Discovering Distinct Patterns of Alpha Activity in Adults with Inattentive ADHD Using Electroencephalography

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PROJECT SUMMARY

According to data collected and analyzed by researchers, it has been estimated that roughly 8.7 million adults live with attention-deficit/hyperactivity disorder (ADHD), resulting in an estimated $122.8 billion in excess societal costs due to increased healthcare costs, unemployment, and loss of productivity all of which are linked to ADHD symptoms (Schein et al., 2022). Additionally, literature suggests that adult ADHD is associated with increased risk of imprisonment and substance abuse, decreased educational achievement, increased comorbid psychiatric conditions, and poorer clinical outcomes (Ginsberg et al., 2014). Although there is a relatively clearer understanding about ADHD in adolescents, particularly the hyperactive ADHD subtype, gaps remain in terms of knowledge regarding the inattentive ADHD subtype which has led to the formation of diagnostic cracks in the diagnosis of ADHD in adults compared to adolescents.

Previous literature has documented known relationships between mind-wandering, inattention, and increased alpha activity in the brain (Arns et al.,2018; Bloomington, 2022). Because mind-wandering and inattention are characteristic symptoms of inattentive ADHD, this proposed study aims to use electroencephalography (EEG) technology to determine distinct patterns of alpha activity during mind-wandering in adult subjects with inattentive ADHD (Ginsberg et al.,2014; Solanto, 2000). The Sustained Attention Response Task (SART) has become the gold standard for mind-wandering research allowing subjects to self-report mind-wandering while analyzing alpha activity in real time using EEG. Previous studies using this method have shown that during periods of self-reported mind-wandering, participants have increased alpha activity in frontal and parietal brain regions as well as decreased performance in the SART task which is measured by increased response time and an increased number of task errors (Jin et al., 2019; McLoughlin et al., 2022; Sharma et al., 2015). This study will therefore build upon previous literature by utilizing the SART-EEG method to look into three specific aims: 1) assessing the patterns of alpha activity and 2) task performance during mind-wandering for adults with inattentive ADHD compared to typically developed adults, and 3) to assess the potential behavioral-neurological connection between SART task performance and alpha activity together. The overarching goal of the proposed study is to recognize distinct patterns of alpha activity in adult inattentive ADHD which could open the door for alpha activity serving as a neural correlate for the condition. Better understanding the neural mechanism of inattentive ADHD in adults while also having a possible biomarker could potentially lead to more robust diagnostic testing utilizing EEG, improved diagnosis, and increased treatment of inattentive ADHD in adults specifically.

Relevance

Attention-deficit/hyperactivity disorder (ADHD) is a condition still widely misunderstood, underdiagnosed, and undertreated in adults (Coker et al., 2016; Compton et al., 2019). With public perception and the media characterizing ADHD as a disorder mainly affecting children and research focusing on the hyperactive ADHD subtype in adolescents, there is a need for funding and studies dedicated to better understanding inattentive ADHD in adults specifically. This proposed research study's goal is to determine distinct neural patterns associated with inattentive ADHD in order to find a neural correlate of the inattentive ADHD subtype which could serve as a more robust diagnostic tool for clinical use. Information gained from this study will allow for increased understanding of the neural mechanisms underlying inattentive ADHD, and potentially increase rates of diagnosis and treatment of adults in order to alleviate symptoms of the condition. This proposed study would open the door for further research looking into adult ADHD of other subtypes and for the potential creation of new diagnostic tools with the utilization of EEG technology in clinical settings.

SPECIFIC AIMS

In recent decades, there have been rising concerns regarding the overdiagnosis of attention-deficit/hyperactivity disorder (ADHD), its underdiagnosis in underserved populations and in adults, and the overprescription and abuse of stimulant medications prescribed for the treatment of ADHD. These concerns suggest that additional studies looking into more robust diagnostic tools for ADHD subtypes and an increased understanding of the mechanisms and long term effects of stimulant medications are vital in order to improve the diagnosis and treatment of the condition.

Previous literature regarding EEG correlated biomarkers for ADHD have often considered the condition as a homogeneous disorder, looking mainly into hyperactive subtypes with little to no research regarding inattentive ADHD (Asherson et al., 2012). This inattentive form is associated with a short attention span, being easily distracted, having difficulty carrying out basic instructions, and troubles remaining focused or concentrated (Arns et al., 2018). This symptomatology is often associated with increases in mind-wandering, which through electroencephalography (EEG) in previous research, has been determined to be associated with characteristically increased alpha power and alpha activity in posterior parietal-occipital brain regions (Arnau et al., 2020). Alpha activity is slow wave, 8-12Hz, high amplitude neural activity connected to decreased active cognition and has an inverse relationship with brain activation. These alpha brain waves and alpha patterns are relatively constant in individuals across time and across EEG recordings making them an optimal candidate for EEG studies looking into biomarkers for inattentive ADHD (Chabot et al., 1996).

In order to examine possible EEG correlated biomarkers for inattentive ADHD in adults, an empirical study using a 64-channel EEG and the Sustained Attention Response Task (SART) will be implemented to observe differences in distinct patterns of alpha activity and task performance between non-medicated subjects with inattentive ADHD compared to typically developed adult control subjects.

Aim 1: I will determine differences in total alpha power and alpha activity in posterior-occipital brain regions between adults with inattentive attention-deficit/hyperactivity disorder (ADHD) and typically developed adult control subjects using a performance task (SART) and continuous EEG recording.

Aim 2: I will compare SART task performance, response time, and accuracy - indicated by increased error and noGo trials - between adults with inattentive attention-deficit/hyperactivity disorder (ADHD) and typically developed adult control subjects.

Aim 3: I will examine the relationship between SART task performance and alpha power/alpha activity in both non-medicated adult inattentive ADHD subjects as well as typically developed adult subjects. Additionally, potential differences in this behavioral-neurological connection between subject groups will be investigated.

The proposed EEG based study will utilize human adult subjects in order to discover neural correlated biomarkers of inattentive ADHD, specifically, distinct alpha patterns in parietal-occipital brain regions, in order to help create a more robust diagnostic tool for this inattentive ADHD subtype. Additionally, this research will contribute to further understanding of the neural mechanisms of inattentive ADHD in order to improve diagnosis and treatment of ADHD subtypes and to serve as a foundation for future inquiry on the specific topic.

RESEARCH STRATEGY

Significance

Attention Deficit/Hyperactivity Disorder (ADHD):

Attention-deficit/hyperactivity disorder (ADHD) is a psychiatric condition with symptomatology ranging from difficulties remaining still, lack of concentration and focus, excessive talking, interrupting, and impulsivity (Wilens et al., 2010) . However, literature often treats ADHD as a homogenous condition despite the fact that the most recent Diagnostic Statistical Manual of Mental Disorders (DSM-5-TR) was revised to reflect subtypes of the condition which are hyperactive ADHD,

inattentive ADHD, and combined ADHD, all of which present with varying characteristic symptoms (Chabot et al., 1996). Additionally, ADHD is now considered a fluid disorder which can have different clinical presentations based on age that can change over the course of life. However, public perception often categorizes ADHD as a condition affecting only children which has created diagnostic cracks and has led to a lack of proper diagnostic tools for adult ADHD and ultimately the underdiagnosis and undertreatment of the condition amongst adults, which is especially prominent among racial and ethnic minority groups.

Adults with ADHD often present with the inattentive ADHD subtype which has characteristic symptoms of forgetfulness, trouble carrying out basic instructions, mind-wandering, and short attention span (Ginsberg et al., 2014). This form of ADHD in adults has been found to be associated with increased risks of substance abuse, accidents, comorbid conditions, and use of medical resources. Additionally, adults with ADHD have been found to have lower educational attainment, difficulty retaining jobs, and lower socioeconomic status, suggesting a significant personal and societal impact (Asherson et al., 2012). However, literature suggests that the inattentive subtype specifically is still not completely understood and is the most likely to go undiagnosed and untreated (Solanto et al., 2000). Researchers have discussed that inattentive ADHD in adults often presents with minimal hyperactive or impulsive symptoms which are characteristic of ADHD in children, making the condition harder to catch as diagnostic criteria center on these hyperactive aspects of ADHD. Additionally, inattentive ADHD in adults often presents with comorbid psychiatric conditions such as depression, anxiety, and learning impairments which can mimic symptoms of ADHD and can delay an accurate ADHD diagnosis (Solanto et al., 2000). This further suggests the need for more robust diagnostic tools and a possible neural correlate of inattentive ADHD itself to narrow the gap in diagnostic cracks of ADHD.

EEG and Mind-Wandering Approaches Applied to ADHD:

Electroencephalography (EEG) has been frequently utilized in research with the goal of discovering EEG correlated biomarkers for ADHD. EEG technology has the ability to monitor and record brain wave patterns while participants are undergoing a task in order to observe neural changes in response to stimuli during real time (Michel et al., 2019). Where previous literature often focuses on theta activity, beta activity, and the theta-beta ratio involved with hyperactive symptoms, the proposed study will look further into alpha activity associated with mind-wandering during the Sustained Attention Response Task (SART) (Arns et al., 2018; Bloomington, 2022; Chabot et al., 1996). Previous EEG studies have demonstrated that multiple neural circuits are involved in ADHD and due to the heterogeneity of the disorder, suggest that there are likely differences in EEG profiles for different clinical presentations of ADHD (McLoughlin et al., 2022). Therefore, research has suggested that changes in alpha waves, which are slow brain oscillations in the 8-12Hz frequency range, are

associated with mind-wandering and a relaxed wakeful state which may be applicable to the inattentive ADHD subtype specifically despite its lack of use in ADHD research previously (Sharma et al., 2015). This study will utilize this information to determine if alpha activity changes caught by EEG during mind-wandering throughout the SART task can be related to inattentive ADHD in adults. Considering that mind-wandering and difficulties concentrating are primary symptoms of inattentive ADHD, this study will examine if alpha activity changes could be characteristic of the condition.

Relationship Between SART and EEG:

The behavioral-neurological connection between SART task performance, in terms of response time and task accuracy, and alpha wave activity has been discussed in previous literature but is not as well studied as both concepts individually. Various studies have suggested that worse task performance, increased response time, and increased errors during the SART task are all associated with mind-wandering, as expected (Jin et al., 2019). However, multiple studies have discussed that alpha power in EEG data was the most predictive of mind-wandering rather than the SART task performance data (Jin et al., 2019). Additionally, previous research has determined that performance differences did not indicate differences in mind-wandering; however, self-reported assessment and increased alpha activity did (Compton et al., 2019; Epstein et al., 2013). This research study will build upon previous research while also further exploring the actual relationship between SART task performance and the EEG data and working towards highlighting the importance of using EEG combined with task performance as a predictive tool of mind-wandering and inattentive ADHD rather than using task performance alone.

Innovation

Due to recent societal concerns about the rise in ADHD diagnoses and the overprescription and abuse of stimulant medications, previous research on ADHD has often focused on hyperactive ADHD in children specifically (Chabot et al., 1996; Guo et al., 2019; Hale et al., 2010). These research studies often include investigations into various different brain waves, task performance, and their associations with hyperactive ADHD in children and with medication use. Research has found that children with ADHD have worse task performance and slower response times in studies compared to typically developing children (Guo et al., 2019; Jin et al., 2019). Additionally, inconsistencies in data regarding alpha activity patterns in ADHD exist, some of which suggest increased alpha power in ADHD, others which found the opposite occurrence, and some discovering alpha asymmetry across hemispheres in those with ADHD (Compton et al., 2019; Deiber et al., 2020). However, there are issues regarding previous literature looking into EEG and performance studies of ADHD with inconsistencies and a focus on adolescent ADHD, perpetuating the diagnosis cracks in adult ADHD (Asherson et al., 2012). Additionally, the ADHD subtypes are often not specified in research leading to the homogenization of

ADHD and a severe lack of research on the inattentive ADHD subtype specifically (Asherson et al., 2012; Buitelaar et al., 2022; McLoughlin et al., 2022). This study will attempt to minimize these cracks by investigating inattentive ADHD specifically in adults, recognizing the heterogeneity of the disorder and the need for increased understanding of the inattentive ADHD subtype.

Although there is a lack of understanding regarding the underlying neural mechanisms of inattentive ADHD, there is a significant amount of research looking into the role of alpha activity during mind-wandering, which is a standard symptom of inattentive ADHD in adults. Mind-wandering has been defined as a stimulus independent process in which the mind is thinking about things unrelated to a task while in the midst of performing that task, and research has found that alpha activity caught by EEG is the most predictive mind-wandering tool (Jin et al., 2019). Although this research does not specifically mention associations with ADHD, researchers have found that mind-wandering is associated with increased alpha power and alpha activity in posterior-occipital brain regions as detected by EEG (Ginsberg et al., 2014). Although there are inconsistencies in alpha patterns during mind-wandering based on the region of the brain being examined, researchers have collectively concluded that alpha activity is associated with inhibition and decreased brain activation (Klimesch et al., 2012). This study will attempt to utilize these known functions of alpha activity to determine if alpha brain oscillations may be correlated with inattentive ADHD in adults. The goal is to use alpha activity and alpha power in posterior-occipital brain regions, determined by EEG, as a biomarker of both mind-wandering and inattentive ADHD depending on the findings.

Diagnostic tools for adult ADHD are severely lacking and updates to the DSM-5 criteria do not seem to be mitigating the underdiagnosis of inattentive ADHD in this age group. Current diagnostic criteria require adults to self-report and analyze ADHD symptoms all the way back into childhood, a criteria that is not robust and difficult to manage for many adults (Asherson et al., 2012). Discovering neural correlates of inattentive ADHD specifically can lead to more robust and accurate diagnostic testing of the condition to improve diagnosis rates of adult ADHD and to reduce the personal and societal impacts associated with the condition.

Approach

The proposed research study will examine the differences in task performance between those with inattentive ADHD and typically developed adult control subjects. In order to do this, the Sustained Attention Response Task (SART) will be used as the task for the study which will provide data for differences in task performance between participant groups. Additionally, the study will compare alpha activity and alpha power in parietal-occipital brain regions during mind-wandering between groups. This will lead to suggestions regarding alpha activity as a neural correlate of mind-wandering and inattentive ADHD. Finally, the relationship between SART task performance and

alpha activity in non-medicated ADHD subjects and typically developed subjects will be observed to identify a possible behavioral-neurological connection.

Empirical Study

Participants:

50 adult participants between the ages of 18-60 years old will serve as the total subject cohort for the proposed empirical study. Previous studies looking into alpha activity, mind-wandering, and adult ADHD have used adult cohorts in this age group and have yielded significant results (Arnau et al., 2020). 25 of the adult subjects will create the inattentive ADHD experimental group and the remaining 25 participants will form the control group. The experimental group must consist of participants all who have been clinically diagnosed with inattentive ADHD by a licensed healthcare professional according to the updated DSM-5 and may be medicated or unmedicated for the condition at the time of enrollment. The control group will be made up of typically developed healthy adult subjects with no history of any ADHD diagnosis and with no other psychiatric conditions.

Participant Assessments:

Upon recruitment for the empirical study, participants will provide both written and verbal consent before undergoing any eligibility assessments. Both control and experimental group subjects will meet with a licensed healthcare provider for assessment of ADHD (of any subtype) as well as screening for other psychiatric conditions that may serve as confounding variables in this study. These diagnoses will be based upon the current updated American Psychiatric Association's Diagnostic and Statistical Manual (DSM-5). Following research protocol conducted by Vollebregt and researchers, participants in the experimental group with previously diagnosed inattentive ADHD only, and upon confirmation of the diagnosis, must receive approval by the healthcare provider to stop all ADHD medications 12 hours prior to the experimental session (Madelon et al., 2016). This requirement is in place to minimize confounding variables and to eliminate potential impacts of ADHD medications on brain activity or task performance. All participants will also complete a questionnaire related to their demographics, family history of ADHD, and experiences being diagnosed with inattentive ADHD if in the experimental group.

SART Task & EEG Methods:

The Sustained Attention Response Task (SART) serves as the gold standard for mind-wandering research in previous methodology looking into alpha activity and mind-wandering using EEG (Jin et al,., 2019). Following research protocol involving the SART task created by researchers at the Bernoulli Institute for Mathematics, Computer Science, and Artificial Intelligence, each participant, in both the control and experimental research group, will undergo one 2.5 hour testing session in which the SART task will be completed while participants are hooked up to a 64-channel

continuous EEG monitoring system (Jin et al., 2019). The task itself contains 135 trials and will be completed in 20 minutes, however, time is also allocated for EEG set up and clean up as well as a thorough explanation of procedures to participants. Participants in the experimental group with inattentive ADHD must stop medications 12 hours prior to the testing session and must confirm this prior to the start of EEG recording.

Subjects will see random numbers (1-9) appear on a monitor in front of them and will be instructed to click the spacebar for any number that is not a 3, and withhold any response if a 3 appears. Additionally, thought probes will randomly display themselves throughout the task which ask participants to self-rate mind-wandering:

1 = I was paying attention to the task
2 = I was focused on my performance
3 = My mind drifted and I was not aware of this until you asked me
4 = My mind drifted and I was aware of this

The thought probes aid in splitting up task trials into the on-task or off-task (mind-wandering) group. The four trials preceding each thought probe will be analyzed for alpha activity and alpha power which will then be used to determine differences in alpha activity during self-reported focused attention versus self-reported mind-wandering. Thought probes and self-reported scales for the detection of mind-wandering as methodology in this experiment were determined via proposed methodology in previous literature suggesting the difficulties in conceptualizing mind-wandering on EEG without human input via self-reports (Arnau et al., 2020; Jin et al., 2019).

Following the completion of all 50 subjects' SART sessions with continuous EEG monitoring, data will be analyzed to satisfy the aims of the experiment. The first goal will be to use SART trial data in Excel software to determine the overall performance of each participant in the SART task. This will be measured by finding the number of errors (trials where participants clicked the spacebar for a 3), noGo trials (trials where the participant didn't click the spacebar during anything other than a 3), and response time. Differences between the mean and standard deviations in the experimental and control groups will be assessed using SPSS software with a $p<0.05$ being significant. Additionally, EEG brain data will be analyzed using MATLAB and EEGLAB software to analyze alpha activity/power and brainwave pattern differences between the experimental and control groups.

Hypotheses & Analyses:

- Hypothesis 1: I predict that participants in the inattentive ADHD experimental group will have worse SART task performance compared to the control group as indicated by increased errors and noGo trials, increased response time, and decreased overall task accuracy. By analyzing SART task performance differences between groups, I will be able to determine whether inattentive ADHD has the ability to significantly impair performance on daily activities.

- Hypothesis 2: I predict that participants with inattentive ADHD will have increased alpha power and alpha activity - specifically in the 8-12Hz band - in posterior and occipital brain regions compared to typically developed control subjects. I will use data from the SART task and continuous EEG monitoring to determine if alpha activity in parietal-occipital brain regions could serve as a potential biomarker for inattentive ADHD.

- Hypothesis 3: I predict that a relationship exists between worse SART task performance and increased alpha activity/alpha power in participants in the inattentive ADHD experimental group and in the control group. Therefore, I assume that increased alpha activity will be associated with mind-wandering and poor task performance.

TIMELINE

In order to complete this empirical study, it is expected that 20 months will be required to thoroughly investigate the topic and form meaningful conclusions regarding the hypotheses. The first 6 months of the process will involve the recruitment of participants which is expected to be a lengthy process given the relatively smaller number of individuals with inattentive ADHD compared to other ADHD subtypes, however, both inattentive ADHD subjects and control subjects will be recruited during this time. The following two (months 6-8) months will be allocated to the verification of participants' diagnoses, or lack thereof, to ensure all participants meet the eligibility criteria, and to conduct pre-experiment testing and questionnaires. Next, it is expected that the experimental testing procedures will be completed in a six month timeframe from months 8-14 of the funding period in which data on both inattentive ADHD and control subjects will be collected. The final six months of the study (months 14-20) will then include data analysis and the formation of conclusions based on the hypotheses as well as discussion of future directions and implications of the research. Following the conclusion of the entire empirical study, findings will be published in the International Journal of Psychophysiology and will be presented at the Society for Psychophysiological Research Conference.

TRAINING PLAN

Indiana University Bloomington has a Cognitive Neuroscience Program which provides opportunities for undergraduate students, graduate students, and faculty to collaborate on research projects similar to the proposed study. The program itself comprises research labs looking into a wide variety of cognitive neuroscience topics, opening the door for collaboration. Dr. Bennet Bertenthal from IU's Developmental Cognitive Neuroscience Lab conducts research looking into social attention, self-regulation, and attention and decision making. Dr. Bertenthal has published many studies which involve subject cohorts ranging from infants, children, adolescents, and adults which would allow him to offer insight into the benefits and foreseen difficulties with using adult subjects in this proposed study. Additionally, the Cognitive Neuroscience Program and Dr. Bertenthal's lab have EEG and ERP technology which will be needed for this study as well as a familiarity with brain activity determined using EEG and the mechanisms of EEG data analysis. Therefore, Indiana University Bloomington's Developmental and Cognitive Neuroscience Lab with the guidance of Dr. Bertenthal would allow me to carry out the proposed research project by providing laboratory facilities, EEG equipment, and knowledge on the subjects of attention and ADHD.

HUMAN SUBJECTS

Risk to Subjects

Human Subjects Involvement, Characteristics, and Design

For this proposed research study, 50 adult participants will be recruited to undergo the SART task with continuous 64-channel EEG monitoring in order to determine distinct patterns of alpha activity in inattentive ADHD in adults compared to typically developed adult subjects. Following recruitment, participants will undergo assessments by health care professionals in order to confirm ADHD diagnosis with subtype validation according to the Diagnostic Statistical Manual for Mental Disorders (DSM), approve the discontinuation of ADHD medication for the experiment, and to assess the possible presence of other psychiatric conditions. The experimental portion beginning at 8 months will involve all 50 participants undergoing a 2.5 hour testing session in which they will perform the SART task while being continuously monitored via EEG.

Approach:

All participants in the study will receive $50 for completing initial assessments, evaluations, and onboarding requirements following their initial recruitment into the study, comprising months 6

through eight. An additional $100 will be provided to those who complete the experimental period which includes the SART task and EEG monitoring, which will occur throughout months 8 through 14.

Sources of Materials:

Information regarding patient demographics, health history information, and assessment data from healthcare provider evaluations will be required for the proposed study. The Diagnostic Statistical Manual for Mental Disorders (DSM-5) will be used to accurately confirm the presence or absence of inattentive ADHD and to screen for other psychiatric disorders. All of this data will be recorded on paper documents which will be secured in lockable cabinets and in a locked laboratory which only the researchers and the University will have access to. Electronic and digital data will be collected for the behavioral SART task and for the EEG recordings. This will all be stored on private hard drives within password protected computers. Additionally, participants will all be assigned ID numbers which will be used on all materials rather than personal identifying names to provide further confidentiality of data.

Potential Risk:

The proposed research study poses very minimal risk to subjects in both the experimental and control groups. The main risk associated with the experimental procedure is the need for participants with inattentive ADHD in the experimental group to stop all medications used to treat ADHD at least 12 hours prior to their experiment session. Thorough assessment of the ability for subjects to withdraw medication will be completed by healthcare providers in order to alleviate risk. Additional risk may result from anxiety regarding the task at hand as well as slight discomfort and headache from the EEG cap. However, each step will be clearly explained and discussed with participants during the experiment to ease any worry while measures such as cap sizing and adjustments will be made to provide optimal comfort during EEG.

Adequacy of Protection Against Risk

Recruitment and Informed Consent:

Participants in this proposed study will be recruited from the Bloomington, Indiana area near the Indiana University campus. Bloomington's population is categorized as roughly 77.8% white, 9.88% Asian, 4.41% Black, and 3.3% Hispanic (Bloomington, 2022). Effort will be made to recruit participants from diverse backgrounds to accurately represent the population at hand. Recruitment will

involve flyers discussing the study, postings in IU's All IN for Health database, and letters/emails with descriptions of the experiment.

Following recruitment into the study, participants will be evaluated by healthcare providers using the Diagnostic Statistical Manual of Mental Disorder (DSM-5) to confirm ADHD diagnosis and assess well being prior to experiment involvement. Additionally, the experimental period will include an introduction of the basic experiment, informed consent paperwork, and communication about experiment procedures throughout.

Protection Against Risk:

One of the main risks posed in the study involves the stopping of all medications to treat ADHD at least 12 hours prior to the 2.5 hour experimental period. To protect subjects from any potential risk resulting from this, all participants in the inattentive ADHD experimental group will be assessed by a healthcare provider for psychiatric conditions, ADHD, and for the ability to briefly stop ADHD medication. Additionally, patients will have the ability to provide any information about negative experiences resulting from the study and have the opportunity to withdraw from the experiment at any time.

Any study materials, data, and personal subject information will remain private and confidential via security measures in the laboratory including locked cabinets and a locked general laboratory as well. No personal or identifying information will be included in any final experiment reports and subjects will receive an ID number following recruitment which will be used on all experimental materials rather than using subjects personal names. Digital EEG and behavioral data will be collected, stored, and analyzed within the laboratory itself using password protected software and will also be marked with subject ID numbers rather than personal identifiers.

Potential Benefits of the Proposed Research to the Subjects and Others

The proposed research study aims to help researchers and participants in the study better understand the relationships between neural activity, specifically alpha power, mind-wandering, and inattentive ADHD. By better understanding the distinct patterns of alpha activity in adults with inattentive ADHD, participants will have the potential for improved diagnosis, management, and understanding of their condition. Additionally, it is important to note that inattentive ADHD as well as adult ADHD are both generally underdiagnosed and undertreated leading to high personal and societal impacts resulting from symptoms of the condition (Asherson et al., 2012). Therefore, the proposed study poses potential benefits to the larger population as its overarching goal is to aid in creating a

more robust diagnostic tool for inattentive ADHD leading to increased rates of diagnosis and treatment of the condition to help alleviate symptoms and improve quality of life.

Importance of Knowledge to be Gained

This study will work to determine distinct patterns of alpha activity in the brain in adults with inattentive ADHD compared to typically developed match adult controls. By better understanding the relationship between alpha activity, mind wandering, and inattentive ADHD, EEG technology may have the ability to be utilized in a clinical setting with alpha activity patterns being a potential biomarker of inattentive ADHD in adults. The overall goal of this proposed study and further research on this topic would be to create a more robust diagnostic tool for the diagnosis of inattentive ADHD in adults and therefore increased treatment of those with this condition.

Inclusion of Women and Minorities

Inclusion of Women:

Public perception of ADHD centers around the condition being one primarily affecting adolescent boys which has been perpetuated by research which includes subject cohorts that are predominantly male children (Coker et al., 1996; Ginsberg et al., 2014). Because of this information, roughly equal numbers of both male and female participants will be recruited for the proposed study.

Inclusion of Minorities:

Research studies looking into disparities in diagnosis of ADHD have found that African American and Latino individuals have a decreased chance of being diagnosed with and/or treated for ADHD (Clarke et al., 2002). These findings combined with public perception of ADHD as a condition often affecting white middle class adolescents suggest the need for inclusion of minority groups in research on the topic. The proposed study at hand will make an intentional effort to include participants from a range of racial and ethnic backgrounds.

Inclusion of Children

The proposed study includes participants 18 years of age and older while looking specifically into alpha power patterns in inattentive ADHD in adults only. Therefore, no children will be included in the study. However, this study builds upon information discovered in various research studies which incorporated children in their subject cohorts. Ultimately, a lack of research on adult ADHD and inattentive ADHD has led to the decision for adult subjects to be chosen for both the experimental and control groups in this proposed study.

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