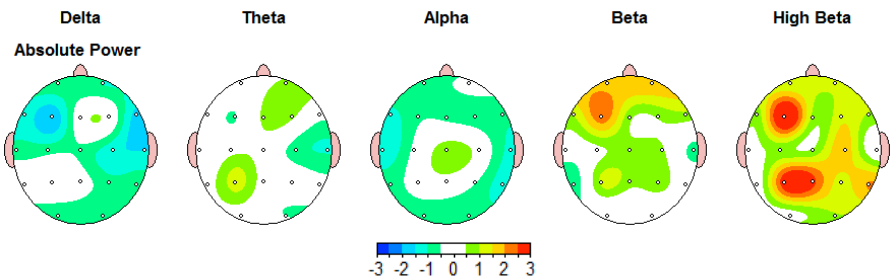
Participant ID 11

Pretest Eyes Closed  Posttest Eyes Closed 	Bilateral frontal decrease in all bands except increase in alpha, Some decrease in slow activity (delta and theta) seen at left frontal (FP1) Marked difference across all bands at C3 and C4 with some generalized improvement in the occipital region.
Pretest Eyes Open  Posttest Eyes Open 	Marked generalized decrease, esp at right frontal/temporal junction only moderately mediated by mental activity.
Eyes Open Serial Sevens (Mental Activity) 	

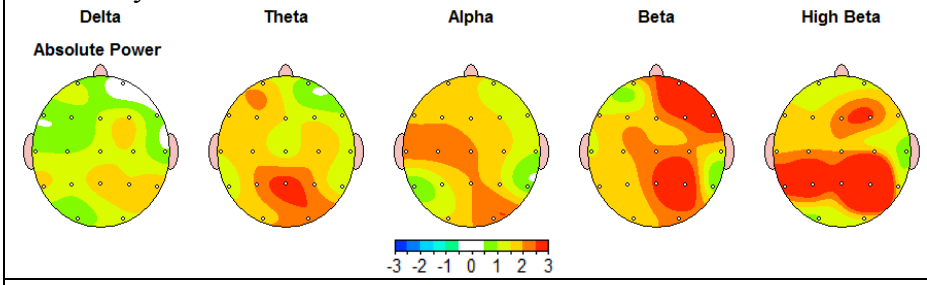
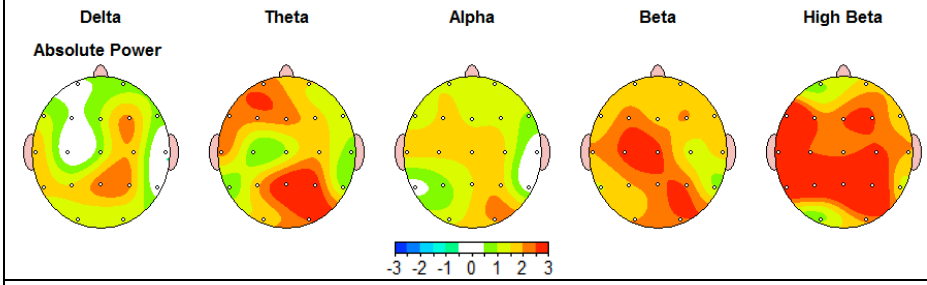
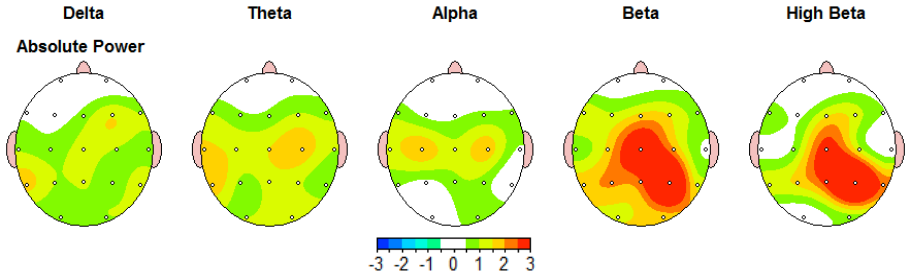
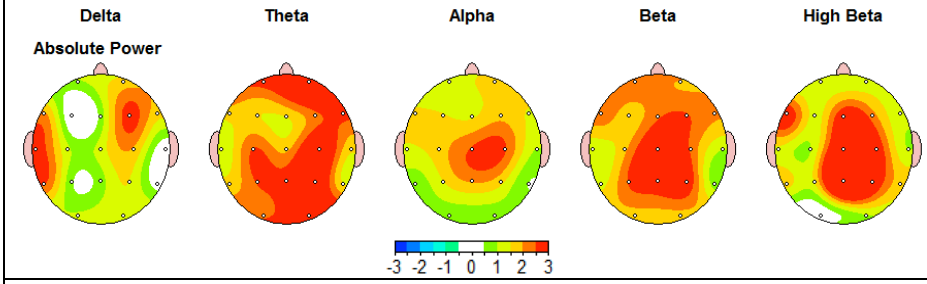
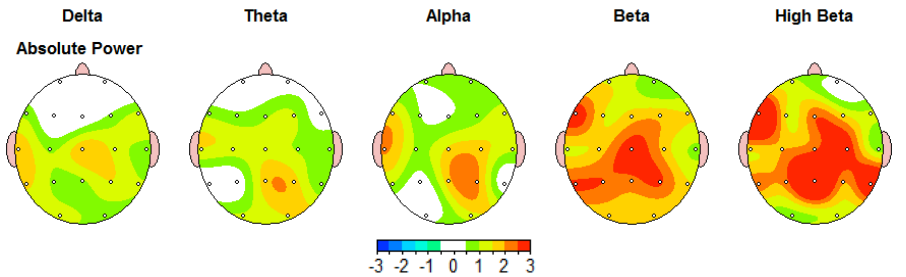
Participant ID 13

Pretest Eyes Closed 	Some decrease across frontal in all bands except delta where there is a bit of upregulation
Posttest Eyes Closed 	
Pretest Eyes Open 	Increase in frontal beta and high beta with decrease in theta
Posttest Eyes Open 	
Eyes Open Serial Sevens (Mental Activity) 	

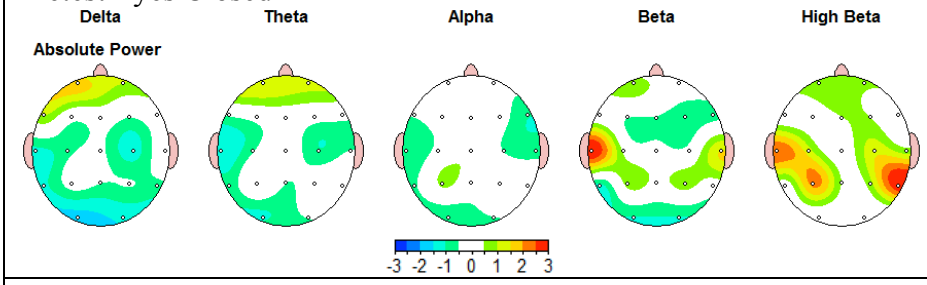
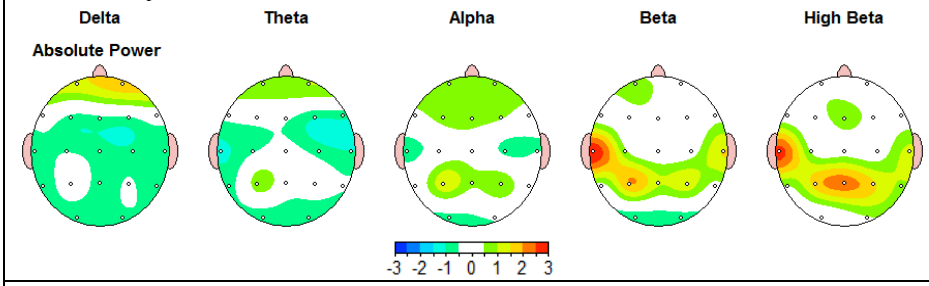
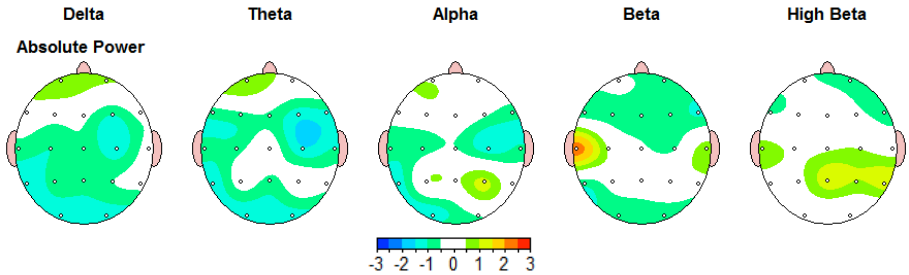
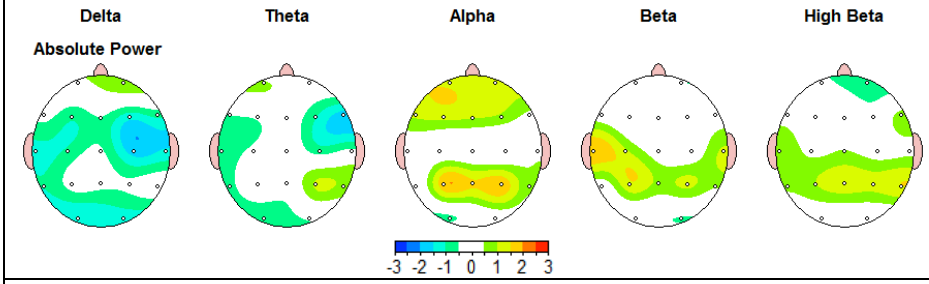
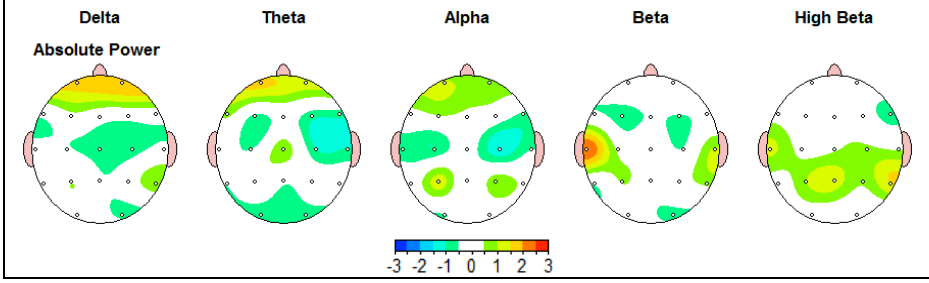
Participant ID 14

Pretest Eyes Closed 	Frontal upregulation in delta and theta; marked decrease in R frontal with marked increase in L frontal fast activity (F3) (some activity at F3 accounted for in S7 condition) Increase in beta and high beta at P3
Posttest Eyes Closed 	
Pretest Eyes Open 	Marked decrease in fast activity except at F3 accompanied by increase in slow rhythms frontally;
Posttest Eyes Open 	
Eyes Open Serial Sevens (Mental Activity) 	Participant is caffeinated by report

Participant ID 15

Pretest Eyes Closed 	Widespread frontal increase (except in alpha) but more on the L (more than observed in S7) esp. at F3 and F7 (Increase at T5 is accounted for by Mental Activity)
Posttest Eyes Closed 	
Pretest Eyes Open 	Marked but generalized increase; notable at P3 and CZ as well as F7
Posttest Eyes Open 	
Eyes Open Serial Sevens (Mental Activity) 	

Participant ID 18

Pretest Eyes Closed 	Some generalized decrease frontally (except beta), not accounted for in S7; upregulation at P3 and PZ greater than accounted for in S7
Posttest Eyes Closed 	
Pretest Eyes Open 	Marked increase in frontal, esp alpha; increase across all bands at P3, more than S7
Posttest Eyes Open 	
Eyes Open Serial Sevens (Mental Activity) 	Participant is caffeinated by report

Participant ID 19

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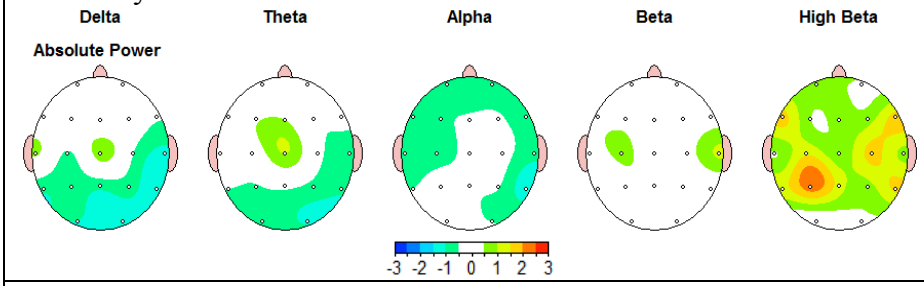
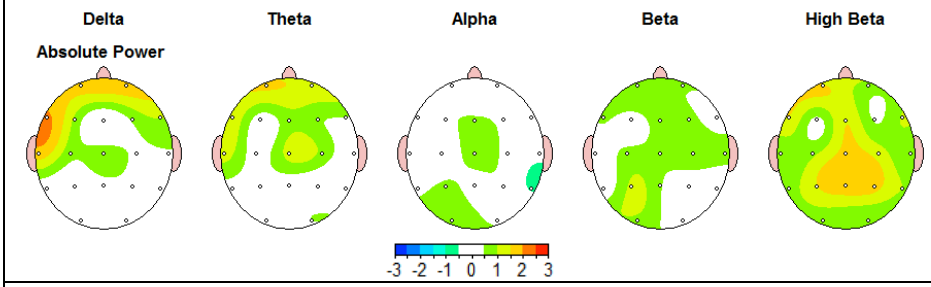
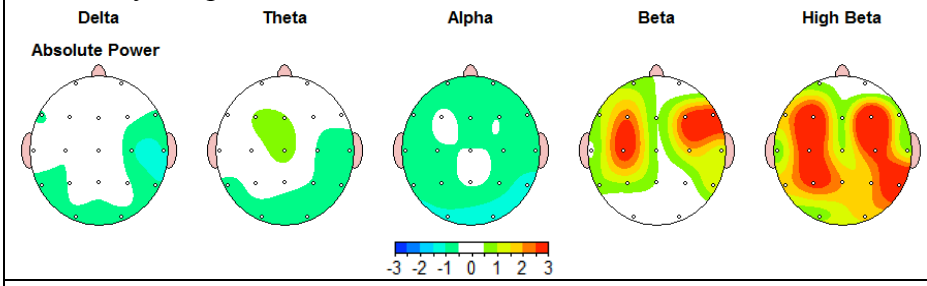
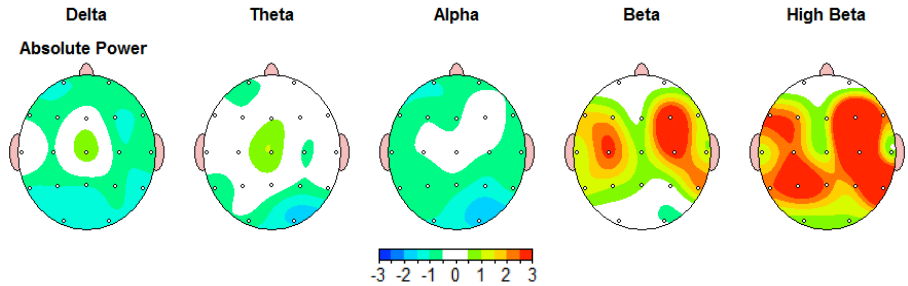
 
</td><td rowspan="2">Marked increase frontally, pronounced at FP1 and F7; accompanied by generalized increase across the occipital and parietal in all bands. Decrease in high beta at P3</td></tr>
<tr><td>Posttest Eyes Closed
 
</td></tr>
<tr><td>Pretest Eyes Open
 
</td><td rowspan="2">Some decrease in occipital but largely accounted for by mental activity; however, consistent decrease across frontal, more pronounced on left not accounted for in S7</td></tr>
<tr><td>Posttest Eyes Open
 
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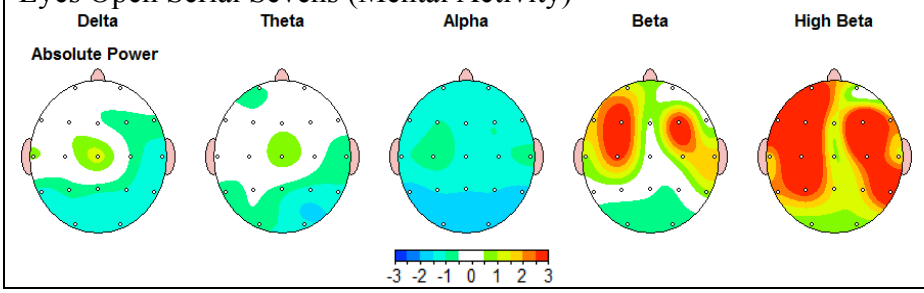
<tr><td>Eyes Open Serial Sevens (Mental Activity)
 
</td><td>Participant is caffeinated by report</td></tr>
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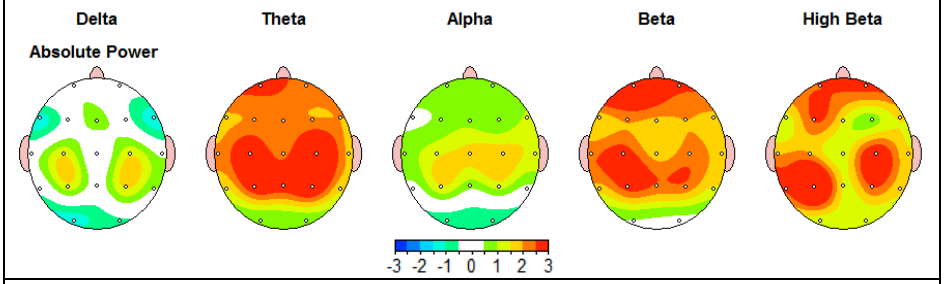
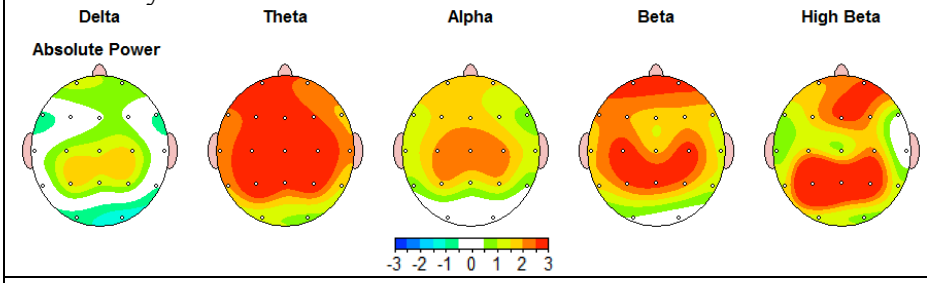
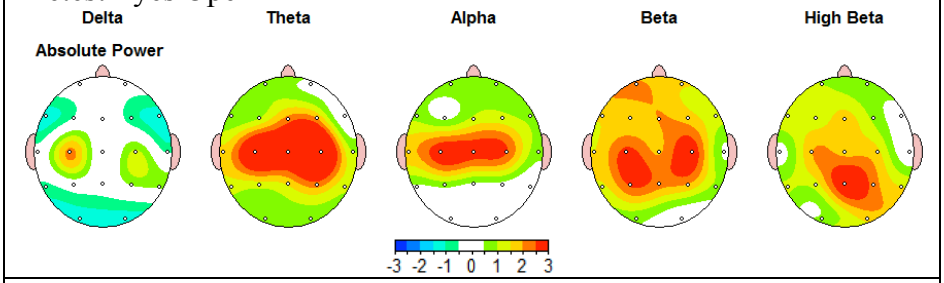
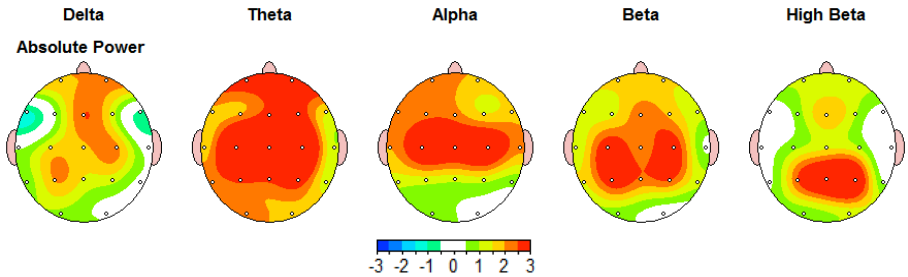
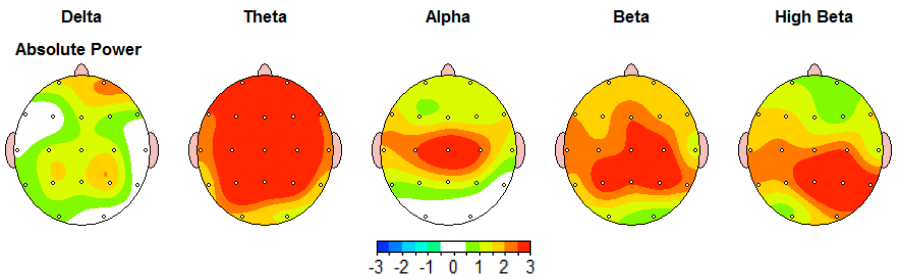
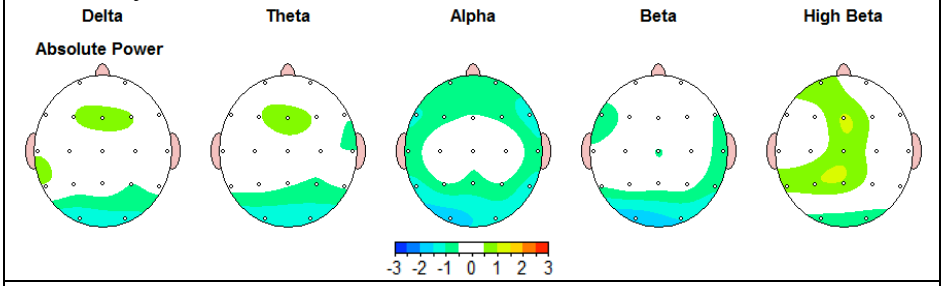
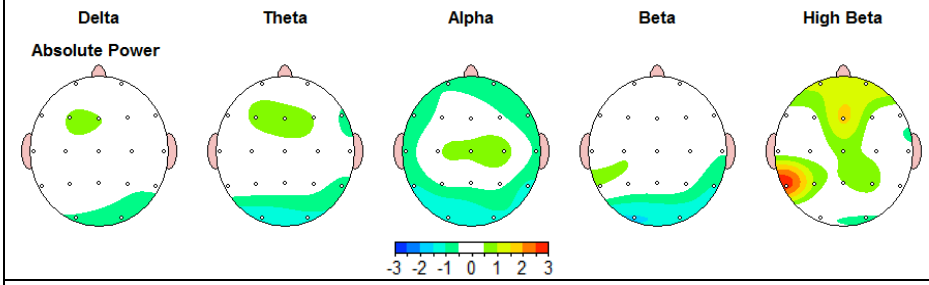
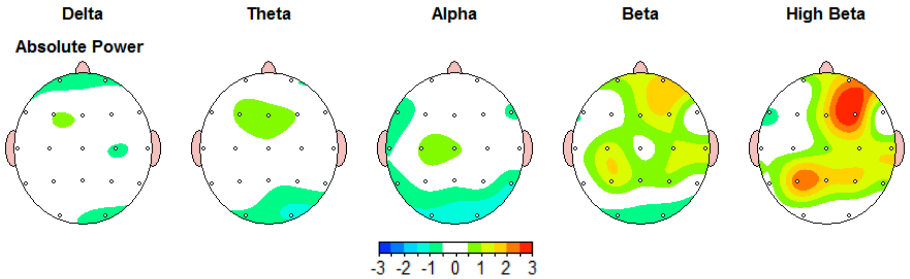
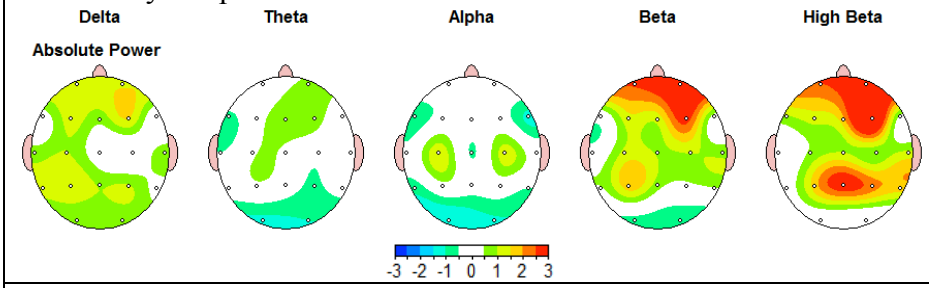
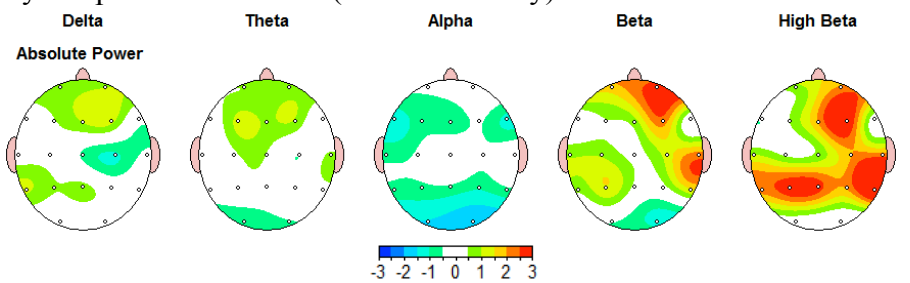
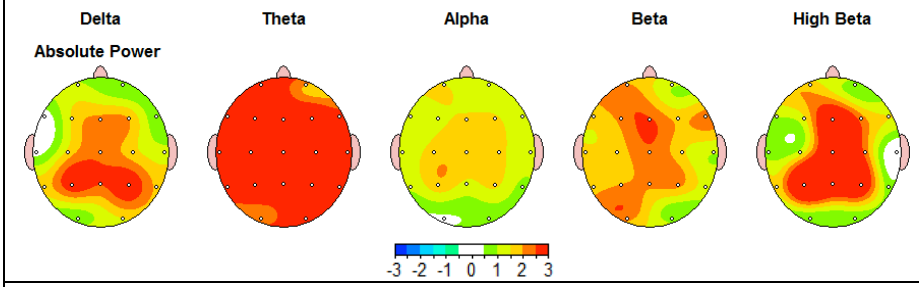
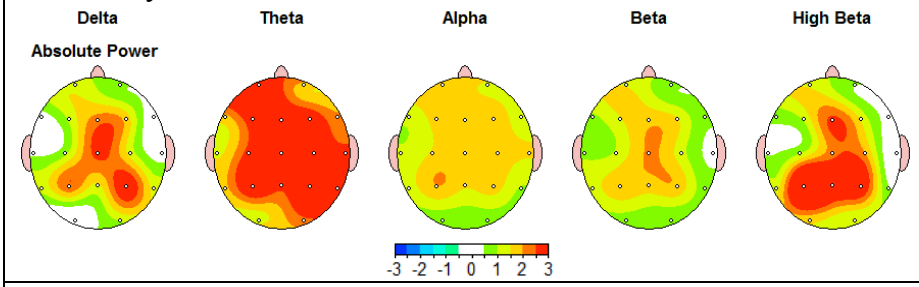
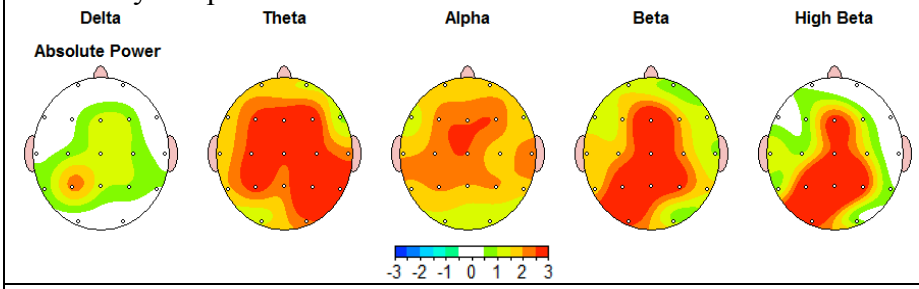
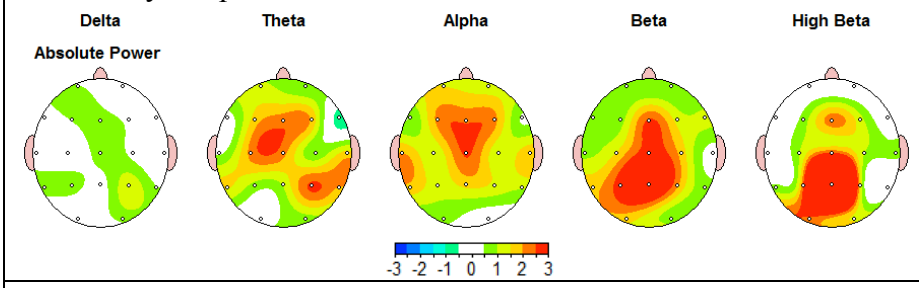
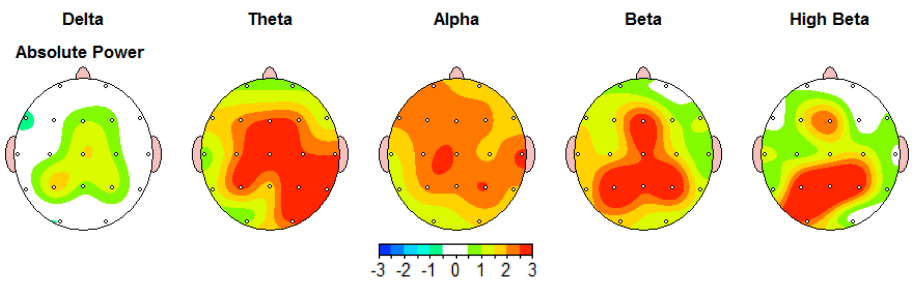
Participant ID 21

Pretest Eyes Closed 	Marked increase between PZ and CZ across all bands; increase across frontal in all bands except in high beta at FP2 and FZ
Posttest Eyes Closed 	
Pretest Eyes Open 	Only difference not likely accounted for by mental activity is increase in delta rhythm FZ and C4, bearing in mind N has recent Hx of R side HI
Posttest Eyes Open 	
Eyes Open Serial Sevens (Mental Activity) 	Moderate Concussion approximately 1 yr ago due to impact to right side of forehead during cheerleading. High Theta not present in LaPlacian

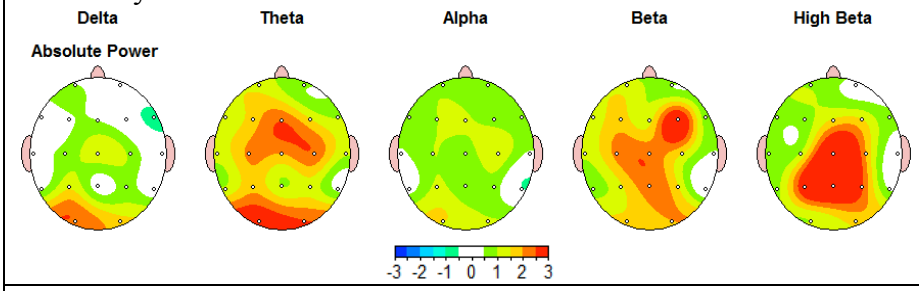
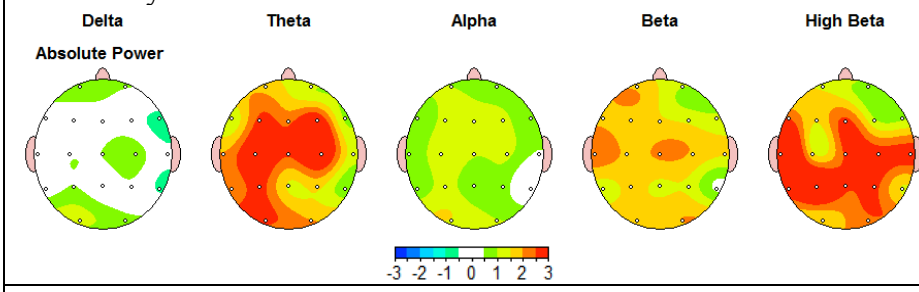
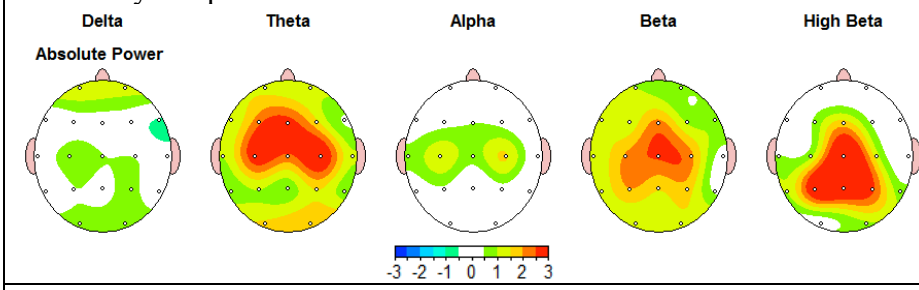
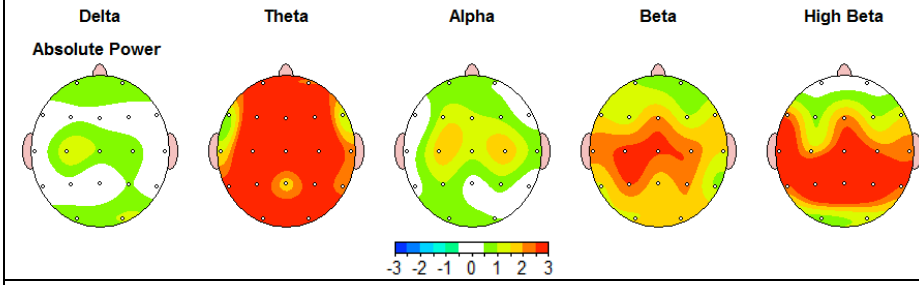
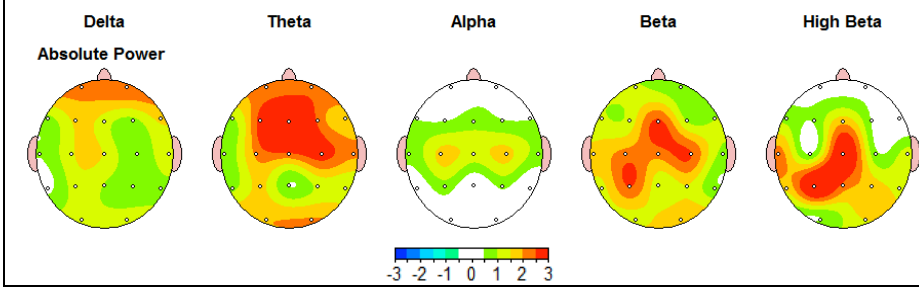
Participant ID 22

Pretest Eyes Closed 	Generalized frontal increase, which is normal for this n when compared to S7; however, what is remarkable is that baseline data demonstrates that increase to be associated with right frontal activity, where here it is somewhat pronounced on the left.
Posttest Eyes Closed 	
Pretest Eyes Open 	Frontal increase, more pronounced on left, esp. when taking into account S7 condition
Posttest Eyes Open 	
Eyes Open Serial Sevens (Mental Activity) 	Possible caffeinated

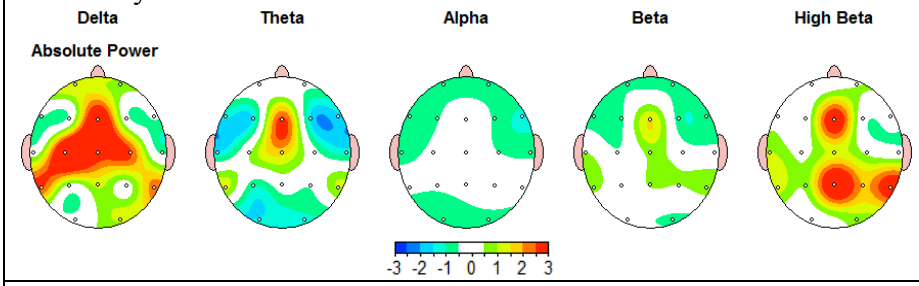
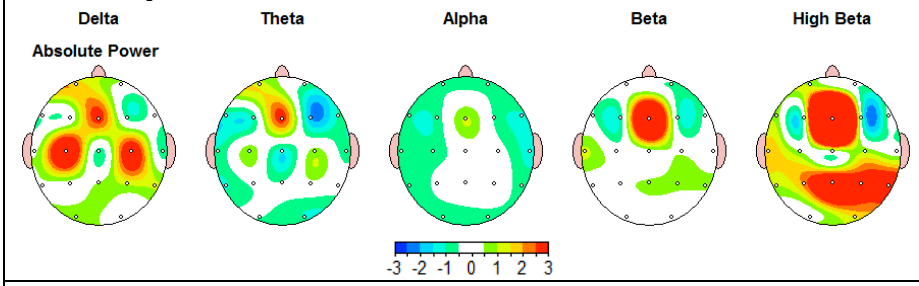
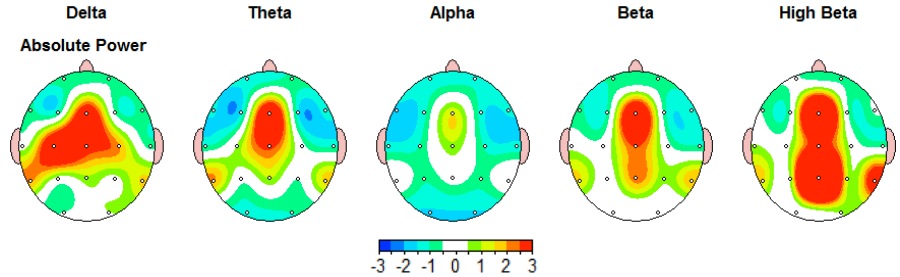
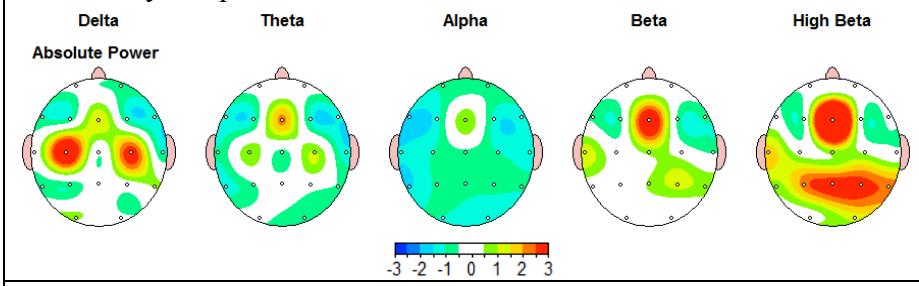
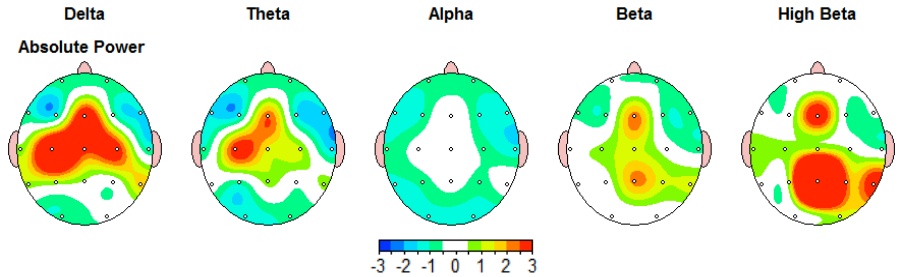
Participant ID 23

Pretest Eyes Closed 	Generalized frontal decrease more than can be accounted for by mental activity
Posttest Eyes Closed 	
Pretest Eyes Open 	Widespread bilateral frontal decrease across bands except in delta where there is a small increase on the left between FP1 and F3;
Posttest Eyes Open 	
Eyes Open Serial Sevens (Mental Activity) 	Left handed Both theta and delta are markedly lower in the LaPlacian montage; however, the beta and high beta are higher and appear consistent with eye movement

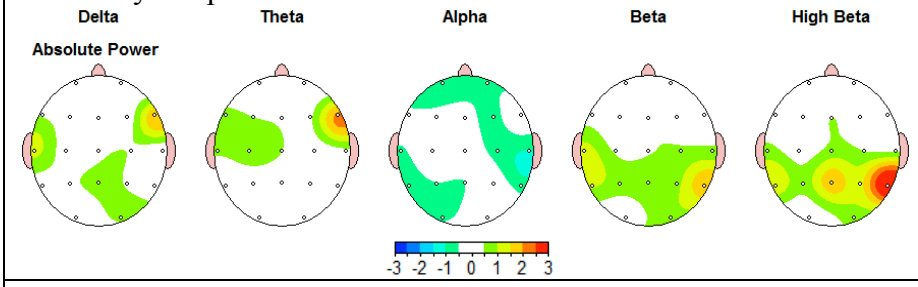
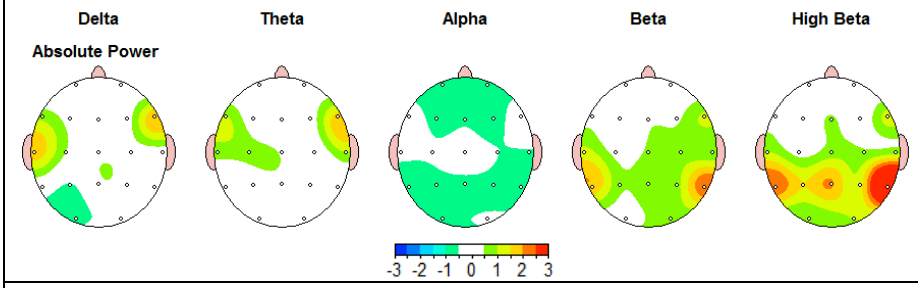
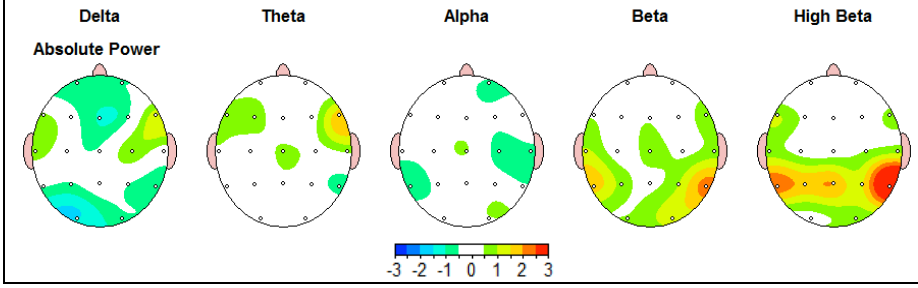
Participant ID 24

Pretest Eyes Closed 	Generalized Left side frontal increase greater than what is observed with mental activity; also an increase at P3 and across the central sites in the theta, alpha, and high beta rhythms
Posttest Eyes Closed 	
Pretest Eyes Open 	Frontal increase in all rhythms except delta beyond what is seen in mental activity; more pronounced on the left in alpha, beta and high beta. Note wide spread increase in theta accompanied by marked increase in high beta at F7, T3, and T5, and along central and parietal midlines
Posttest Eyes Open 	
Eyes Open Serial Sevens (Mental Activity) 	Participant is caffeinated by report

Participant ID 26

Pretest Eyes Closed 	Increase at FZ in alpha, beta and HB, decrease in theta and delta; but, marked decrease bilaterally in frontal in alpha, beta and HB (complete opposite of what is seen in S7). Decrease is a little more pronounced on the R Marked increase in HB at T6, P4, and PZ, consistent with EO conditions (may be mastoid or EMG related artifact)
Posttest Eyes Closed 	
Pretest Eyes Open 	Moderate generalized increase across all rhythms frontally but largely accounted for by mental activity. Decrease at PZ and CZ not accounted for by mental activity,
Posttest Eyes Open 	
Eyes Open Serial Sevens (Mental Activity) 	Hx of HI in the grade 5, secondary to being hit by a baseball in the center of forehead.

Participant ID 27

<table>
<tr><td>Pretest Eyes Closed
(no data to show)</td><td rowspan="2">Pretest eyes closed data could not be used. Therefore, no comparisons made.</td></tr>
<tr><td>Posttest Eyes Closed
(data not compared)</td></tr>
<tr><td>Pretest Eyes Open
 
</td><td rowspan="2">Increase in Right Frontal in beta and high beta rhythms but is moderately accounted for by mental activity. Also increase in frontal alpha and across the parietal midline as well as left occipital</td></tr>
<tr><td>Posttest Eyes Open
 
</td></tr>
<tr><td>Eyes Open Serial Sevens (Mental Activity)
 
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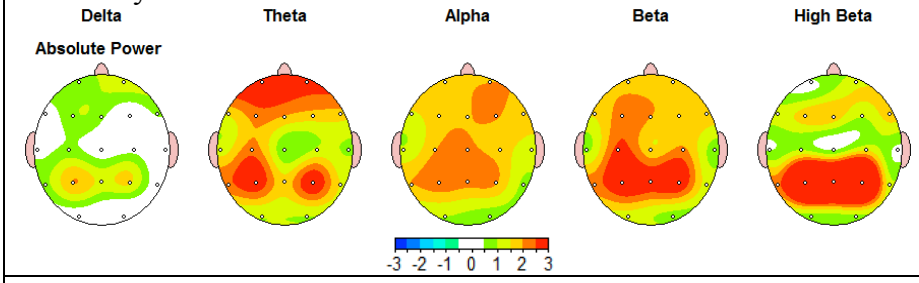
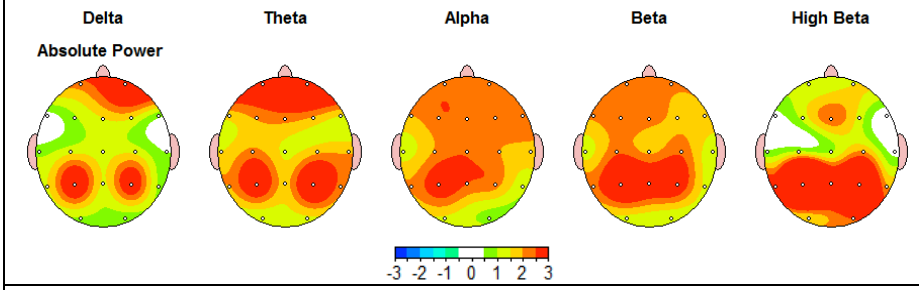
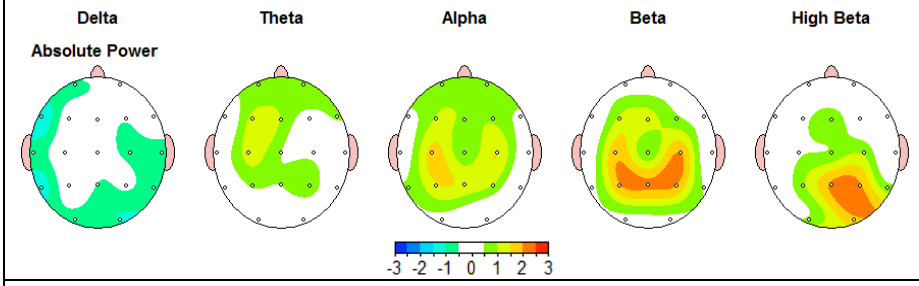
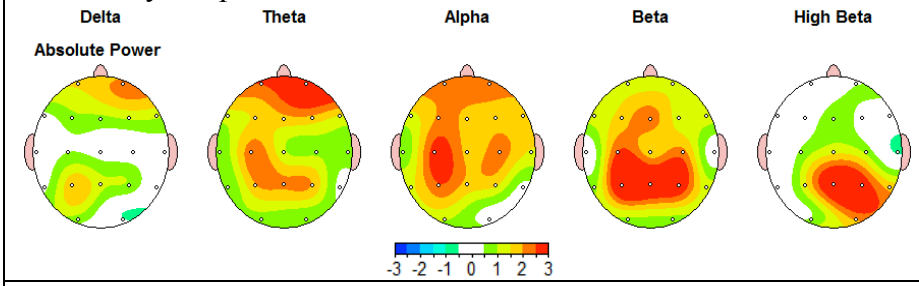
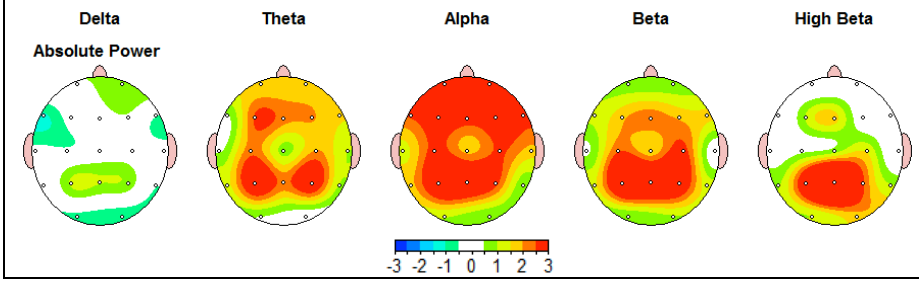
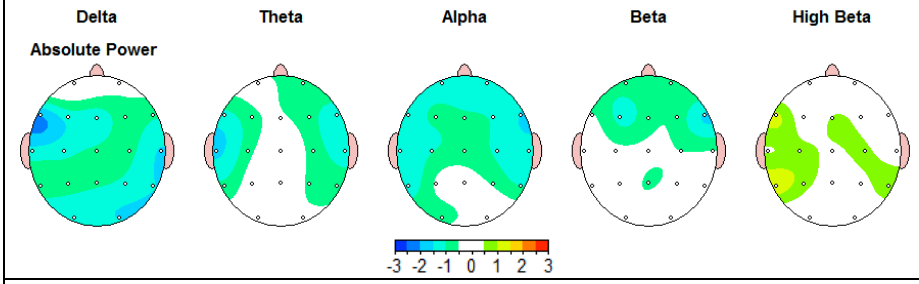
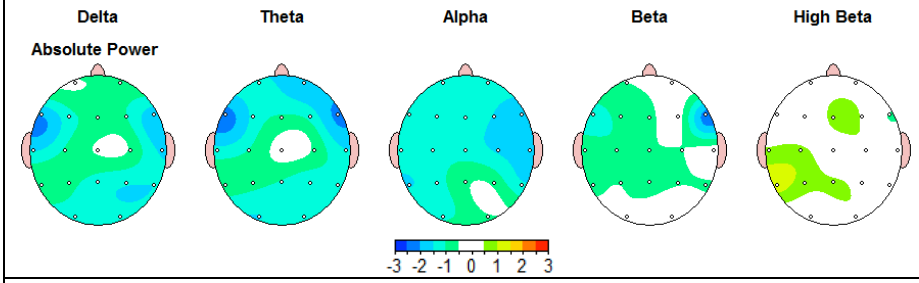
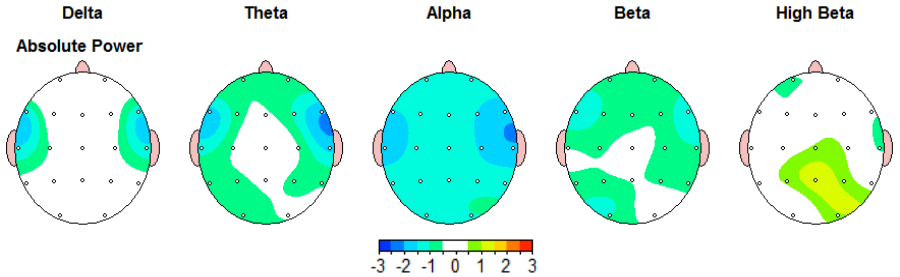
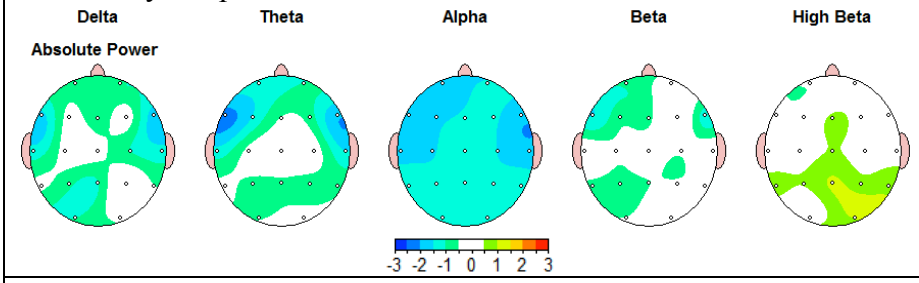
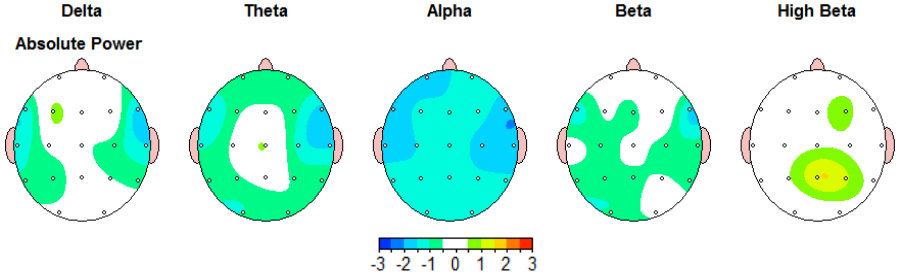
Participant ID 28

Pretest Eyes Closed 	Right side hot spot associated with OD Bx present in baseline but disappears in posttest. Increase in frontal in theta, alps and beta rhythms; in delta the increase is on the right. Bilateral increase along the parietal midline appears consistent with mental activity.
Posttest Eyes Closed 	
Pretest Eyes Open 	Generalized frontal increase more than what is seen in S7; note especially increase in delta and theta at FP2. Note decrease in high beta at T4 P3 increase appears only in the delta rhythm.
Posttest Eyes Open 	
Eyes Open Serial Sevens (Mental Activity) 	Sole non-conformist Hx of Head Injury E/M

Participant ID 29

Pretest Eyes Closed 	Generalized downregulation in several regions; frontally it is more pronounced on the right, especially at F8.
Posttest Eyes Closed 	
Pretest Eyes Open 	Some frontal down regulation, more pronounced on left; Some decrease in PZ not seen in S7
Posttest Eyes Open 	
Eyes Open Serial Sevens (Mental Activity) 	

Participant ID 30

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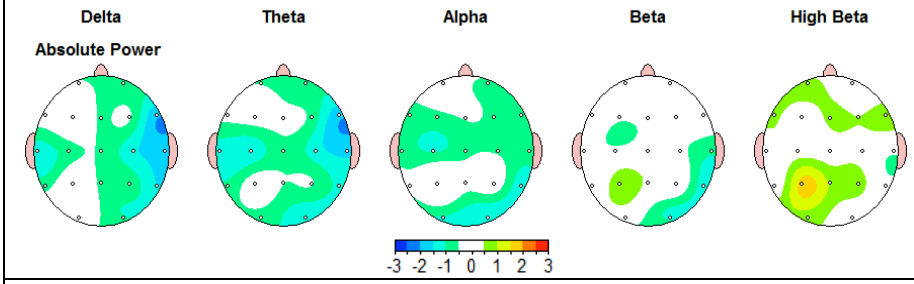
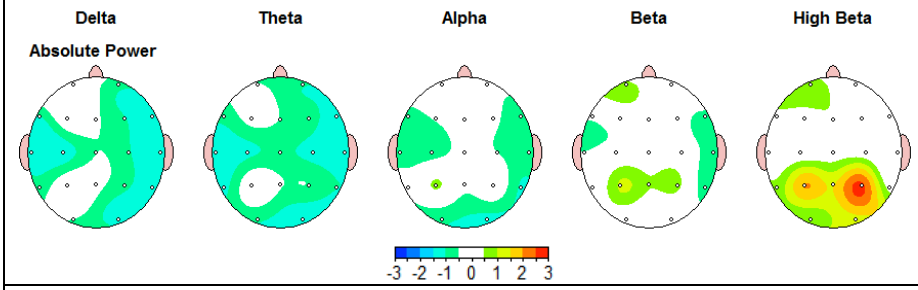
 
</td>
<td rowspan="2">Some decrease in right frontal in beta and high beta. Some increase on the left in all rhythms except high beta and delta. Some increase along parietal midline, more pronounced on the right, generalizing to the right occipital in the beta and high beta rhythms.</td>
</tr>
<tr>
<td>Posttest Eyes Closed
 
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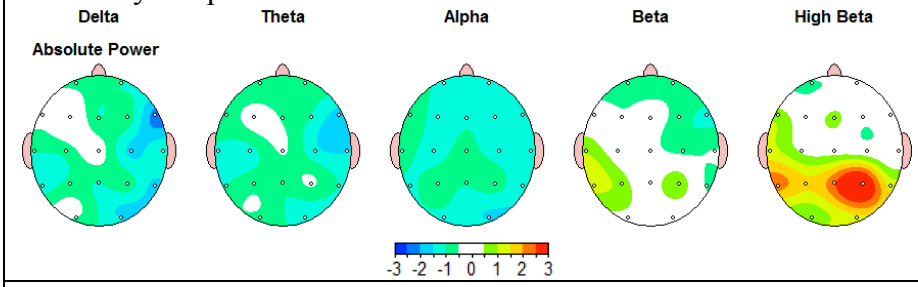
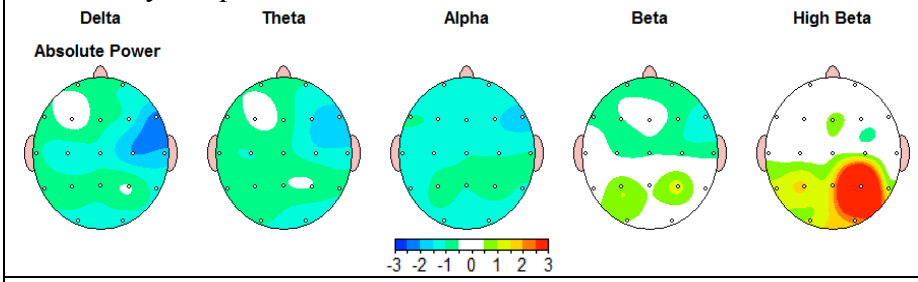
</tr>
<tr>
<td>Pretest Eyes Open
 
</td>
<td rowspan="2">Bilateral frontal decrease, more pronounced on the right, fairly accounted for by mental activity except at F8 in alpha and beta rhythms. Also note decrease at T3 and F7 accompanied by small increase at P3 and P4 in the beta rhythm and decrease at CZ in theta, alpha, and beta rhythms.</td>
</tr>
<tr>
<td>Posttest Eyes Open
 
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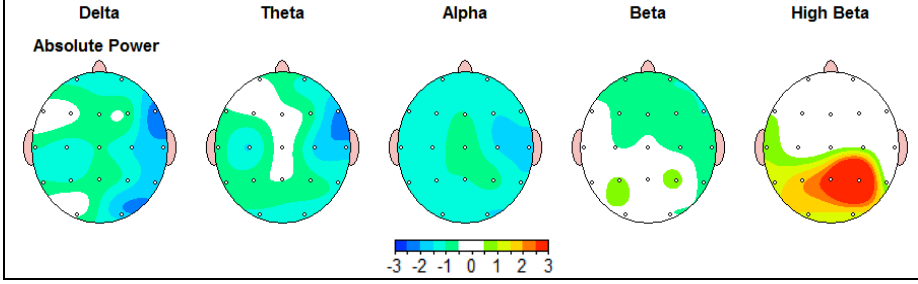
<tr>
<td>Eyes Open Serial Sevens (Mental Activity)
 
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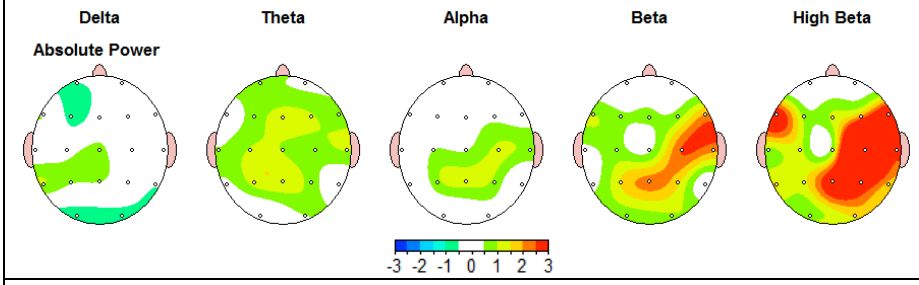
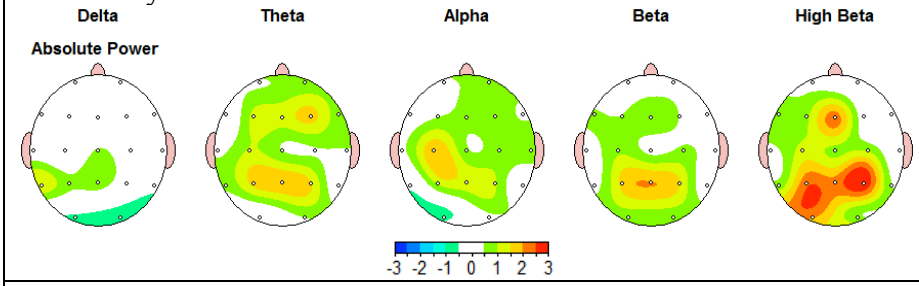
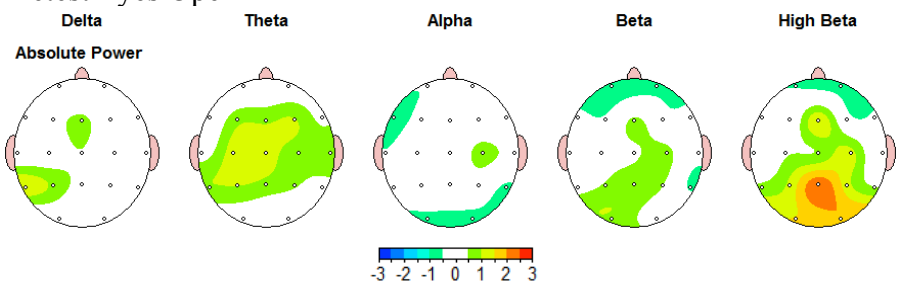
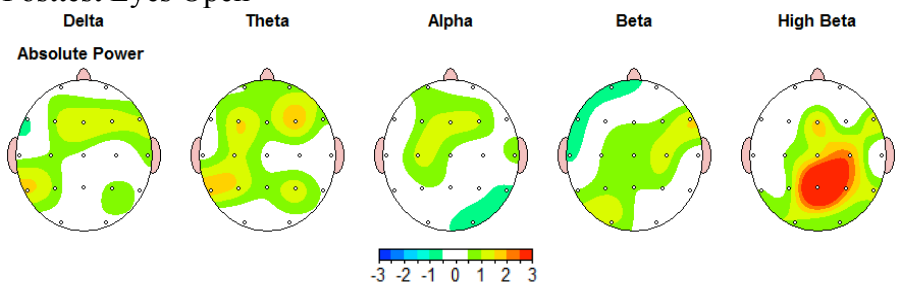
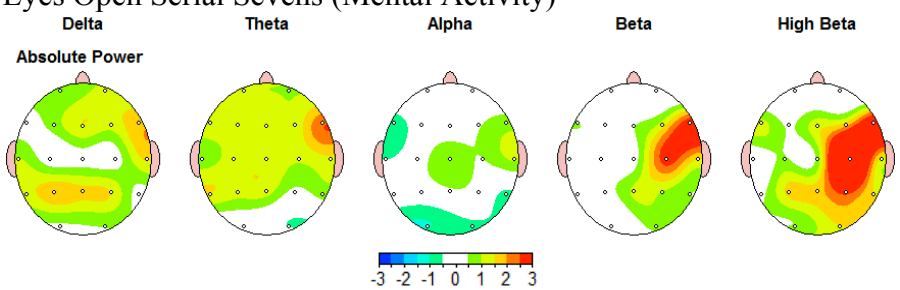
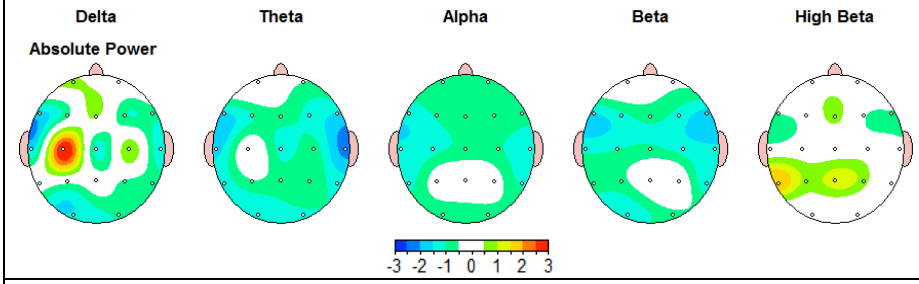
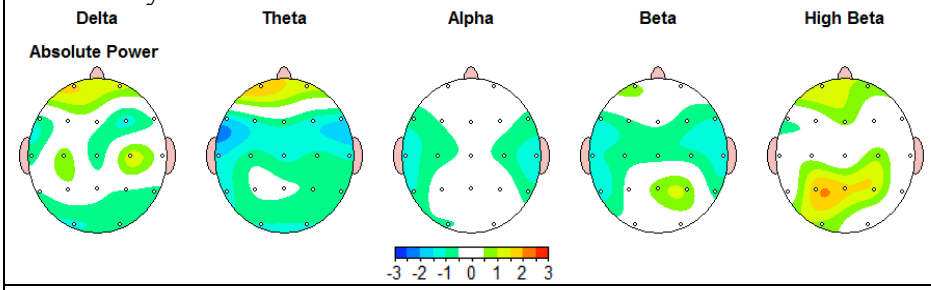
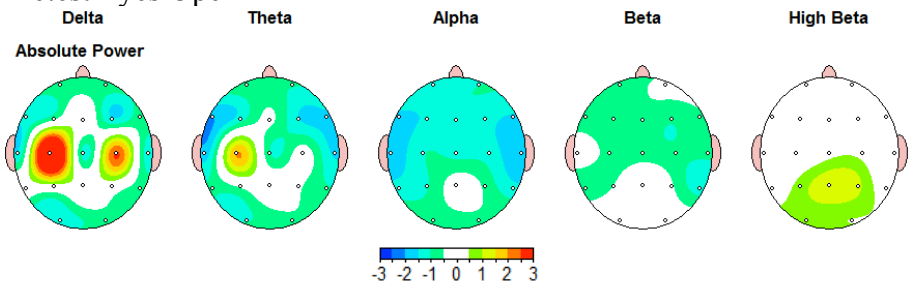
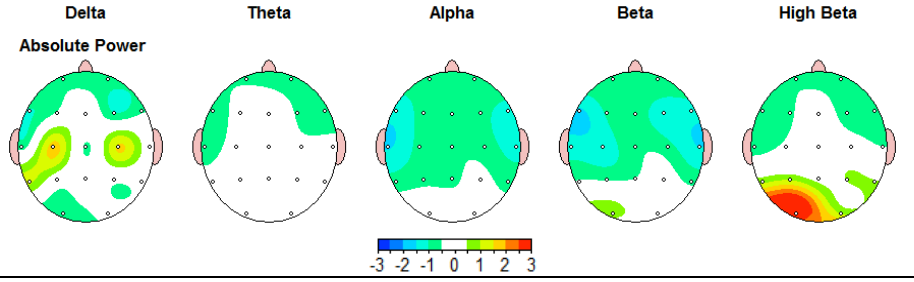
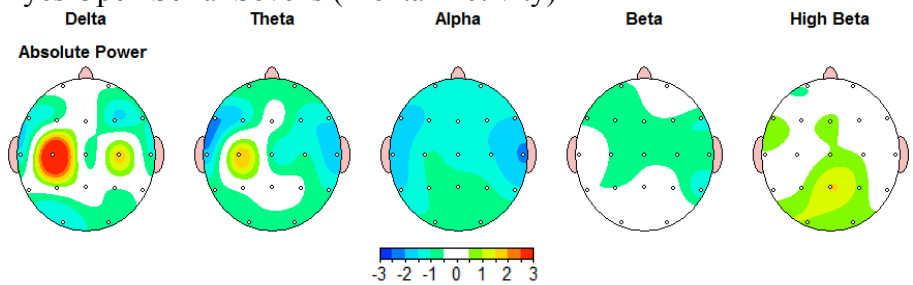
Participant ID 31

Pretest Eyes Closed 	Decrease in right frontal in beta and high beta. Decrease across rhythms in the left frontal. But note increase at FZ in high beta, beta, and alpha. Increase at P3 and C3 noted in theta, alpha and high beta.
Posttest Eyes Closed 	
Pretest Eyes Open 	Increase in activity frontally, only partially accounted for by mental activity. However, note decrease in Delta at F7 and increase at T5 in the Beta rhythm.
Posttest Eyes Open 	
Eyes Open Serial Sevens (Mental Activity) 	Participant was caffeinate and yet drowsy. Possible signal interference due to cartilage piercing.

Participant ID 32

Pretest Eyes Closed 	Generalized increase frontally, concentrated on the left. Improved alpha in posttest condition. Note marked decrease at C3 in delta rhythm accompanied by increase in fast (beta and high beta) at P3 and in the occipital.
Posttest Eyes Closed 	
Pretest Eyes Open 	Decrease in fast rhythms (beta and high beta) frontally but with increase in slow rhythms (theta, and alpha). Note marked decrease at C3. Note decrease at PZ accompanied but marked increase in high beta in the left occipital.
Posttest Eyes Open 	
Eyes Open Serial Sevens (Mental Activity) 	

Participant ID 33

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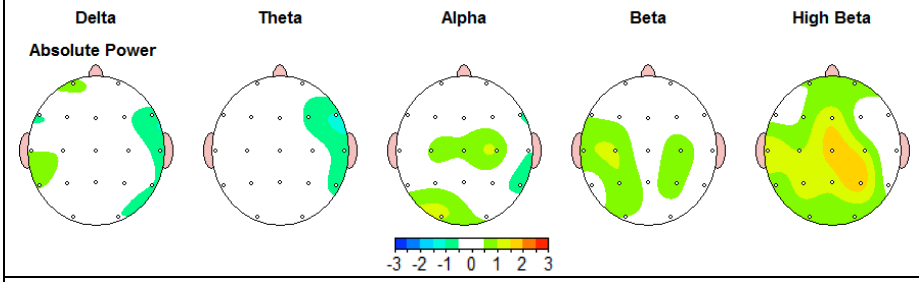
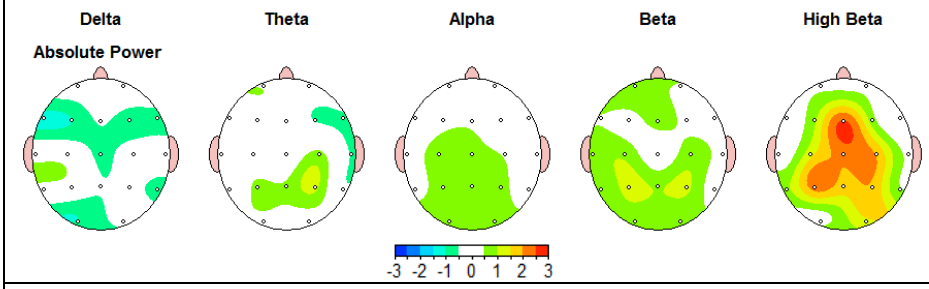
 
</td>
<td rowspan="2">Increases along sagittal midline most likely linked to mental activity, with the exception of increases at P3. Slowing in the occipital (see O1 in the delta rhythm) is most likely drowsiness.</td>
</tr>
<tr>
<td>Posttest Eyes Closed
 
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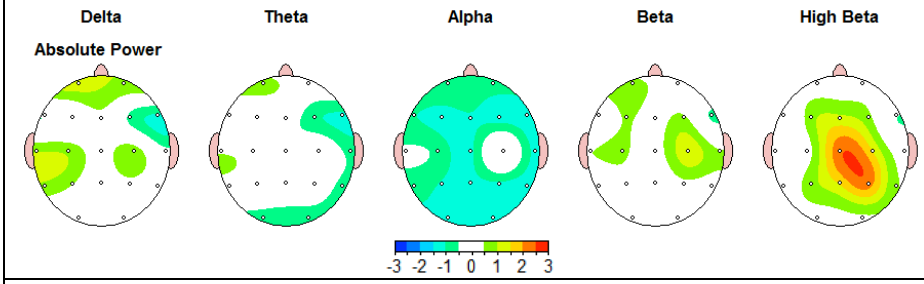
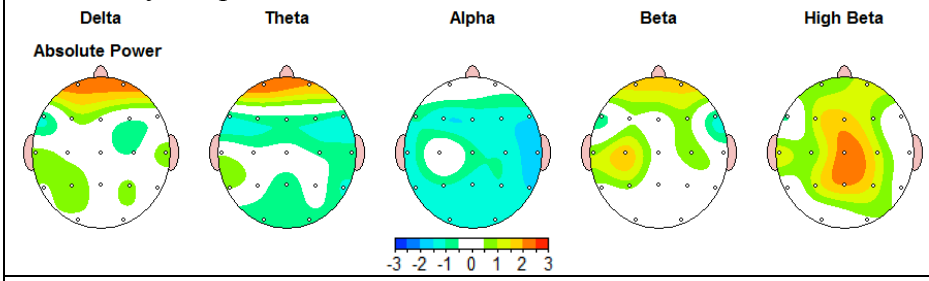
<td>Pretest Eyes Open
 
</td>
<td rowspan="2">Decrease in alpha and beta on the right frontal with frontal increase in delta and theta, more pronounced on the left. Also note the marked decrease in theta between the frontal and central midlines.</td>
</tr>
<tr>
<td>Posttest Eyes Open
 
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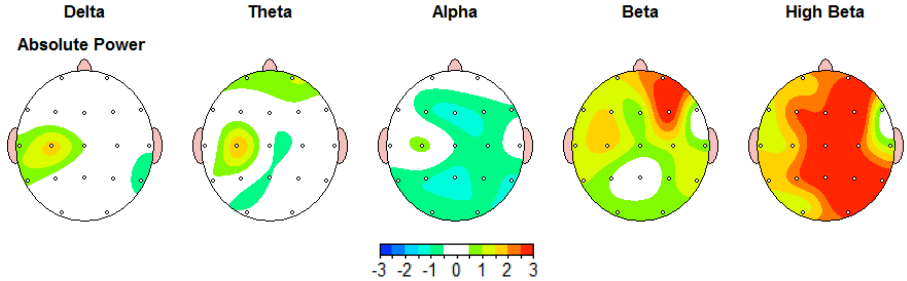
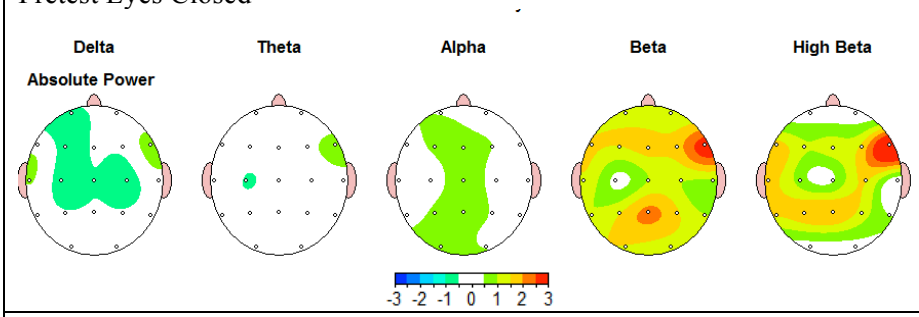
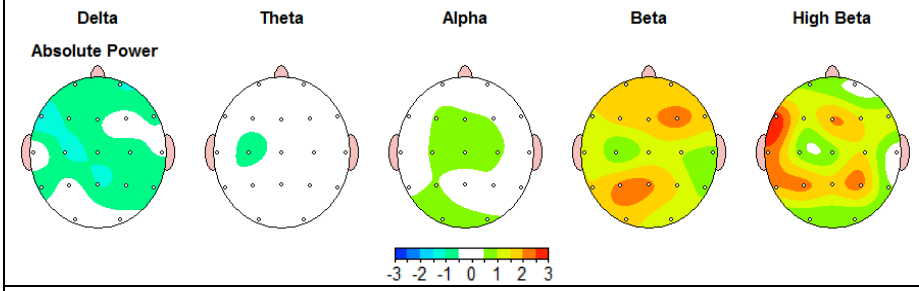
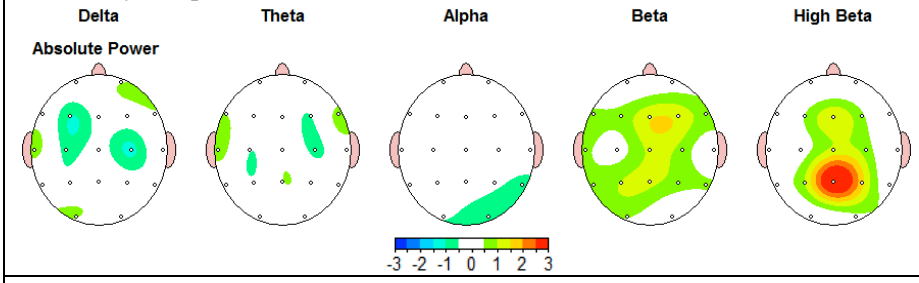
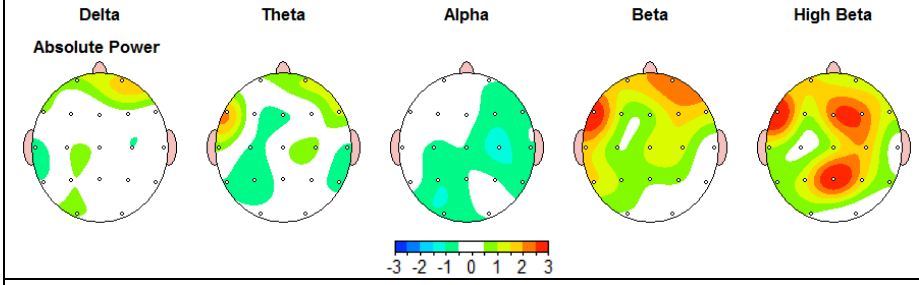
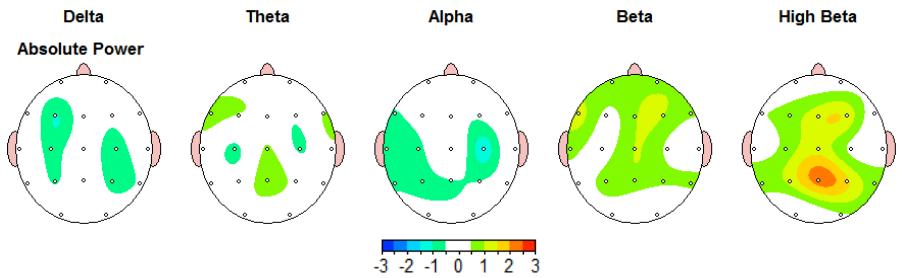
<tr>
<td>Eyes Open Serial Sevens (Mental Activity)
 
</td>
<td>Probable history of head injury related to long history of race car driving.</td>
</tr>
</table>

Participant ID 34

Pretest Eyes Closed 	Frontal increase across in beta and high beta but with marked decrease at F8, increase at P3 in beta and high beta.
Posttest Eyes Closed 	
Pretest Eyes Open 	Increase in frontal, more pronounced on the right, but note marked increase at F7.
Posttest Eyes Open 	
Eyes Open Serial Sevens (Mental Activity) 	

APPENDIX P

Posttest Comparison and LORETA Findings Tables (Personal Notes)

N ID	Eyes Closed Finding	LORETA Source Generation	Eyes Open Findings	LORETA Source Generation	Notes
10	Widespread decrease esp. in the right	Decreased activity in the frontal lobe (specifically in the middle and subcallosal gyrus of the frontal lobe)	Increase (HB) at PZ	Appears to be generated from the cuneus	
	Increase at P3 (theta, beta)	Anterior cingulate in the limbic system, with some activity in the cuneus/precuneus of the occipital lobe			
11	Slowing due to bilateral frontal decrease in beta & HB; increase in alpha, theta and delta on the right.	Increase at Medial frontal gyrus	Large decrease R frontal/temporal, esp. between F8 and T4	Marked downregulation of the Insula as well as the precentral and medial frontal gyri of the frontal lobe	
	Some decrease (delta and theta) seen at (FP1)	Decrease in Superior frontal gyrus,			
	Marked diff at C3 and C4 & in the occipital	C3 and C4 accounted for by Upregulation at Medial Frontal Gyrus; Cuneus is source for changes at O1, O2			

13	Slowing due to decrease in fast activity across frontal except for increase in delta	Appears to be marked upregulation in the anterior cingulate of the limbic system, possibly extending into the medial frontal gyrus3	Increase in frontal fast rhythms with decrease in theta	Medial frontal gyrus is upregulated	
14	Slowing due to frontal increase delta and theta;	Appears to be marked upregulation in the anterior cingulate of the limbic system, possibly extending into the medial frontal gyrus	Increase in frontal fast rhythms with decrease in theta	Upregulation in Medial Frontal gyrus, with marked upregulation in Left middle frontal gyrus accounting for increased activity at F3. Right side continues to appear downregulated in frontal lobe.	
	marked decrease in R frontal	Downregulation in Middle frontal Gyrus of Frontal Lobe			
	with marked increase in L frontal (F3)	Marked Upregulation in Middle Frontal Gyrus of Frontal Lobe			
15	Widespread frontal increase, more pronounced on left	Appears to be secondary to fluctuations in both the anterior cingulate as well as the medial frontal gyrus	Widespread, generalized increase (also accounts for increase at P3 and CZ)	Marked upregulation along the entire medial frontal gyrus extending back to the paracentral lobule of the frontal lobe, as well as the cingulate in the limbic system	
			Greatest at F7	Left Middle frontal gyrus	

18	Some decrease frontally,	Down regulation in superior and middle frontal gyri of the frontal lobe	Increase in frontal alpha and beta	Limbically generated from the anterior cingulate	
	increase at P3 and PZ	Up regulation in the precuneus of the parietal lobe	Increase at P3	Appears to be generated in the cuneus of the occipital lobe but can also be seen generating into the posterior cingulate of the limbic system as well as the precuneus in the occipital region.	
19	Marked increase frontally, pronounced at FP1 and F7;	Some upregulation in Medial Frontal Gyrus of frontal lobe	Frontal decrease, more pronounced on the left	Marked decrease in superior and middle frontal gyri in the left frontal lobe	
	Increase across the occipital and parietal in all bands except high beta.	Marked upregulation in the precuneus of the parietal			
	Decrease in high beta at P3	Possibly generated by marked upregulation in inferior parietal lobule on the left side			

21	Marked increase between PZ and CZ;	Appears secondary to upregulation in the medial frontal gyrus that is generating back through the paracentral lobule in the parietal to the precuneus in the parietal lobe.	Slowing due to increase in delta at FZ and C4	LORETA Time Domain Capture Reveals marked dysfunction along entire Right side in both the middle and superior gyri of frontal lobe; when compared to TDC for EC, insula may also be affected	Head Injury
	increase across frontal except in high beta which increases at FP2 and FZ	Fluctuations both up and down in right superior frontal gyrus (region is consistent with head injury location); upregulation in medial frontal gyrus also present			
22	Generalized frontal increase, pronounced on the left.	Upregulation along Medial Frontal Gyrus and in Anterior Cingulate. Upregulation on left likely due to upregulation in middle frontal gyrus on that side.	Generalized frontal increase, pronounced on the left.	Same upregulation along Medial Frontal Gyrus and in Anterior Cingulate. Upregulation in middle frontal gyrus on left side still present.	

23	Generalized frontal decrease	Widespread downregulation across frontal lobe in all substructures. (However, his precuneus in the parietal is still working.)	Slowing due to bilateral frontal increase except in delta	Seems to be generated by upregulation in both the precuneus in the parietal and the cingulate in the limbic system	Left handed; the pronunciation in the left temporal for almost all subjects is seen in this record on the right (demonstrating differences in part of the brain used to process language and perhaps some social cognition)
			Note increase between FP1 and F3	Some intermittent upregulation in middle and superior frontal gyri	
24	Generalized Left side frontal increase;	Increase in anterior cingulate at limbic system juncture. Left side increase may sourcing from here or from temporal fluctuations	Generalized frontal increase, pronounced on the left.	Both temporal lobes in flux, but increase appears attributed to increase in anterior cingulate, as well as some increase noted in superior, inferior, and middle frontal gyri. It is also noted that the precuneus in the parietal is upregulated	
	increase at P3 and across the central sites	Bilateral fluctuations in temporal lobes			

26	Increase at FZ in alpha, beta and HB, decrease in theta and delta;	Most likely coming from Upregulation in the anterior cingulate and cingulate structures in the limbic system	Decrease at PZ and CZ	May be related to the downregulation in cingulate gyrus in limbic system	ROTC Head Injury
	Slowing due to marked decrease bilaterally in frontally in alpha, beta and HB, more pronounced on the right	Upregulation in the anterior cingulate and cingulate structures in the limbic system and in the medial frontal gyrus. There is differentiation between R and L middle frontal gyri (left is upregulated; right is down)			
	Marked increase in HB at T6, P4, and PZ	May be related to increase in cingulate			

27	Not analyzed due to poor recording.		Increase in right frontal fast	Increase sourcing from insula. Other increases seen in right middle frontal gyrus, superior frontal gyrus, and anterior cingulate from the limbic system.	
			Increase in frontal alpha that generalizes back along parietal midline to occipital region	Upregulation in both the anterior cingulate and the precuneus and cuneus in the parietal and occipital lobes	
28	(Right side hot spot present in baseline but disappears in posttest) Increase frontally in theta, alpha and beta rhythms; in delta the increase is on the right.		Slowing due to frontal increase esp. in delta and theta at FP2		
		Some down regulation in frontal lobe accompanied by some activity in medial frontal gyrus. Note: "Hot spot" seems to have moved to R temporal.	Increase in HB at T4	Marked increase in R temporal	
			Some slowing due to increase in Delta at P3	Fluctuations in regulation in left parietal gyri	

29	Decrease in several regions; frontally it is more pronounced on the right, especially at F8.	Widespread downregulation in the frontal lobe; some activity along the medial frontal gyrus. (Upregulation in the cuneus of the occipital and the precuneus of the parietal lobes)	Frontal decrease, more pronounced on the left	Down regulation across all the gyri of the frontal lobe, especially at the medial frontal gyrus. The anterior cingulate of the limbic system also appears downregulated.	
			Decrease at PZ	May be accounted for by the marked decrease in the parahippocampal gyrus of the limbic system	

30	Some slowing due to slight decrease in right frontal in beta and high beta with some increase on the left in except high beta and delta.	Right side slowing may be consistent with the observed decrease in right side activity; left side increase most likely correlated with increase, especially in the left middle frontal gyrus. There is also marked activity in the anterior cingulate in the limbic system.	Frontal increase with decrease in delta at F7	Increase in left middle frontal gyrus	
			Increase in beta at T5	Increase is consistent with language processing or semantic memory	
	Some increase along parietal medial line, more pronounced on the right, generalizing to the right occipital in the beta and high beta rhythms.	Source generation indicated the precuneus in both the parietal and occipital lobes.			

31	Slowing due to decrease in right frontal in beta and high beta. Decrease in left frontal.	Widespread down regulation in the frontal lobe	Frontal increase with decrease in delta at F7	Increase from the anterior cingulate in the limbic system	
	But note increase at FZ in high beta, beta, and alpha.	Dysregulation along medial frontal gyrus	Increase in HB at T5	Increase is consistent with language processing or semantic memory	
	Increase at P3 and C3 noted in theta, alpha and high beta.	Marked increase in precuneus of the parietal and occipital lobes			
32	Generalized increase frontally, concentrated on the left. Improved alpha in posttest condition.	Marked increase in the anterior cingulate generalizing into the medial frontal gyrus	Frontal slowing (decrease in fast with increase in slower rhythms)	Widespread downregulation across frontal region.	
	increase in fast (beta and high beta) at P3 and at O1, O2	Increase in posterior cingulate in the limbic system as well as the cuneus of the occipital	Increase in HB at O1	Marked increase in the posterior cingulate and occipital cuneus	
33	Increases at P3.	Most likely the posterior cingulate in the limbic system	Slowing due to decrease in alpha and beta in right frontal, with increase in delta and theta on the left with decreased theta between frontal and central midlines	Widespread frontal downregulation except for activity generated from anterior cingulate in the limbic system	Head Injury

34	Frontal increase across in beta and high beta but with marked decrease at F8	Possible decrease at F8 but increase in anterior cingulate in limbic system	Frontal increase, more pronounced on the right but also a marked increase at F7	Increase in activity being generated in the anterior cingulate of the limbic system	
	Increase at P3 in beta and high beta.	Increase in the cingulate gyrus of the limbic system and possibly the parietal's precuneus			

APPENDIX Q

Approval Letter from Pepperdine GPS IRB

PEPPERDINE UNIVERSITY

Graduate & Professional Schools Institutional Review Board

May 22, 2014

Angela Deulen

Protocol #: E0214D02 Project Title: The Neurobiology of Group Decision-Making

Dear Ms. Deulen:

Thank you for submitting your application, *The Neurobiology of Group Decision-Making*, for expedited review to Pepperdine University's Graduate and Professional Schools Institutional Review Board (GPS IRB). The IRB appreciates the work you and your advisor, Dr. Rhodes completed on the proposal. The IRB has reviewed your submitted IRB application and all ancillary materials. As the nature of the research met the requirements for expedited review under provision Title 45 CFR 46.110 (Research Category 7) of the federal Protection of Human Subjects Act, the IRB conducted a formal, but expedited, review of your application materials.

I am pleased to inform you that your application for your study was granted **Full Approval.** The IRB approval begins today, **May 22, 2014,** and terminates on **May 22, 2015**.

Your final consent form has been stamped by the IRB to indicate the expiration date of study approval. One copy of the consent form is enclosed with this letter and one copy will be retained for our records**. You can only use copies of the consent that have been stamped with the GPS IRB expiration date to obtain consent from your participants.**

Please note that your research must be conducted according to the proposal that was submitted to the GPS IRB. If changes to the approved protocol occur, a revised protocol must be reviewed and approved by the IRB before implementation. For ***any*** proposed changes in your research protocol, please submit a Request for Modification form to the GPS IRB. Please be aware that changes to your protocol may prevent the research from qualifying for expedited review and require submission of a new IRB application or other materials to the GPS IRB. If contact with subjects will extend beyond **May 22, 2015,** a **Continuation or Completion of Review Form** must be submitted at least one month prior to the expiration date of study approval to avoid a lapse in approval.

A goal of the IRB is to prevent negative occurrences during any research study. However, despite our best intent, unforeseen circumstances or events may arise during the research. If an unexpected situation or adverse event happens during your investigation, please notify the GPS IRB as soon as possible. We will ask for a complete explanation of the event and your response. Other actions also may be required depending on the nature of the event. Details regarding the timeframe in which adverse events must be reported to the GPS IRB and the appropriate form to be used to report this information can be found in the *Pepperdine University Protection of Human Participants in Research: Policies and Procedures Manual* (see link to "policy material" at http://www.pepperdine.edu/irb/graduate/).

Please refer to the protocol number denoted above in all further communication or correspondence related to this approval. Should you have additional questions, please contact me. On behalf of the GPS IRB, I wish you success in this scholarly pursuit.

Sincerely,

Thema Bryant-Davis, Ph.D. Chair, Graduate and Professional Schools IRB Pepperdine University

cc: Dr. Lee Kats, Vice Provost for Research and Strategic Initiatives Mr. Brett Leach, Compliance Attorney Dr. Kent Rhodes, Faculty Advisor

APPENDIX R

Approval Letter from Secondary Institution's IRB

RE: IRB Review **IRB No.:** 14-EF-002

Project: *The Neurobiology of Group Decision-Making*
Date Received: 1/30/2014
Principle Investigator: Angela Deulen (Faculty member completing doctoral studies at Pepperdine University, CA)
Faculty Advisor: Kent Rhodes (non-CBU faculty associated with Pepperdine University)
Department/Program: School of Behavioral Sciences

IRB Determination: Expedited Status Approved (filed for Full Review, which is not warranted; expedited criteria utilized) – Pilot and subsequent study (two Studys) conducted using laboratory-based research with human subjects/participants who are not members of a protected class; contrived situation using voluntary subjects; safe EEG/qEEG caps used, minimal risk to subjects; some data collected via online surveys; deception utilized as part of the independent variable, but in keeping with accepted practices for such research; may begin data collection.

NOTE: PI may not recruit students in her courses; CBU student subjects may not be coerced or required to participate in this research.

IRB renewal is for one (1) year from the date shown below. PI must notify the IRB within ten (10) working days after completing or discontinuing the research.

Date: 2/4/2014

Neal F. McBride
Certified IRB Professional (CIP)
Chair, IRB

Neal F. McBride, Ed.D., Ph.D., CIP
Associate Provost and Professor of Psychology
Office of Institutional Research, Planning, and Assessment (OIRPA)
CALIFORNIA BAPTIST UNIVERSITY
8432 Magnolia Ave
Riverside, CA 92504
951.343.4925
nmcbride@calbaptist.edu

APPENDIX S

Certificate of Human Subjects Training

CITI Collaborative Institutional Training Initiative (CITI)
Social and Behavioral Responsible Conduct of Research Curriculum Completion Report
Printed on 12/6/2011

Learner: Angela Deulen (username: angela.deulen@pepperdine.edu)
Institution: Pepperdine University
Contact Information Department: GSEP
Email: angela.deulen@pepperdine.edu

Social and Behavioral Responsible Conduct of Research: This course is for investigators, staff and students with an interest or focus in **Social and Behavioral** research. This course contains text, embedded case studies AND quizzes.

Stage 1. Basic Course Passed on 12/06/11 (Ref # 7119652)

Elective Modules	Date Completed	Score
Introduction to the Responsible Conduct of Research	12/06/11	no quiz
Research Misconduct 2-1495	12/06/11	4/5 (80%)
Data Acquisition, Management, Sharing and Ownership 2-1523	12/06/11	4/5 (80%)
Publication Practices and Responsible Authorship 2-1518	12/06/11	5/5 (100%)
Peer Review 2-1521	12/06/11	4/5 (80%)
Mentor and Trainee Responsibilities 01234 1250	12/06/11	5/6 (83%)
Using Animal Subjects in Research 13301	12/06/11	6/8 (75%)
Conflicts of Interest and Commitment 2-1462	12/06/11	6/6 (100%)
Collaborative Research 2-1484	12/06/11	4/6 (67%)
Human Subjects 13566	12/06/11	9/11 (82%)
The CITI RCR Course Completion Page	12/06/11	no quiz

For this Completion Report to be valid, the learner listed above must be affiliated with a CITI participating institution. Falsified information and unauthorized use of the CITI course site is unethical, and may be considered scientific misconduct by your institution.

Paul Braunschweiger Ph.D.
Professor, University of Miami
Director Office of Research Education
CITI Course Coordinator

APPENDIX T

Certificate of Completion in qEEG

Certificate of Completion

This certifies that

Angela Deulen

has successfully completed

24 hours*of Professional QEEG Program

coursework on September 16-18, 2013

BSI

* This includes:

2 hrs - Editing artifacts
1 hr - Brain maps
2 hrs - Drug effects
4.5 hrs - Database analysis
5.5 hrs - Clinical aspects
3 hrs - Montages, Spectral, Topographic Aspects
6 hrs - Practicum

Signed,

CKerson, PhD

Cynthia Kerson, PhD, QEEGT, BCN, BCB
Director of Education