2024

Impact of Head Injuries on Executive Functioning and Emotional Regulation

Kaitlin Allison

Impact of Head Injuries on Executive Functioning and Emotional Regulation

Kaitlin Allison

Presented to the Faculty of the

Graduate School of Clinical Psychology

George Fox University

in partial fulfillment for the degree of

Doctor of Psychology

in Clinical Psychology

Newberg, Oregon

Approval Page

Impact of Head Injuries on Executive Functioning and Emotional Regulation

by

Kaitlin Allison

has been approved

at the

Graduate School of Clinical Psychology

George Fox University

as a Dissertation for the PsyD degree

Committee Members,

Rodger K. Bufford, PhD, Chair

Freeman M. Chakara, PsyD, ABPP-CN, Member

Lane Weeks DeWan, PsyD, Member

March 15, 2024

Abstract

Growing interest in diagnosed and undiagnosed head injuries has led to a growth in research focused on mild traumatic brain injuries (mTBIs). However, limited research has focused on the impact of undiagnosed head injuries on executive functioning and self-report measures of executive functioning and self-regulation in individuals' everyday environments. This study aimed to determine the impact of the number of head injuries sustained on executive functioning, emotional regulation, and psychological functioning in current and former athletes. Current and former student-athletes were recruited at a private university. Intake interview, psychological distress measures and measures of executive functioning were completed while undergoing measurement of biophysiological functioning. Results revealed significant differences between athletes who are psychologically healthy and those experiencing psychological distress in self-monitoring, emotional control, behavioral regulation, overall global executive functioning abilities, a task of brief auditory attention, and processing speed. Athletes who more recently experienced a diagnosed or undiagnosed head injury demonstrated lower functioning on measures of executive functioning. Athletes who received treatment for head injuries demonstrated less impulsivity, and better executive functioning abilities than those who remained untreated. Neuropsychological functioning is most greatly impacted in the acute phases of recovery, demonstrating the recovery and resilience of athletes' brain health over time, even with increasing numbers of diagnosed and undiagnosed head injuries. Time since the most recent injury, previous mental health diagnoses, previous diagnosed concussions, and previous treatment of concussions were predictors of psychological and neuropsychological functioning in this sample.

Keywords: head injuries, concussion, executive function, emotional regulation

Table of Contents

Table of Tables

Impact of Head Injuries on Executive Functioning

Chapter 1

Student athletes have intensely busy schedules consisting of practice, meetings, additional weightlifting sessions, and attending classes full time which require a great deal of planning, problem solving, and task switching skills to navigate. Head injuries are common among athletes and the general population, often resulting in mild to severe traumatic brain injuries (TBI) or concussions. Head injuries often are not an isolated event in an athlete's career, with many experiencing multiple injuries within their career. Head injuries may consist of symptoms such as "seeing stars," "getting your bell rung," blurry vision, balance difficulties, or losing consciousness on impact. Other common symptoms that may accompany a head injury include brain swelling, bruising and broken cranial blood vessels, snapped nerve fibers, dizziness, sensitivity to light, headaches, ringing in the ears, poor concentration, memory problems, difficulty thinking, fatigue, irritability, depression, and anxiety (Kashluba et al., 2004). Previous research highlights the elevated risk of head injuries in competitive sports environments with collegiate athletes experiencing 3.74 per 1000 athlete exposures, high school injuries at an injury ration rate of 1.86 per 1000, and youth injury ratio rate at 1.57 per 1000 (Dompier et al, 2015). Additionally, athletes may be at risk of underreporting head injuries. Womack et al. (2022) found that 50.4% of individuals were not evaluated by a healthcare provider following their most recent concussion, particularly if concussion was sustained from an event other than a motor vehicle collision (e.g., a fall, fight, bike accident).

There are both short and long-term effects observed in cognitive functioning following head injuries, particularly in executive functioning and personality (Fleminger, 2008). These

impact the way patients are able to engage in academic skills and daily activities. People experiencing these deficits may have difficulty with planning, emotional regulation, task switching, inhibition, working memory, and problem solving. These challenges can result in individuals having difficulty following their schedules, keeping track of belongings, managing their emotions in an effective way, and following through on their work. Such difficulties leave room for student athletes to fall behind in their course work, further creating challenges in their daily functioning and ability to accomplish the goals which they have set for themselves.

Defining Executive Functioning

Head injuries can result in executive functioning deficits which are crucial to our daily functioning. The cognitive construct of executive functioning was first described in the 1970s based on functional deficits observed in patients with frontal lobe lesions, suggesting this area of the brain may be responsible for processes associated with executive functions (Baddeley & Hitch, 1974). Since this finding, various models of executive functioning have been well researched and developed. Broadly, the three core domains of executive functioning consist of (a) inhibition, (b) working memory, and (c) cognitive flexibility (see Table 1; Lehto et al., 2003; Miyake et al., 2000). Executive functioning skills impact cognitive areas such as reasoning, problem solving, and planning (Collins & Koechlin, 2012; Lunt et al., 2011). Executive functioning abilities are trainable and can be improved with practice. Ongoing research is being conducted to determine the extent to which executive functions are trainable in brain injury patients (Diamond, 2020).

Table 1

Broad Definition of Executive Functioning

Inhibition	Working memory	Cognitive flexibility
Inhibitory control	Central executive	Set shifting
Behavioral inhibition (self-control)	Visuospatial sketchpad	Mental flexibility
Interference control	Phonological loop	Mental set-shifting
Selective attention		Linked to creativity
Cognitive inhibition		

Note. Adapted from "Dimensions of Executive Functioning: Evidence From Children." J.E. Lehto, P. Juujärvi, L. Kooistra, & L. Pulkkinen, (2003). *British Journal of Developmental Psychology*, *21*(1), pp. 59–80, https://doi.org/10.1348/026151003321164627. Copyright 2003 The British Psychological Society. Also from, "The Unity and Diversity of Executive Functions and Their Contributions to Complex 'Frontal Lobe' Tasks: A Latent Variable Analysis," A. Miyake, N. P. Friedman, M. J. Emerson, A. H. Witzki, A. Howerter, & T. D. Wager. (2000). *Cognitive Psychology*, *41*(1), pp. 49–100. https://doi.org/10.1006/cogp.1999.0734 Copyright 2000 Academic Press.

Baddeley and Hitch developed the three-component model of working memory in 1974 to replace Atkinson and Shiffrin's (1968) multi-store model for short-term memory (STM). Baddeley and Hitch (1974) argued the multi-store model for STM was too simple, as it operated as a unitary system without any subsystems. According to the multi-store model, STM holds limited amounts of information for short periods of time with relatively little processing. Baddeley and Hitch (1974) proposed that working memory operates with different systems for different types of information: the central executive, visuospatial sketchpad (inner eye), and phonological loop. The central executive drives the whole systems, allocates data to subsequent subsystems, and manages cognitive tasks such as mental arithmetic and problem solving. The visuospatial sketchpad stores and processes information in a visual or spatial form and is used for navigation. The phonological loop manages spoken and written material. It is further divided into the phonological store (inner ear) which processes speech perception and stores spoken words we hear for 1–2 s, and the articulatory process (inner voice) which processes speech production, rehearses, and stores verbal information from the phonological store. This model proposes the components are reasonably independent of each other and each component has a limited capacity.

According to George McCloskey et al. (2008), executive functions can be defined as neural mechanisms that are responsible for cueing, directing, and coordinating multiple aspects of actions, emotion, cognition, and perception. McCloskey et al proposed there are 33 self-regulation executive functions (SREFs) organized into seven overarching SREF clusters in their model (Table 2).

Table 2

McCloskey's Clusters

Attention	Engagement	Optimization	Efficiency	Memory	Inquiry	Solution
Perceive / cue	Energize	Monitor	Sense time	Hold	Gauge	Generate
Focus / select	Initiate	Modulate	Pace	Manipulate	Anticipate	Associate
Sustain	Inhibit	Balance	Sequence	Store	Estimate time	Organize
	Stop	Correct	Execute	Retrieve	Analyze	Plan
	Interrupt / pause				Compare / evaluate	Decide
	Flexible					Prioritize
	Shift					

Note. Adapted from *Assessment and Intervention for Executive Function Difficulties,* by G. McCloskey, L. Perkins, & B. Diviner (2008). Routledge. Copyright 2009 by Routledge Taylor & Francis Group.

Russel Barkley and Thomas Brown remain two prominent researchers in the field of adult attention deficit- hyperactivity disorder (ADHD) and believe that executive dysfunction lies at the root of ADHD. Thomas Brown's (2005) model suggests there are six clusters (Table 3) operating in an integrated manner. These clusters manage the organization and initiation of tasks, ability to remain engaged and alert, apply working memory and recall, self-monitoring and regulation, and maintaining emotional states (Brown, 2005). Barkley et al.'s (2008) model of executive functioning is based in the idea that the inability to self-regulate lies at the root of many challenges of individuals with executive dysfunction. It is imperative to assess component processes including inhibition, working memory, resistance to distraction, self-awareness,

emotional self-control, and self-motivation to best gauge executive functioning in accordance with this model (Barkley & Murphy, 2011).

Table 3

Brown's Model of Executive Functioning

Executive functioning cluster	Associated functions
1	Organizing, prioritizing, and activating for tasks
2	Focusing, sustaining, and shifting attention to task
3	Regulating alertness, sustaining effort, and processing speed
4	Managing frustration and modulating emotions
5	Utilizing working memory and accessing recall
6	Monitoring and self-regulating action

Note. From *Attention Deficit Disorder: The Unfocused Mind in Children and Adults Brown* (pp 20–58), E. Thomas, 2005, Yale University Press Health and Wellness. Copyright 2005 Yale University Press

Baddeley and Hitch (1986), Barkley and Murphy (2011), Brown (2005), and McCloskey (2008) have proposed various theories of the way in which executive functioning presents and manifests. While their details vary, there is agreement that executive functions often do not function independently; rather they build upon and interact with the other functions. Using McCloskey's (2008) model, if an individual has difficulty with sensing time in the efficiency cluster, they may consequently have difficulty with gauging and estimating time in the inquiry cluster. If an individual has difficulty with inhibition, they may also have difficulty with emotional regulation or task switching. Each component of executive functioning holds an impact on the others; impairments in any domain of executive function likely contribute to impairments in another seemingly unrelated area of executive functioning. Conversely, optimal functioning in each domain facilitates the coordination of executive functions with each other and leads to successful application of the executive functions (Center on the Developing Child at Harvard University, 2020). Successful coordination of the various executive functioning skills may help bolster successful emotional regulation.

Emotional Regulation

Brown (2005) argues emotional regulation and modulation are impacted by the frontal lobe functions associated with executive functioning. Emotional regulation refers to the neuropsychological processes that influence which emotions we have, when we have them, how we experience them, and how we express them (Gross, 1998). Modern research on emotional regulation focuses on the study of psychological defenses (Freud, 2018), stress and coping (Lazarus, 1966), attachment (Bowlby, 1969), and self-regulation (Mischel et al., 1989). Current research seeks to find associations between head injuries and their impacts on emotional functioning.

As many as 70% of individuals who experience a moderate to severe TBI report low empathy, and 13%–39% of individuals experience emotion perception deficits (Westerhof-Evers et al., 2019). Social cognition consists of three stages. Stage one is the ability to perceive social information, (i.e., body language or facial expressions). Stage two is the capacity to process and interpret social information, such as perspective taking or theory of mind. Stage three is the ability to adapt behavior in accordance with the situation (Arioli et al., 2018). Research suggests links between lowered social-cognitive skills and inadequate behavior following TBI (Westerhof-Evers et al., 2019).

Deficits in emotional regulation are common in patients following a TBI. Emotional regulation is a heterogenous set of neuropsychological processes involved in the evaluation, monitoring, and modification of emotional responses (Tsaousides et al., 2017). Observable emotional regulation deficits following a TBI may be failures in executive functioning, emotional and behavioral disinhibition, diminished working memory, and/or reduced emotional awareness and expression, among other factors.

An individual with emotional regulation deficits may be aggressive, irritable, and impulsive. They may experience alexithymia (i.e., emotional unawareness), socially inappropriate behavior, and impairments in goal-directed behavior (Tsaousides et al., 2017). Planning and insight are crucial in keeping TBI patients engaged in rehabilitation and the understanding of their functional limitations. The patient may have difficulty in participating in rehabilitation treatments due to deficits in emotional regulation, planning, and insight. This may manifest as challenges with the social demands of participation, inconsistent attendance, and lowered capacity for engagement. TBIs further impact the brain’s resting states.

Neuroanatomical Correlates of Head Injury

Researchers and clinicians typically associate executive functioning abilities with the prefrontal cortex (PFC) of the brain. The prefrontal cortex includes all portions of the frontal lobes and can be divided into three main convexities: the dorsolateral PFC, the superomedial PFC, and the ventral PFC (Suchy, 2009).

The dorsolateral PFC is often associated with working memory abilities; the superomedial PFC (including the anterior cingulate gyrus) is often associated with sustained attention, response selection, and motivation; the ventral PFC (which can be further divided into orbitofrontal and ventromedial) is associated with inhibition, social appropriateness, and sensitivity to rewards and punishment; the frontal pole (including anterior portions of the dorsolateral and ventral prefrontal cortices) plays a role in morality, empathy, and higher order integration of executive functioning (Suchy, 2009).

Using voxel-based lesion-symptoms mapping, Robinson et al. (2020) found that patients with lesions to the ventromedial PRC primarily had deficits in social and emotional aspects of executive functioning, while patients with lesions to the dorsolateral prefrontal cortex and anterior cingulate primarily demonstrated deficits in the cognitive aspects of executive functioning.

Notably, executive functions are not limited to just the PFC regions. In a study on older adults, prefrontal grey matter volumes are significantly associated with measures of shifting/inhibition and working memory in healthy older adults (Bettcher et al., 2016). However, in the context of global atrophy, fronto-parietal white matter, particularly the corpus collosum and cingulum, continued to predict executive functions after accounting for global grey matter

atrophy. Taken together, these findings suggest executive functions are associated with the dorsolateral PFC, superomedial PFC, the ventral PFC, and fronto-parietal regions of the brain.

Due to the unique nature of the athletic population, athletes are at an increased risk of sustaining head injuries in childhood or adolescence. This raises concern for the impact on brain development as it pertains to executive functioning, particularly as the prefrontal cortices' neuronal connections and myelination are not completed until the mid-20s to 30s (Johnson et al., 2009). Frontal lobe lesions in children and adolescents were associated with deficits in aspects of neurobehavioral function, including attention, impulse control, language, and memory (Anderson et al., 2002). In adults who sustained frontal lobe pathology, they are likely to present with more globally depressed cognitive profiles and are at risk for expressing emerging deficits over time.

Neuropsychological and Physiological Measures

Two forms of psychological testing are typically used to objectively assess executive dysfunction: effort measures and neuropsychological measures. Effort measures (e.g., Test of Memory Malingering, Rey-15, Green's Word Memory Test) are vital in performance-based measures to ensure that you are gathering accurate and reliable data. Neuropsychological tests can be used to objectively test executive functions in a variety of populations (e.g., aging populations, attention-deficit/hyperactivity disorder, TBI patients, anxious and depressive disorders). There are several different neuropsychological tests available to assess different domains of executive functioning, and generally a neuropsychological test is predominantly used to assess a single domain of executive function (Faria et al., 2015).

Current physiological research modalities to measure emotional regulation may consist of electrodermal activity (EDA; i.e., galvanic skin response [GSR]) and electrocardiogram (ECG or EKG). EDA measures have been used in various manners to assess attention, information

processing, and emotion, in an attempt to shed light on the physiological processes associated with normal and abnormal behavior (Dawson et al., 2017). ECG is able to measure changes in the QRS complex (a measure of ventricular depolarization in an ECG) and activation of the autonomic nervous system and provides information of the myocardial conduction system and the impacts emotions have on the cardiovascular system (Risk et al., 2005). The combination of neuropsychological and physiological measures brings a more holistic view of a person's internal processes associated with emotional regulation.

Lasting Impacts of Head Injury

The lasting cognitive impacts following a minor head injury are subject to considerable debate (Cudmore, 1999). Feigning injury (malingering) or exaggerating symptoms may be used to gain financial compensation, insurance claims, leave of absence from work, and to avoid blame (Robinson & McFadden, 2020). Malingering is difficult to estimate in clinical settings; current research works to use measures (e.g., eye-tracking, event-related potentials, validity & effort measures) to better gauge symptom and assessment validity and parse out incidents of malingering. Current estimates of malingering in clinical settings, evidenced by base rate, range between 11%-60% (Mittenberg et al., 2002).

Research suggests the majority of patients sustaining a mild head injury experience the most severe symptoms in the acute stage (< 72 hours after injury) and experience a full recovery within a few weeks to 3 months; well-designed prospective studies suggest about 10%-15% of patients do not recover within one year post injury (Cole & Bailie, 2016). Due to the traumatic nature of a head injury, evidence suggests emotional distress and other cognitive symptoms reported may be attributed to a psychological disorder including post-traumatic stress disorder (PTSD), depression, or anxiety. A study conducted with service members found that one-third of

service members who sustained a mild traumatic brain injury (mTBI) and 44% of service members who had loss of consciousness reported PTSD compared to 9% who did not sustain a head injury (Tanielian & Jaycox, 2008). In civilians, it is estimated 13%–40% of individuals develop PTSD following a mTBI (Cole & Bailie, 2016). Rates of PTSD tend to be higher after a mTBI than a moderate or severe TBI, which may be moderated by the loss of consciousness that is commonly experienced in more severe cases (Bombardier et al., 2006). These findings stress the importance of using both performance and symptom validity measures in the assessment of a minor head injury.

In this study, the researcher sought to discover if the number of diagnosed and undiagnosed head injuries (including times where participant was seeing stars, had nausea, blurry vision, pressure in head, sensitivity to light, confusion, memory problems, or had their bell rung) impacts executive functioning, emotional regulation, mental health symptoms, and physiological functioning using a neuropsychological evaluation and biophysiological data (EKG and EDA). The remaining questions will be considered in future studies, the impact of head injuries on physiological and psychological functioning.

Chapter 2

Method

Participants

This study recruited 21 former and current athletes in western Oregon. Athletes were currently or had formerly participated in football, track and field, basketball, baseball, soccer, volleyball, softball, snowboarding/skiing, swimming/diving, cheerleading, wrestling and rugby at either the high school, collegiate, or professional level. All participants had a history of diagnosed or undiagnosed head injuries. Participants were selected through undergraduate courses and through word of mouth in the community. Participants through undergraduate courses were compensated with research credits.

The participants (age range 17–29 years; $M = 20.33$, $SD = 2.97$) included 12 females (57.1%) and nine males (42.9%). Participants included 13 who identified as White/European American (61.9%), three as Hispanic (14.3%), two as mixed race (9.5%), one as Black/African American (4.8%), one as Asian American (4.8%), and one as Indigenous Heritage (4.8%).

Athletic Engagement

Among the participants, the principal sport played was football for five (23.8%), for four basketball (19.0%), for two swimming/diving (9.5 %), for two volleyball (9.5%), for two snowboarding/skiing (9.5%), for one baseball (4.8%), for one soccer (4.8%), for one competitive cheerleading (4.8%), for one wrestling (4.8%), for one rugby (4.8%), and for one softball (4.8%). The participants included 13 athletes who participated at the high school level (61.9%), seven athletes who participated at the collegiate level (33.3%), and one athlete who participated at the professional level (4.8%).

The participants each had a history of diagnosed or undiagnosed/unreported head injuries.

Diagnosed Head Injuries

The participants each had a history of diagnosed or undiagnosed/unreported head injuries. Of the participants, seven had a history of zero diagnosed concussions/head injuries (33.3%), eight had one diagnosed concussion or head injury (38.1%), two had two diagnosed concussions or head injuries (9.5%), three had three diagnosed concussions or head injuries (14.3%), and one had six diagnosed concussions or head injuries (4.8%).

Undiagnosed/Unreported Head Injuries

Among the participants, two had zero estimated undiagnosed or unreported head injuries (9.5%), six had a history of two estimated undiagnosed or unreported head injuries (28.6%), four had three estimated undiagnosed or unreported head injuries (19.0%), one had five estimated undiagnosed or unreported head injuries (4.8%), one had eight estimated undiagnosed or unreported head injuries (4.8%), One had 10 estimated undiagnosed or unreported head injuries (4.8%), one had 15 estimated undiagnosed or unreported head injuries (4.8%), two had 30 estimated undiagnosed or unreported head injuries (9.5%), one had 60 estimated undiagnosed or unreported head injuries (4.8%), one had 70 estimated undiagnosed or unreported head injuries (4.8%), and one had over 100 estimated undiagnosed or unreported head injuries (4.8%).

Total Head Injuries

Amid the participants, two had one total diagnosed or undiagnosed/unreported head injuries (9.5%), two had two total head injuries (9.5%), two had three total head injuries (9.5%), three had four total head injuries (14.3%), three had five total head injuries (14.3%), one had nine total head injuries (4.8%), one had 10 total head injuries (4.8%), one had 11 total head injuries (4.8%), one had 15 total head injuries (4.8%), one had 31 total head injuries (4.8%), one

had 32 total head injuries (4.8%), one had 61 total head injuries (4.8%), one had 71 total head injuries (4.8%), and one had over 100 total head injuries (4.8%).

Time Since Last Head Injury

Nine of the participants sustained their last head injury < 6 months ago (42.9%), nine sustained their last head injury between > 6 months–5 years ago (42.9%), and three sustained their last head injury more than 5 years ago (14.3%).

Treatment and Previous Testing

Thirteen of the participants had received treatment for their head injury (61.9%) and eight had not received treatment for their head injury (38.1%). Among participants, 16 had received previous neuropsychological or Immediate Post-Concussion Assessment and Cognitive Testing (ImPACT) testing (76.2%) and five had not received previous testing (23.8%). ImPACT testing is a computer-based assessment tool designed for comparing neurocognitive status before and after a concussion occurs.

Mental Health History

With respect to mental health history, 16 of the participants denied any previous or current mental health diagnoses (76.2%), two of the participants reported a history of posttraumatic stress disorder (PTSD; 9.5%), two of the participants reported a history of ADHD; 9.5%, and one of the participants reported a history of depression. (4.8%). Notably, one of the participants who endorsed a history of PTSD reported their PTSD was due to a diagnosed head injury.

Materials

The measures included a signed informed consent, interview (Appendix A and B), a resting phase, and several executive functioning measures. In addition, physiological responding

was examined with a positive and negative stimulus using neurophysiological measures (GSR & EKG).

Executive Functioning, Emotional Regulation, and Psychological Functioning Measures

Neuropsychological measures included the Test of Memory Malingering (TOMM), the Delis-Kaplan Executive Functioning System (D-KEFS) Verbal Fluency, Trails Making, and Color Word Interference test (CWIT) conditions, the Wechsler Adult Intelligence Scale, 4th edition (WAIS-IV) Digit Span and Coding subtests, and the Behavior Rating Inventory of Executive Function, Adult Version (BRIEF-A).

Psychological functioning measures

Psychological functioning measures included the Generalized Anxiety Disorder-7 (GAD-7), Patient Health Questionairre-9 (PHQ-9), and the International Trauma Questionnaire (ITQ).

The TOMM

The TOMM includes 50 items that comprise a visual recognition test designed to help distinguish malingering from genuine memory impairments (Tombaugh, 1996).

The D-KEFS CWIT

The D-KEFS CWIT is designed to measure visual inhibitory control and cognitive flexibility by utilizing the Stroop Effect to identify deficits in suppressing over-learned behaviors (Kane & Engle, 2003). The CWIT, color-naming and word-reading composite, holds internal consistency values ranging from moderate to high correlation across age groups (0.62–0.86). Test-retest reliability for color naming and word reading ranges from poor to high correlation across age groups and suggests improved performance after second exposure to the test across age groups (0.49–0.86). The test-retest reliability for the inhibition condition ranges from poor to excellent across age ranges (0.50–0.90) and for the inhibition/switching condition ranges from

poor to good reliability (0.52–0.80). The CWIT is a first edition executive functioning measure therefore the validity is somewhat limited.

The D-KEFS Verbal Fluency Test

The D-KEFS Verbal Fluency test is designed to measure verbal ability and emotional control (Shao et al., 2014). The normative data for the D-KEFS Verbal Fluency test is the same sample as the D-KEFS CWIT as reviewed below (Delis et al. 2001). The internal consistency values vary across conditions and age groups and fall between the poor to excellent range. Internal consistency values range as follows: Condition 1: 0.68–0.90; Condition 2: 0.53–0.76; Condition 3 category switching correct: 0.37–0.68; Condition 3 category switching total switching: 0.51–0.76. Test-retest reliability was consistent with internal consistency. The test-retest reliability for letter fluency (0.67–0.88) and category fluency (0.70–0.82) fell within the good to high-reliability range. The category switching correct (0.49–0.65) and category switching total switching (0.24–0.53) fell within the unacceptable to questionable range. The Verbal Fluency Test is a first edition executive functioning measure therefore the validity is somewhat limited.

The D-KEFS Trails Making Test

The D-KEFS Trails Making test is designed to measure processing speed and executive functioning that includes five different subtests. The five subtests are visual scanning, number sequencing, letter sequencing, number-letter switching, and motor speed.

The WAIS-IV Digit Span Subtest

The WAIS-IV Digit Span subtest assesses auditory recall, short-term memory, and working memory. Scores may be indicative of strengths or weaknesses with auditory sequential

reasoning, immediate memory, rote memory, memory span, and numerical ability (Wechsler, 2008).

The WAIS-IV Coding Subtest

The WAIS-IV Coding subtest is designed to measure an individual's ability to learn an unfamiliar task involving speed of mental operations and psychomotor speed. Scores may be indicative of an individual's processing speed, rate of test taking, visual-motor coordination, scanning ability, visual short-term memory, visual recall, attention, concentration, visuoperceptual symbol associate skills, visual processing, fine-motor coordination, numerical recognition, and visuoperceptual discrimination (Wechsler, 2008).

The BRIEF-A

The BRIEF-A includes 75 items within nine non-overlapping theoretically and empirically derived clinical scales to measure different domains of executive functioning, including Inhibition, Self-Monitoring, Planning/Organization, Shifting, Initiation, Task Monitoring, Emotional Control, Working Memory, and Organization of Materials (Roth et al., 2005). The clinical scales form two broader indexes: Behavioral Regulation (BRI) and Metacognition (MI). Together these indexes form the overall score, the Global Executive Composite (GEC). The BRIEF-A also includes three validity scales (negativity, inconsistency, and infrequency). All 75 items are rated in terms of frequency on a 3-point-scale: 0 (*never*), 1 (*sometimes*), 2 (*often*). Raw scores for each scale are summed and *T*-scores ($M = 50$, $SD = 10$) are used to interpret the individual's level of executive functioning. The BRIEF-A has been found to have good test-retest reliability for the Self-Report form (interclass correlation = 0.82–0.94) for clinical scales, indexes, and overall scores. Cronbach's alpha for the self-report form was moderate to high for the clinical scales (0.73–0.90) and high for the indexes and overall

scores (0.93–0.96). Moderate to strong correlations for construct validity were obtained for most scales and indexes (BRI = 0.84; MI = 0.73; GEC = 0.84).

The GAD-7

The GAD-7 is a 7 item self-report questionnaire that assesses for symptoms highly correlated with generalized anxiety disorder (Spitzer et al., 2006). The internal consistency of the GAD-7 was excellent (Cronbach α = .92). Test-retest reliability was good (intraclass correlation = 0.83). Comparison of scores derived from the self-report scales with those derived from mental health professional-administered versions of the same scales yielded similar results (intraclass correlation = 0.83), indicating good procedural validity. The GAD-7 also demonstrated good criterion, construct, and factorial validity. Alpha for this sample was .87.

The PHQ-9

The PHQ-9 is a 9 item self-report questionnaire that assesses for symptoms highly correlated with major depressive symptoms. The internal consistency was good (Cronbach alpha ranges between .86 and .89). Alpha for this sample was .85.

The ITQ

The ITQ is a validated self-report measure that assesses ICD-11 PTSD and complex PTSD (Cloitre et al., 2021). The internal consistency ranges between good to excellent (Cronbach alpha .89–.94). Alpha for this sample was .89 for ITQ A and .89 for ITQ B.

Procedure

Approval was Received from the George Fox University IRB

Permission was obtained from current collegiate athlete's coaches and the athletic director to invite college athletes to participate in the study. Athletes were recruited through the general psychology courses, doctor of clinical psychology courses, SONA, and social media. The

students were contacted via SONA by one of the graduate school of clinical psychology researchers or research assistants and provided with information about the study. Once contact was made, a session was scheduled to participate in the measurement.

Before beginning administration for each athlete, the researcher set up the lab for testing. A "Quiet please—testing in progress" sign was posted outside the lab door. All materials for testing were collected, hands were sanitized with hot water and soap, and computers were prepared. The participant was asked to complete an informed consent and interview (Appendix A & B). The participant completed self-report demographic measures in the EEG lab; data were stored in a locked filing cabinet with a unique ID code at the beginning of administration. The participant was introduced to the application of the physiological electrodes using a script (Appendix B).

Physiological Procedures

Physiological Appraisal Stimulus. The stimuli were displayed using stimulus books, pencil, paper, and protocol books. The participants looked at the psychological testing books.

Physiological Equipment. All physiological measurements were gathered in the neurocognitive lab of the graduate school of clinical psychology at the private university. The equipment included: GSR/EDA, and ECG. The data were obtained using the Biopac Data acquisition system (BIOPAC Systems, Inc., n.d.).

To measure changes in EDA over a period of time (a phase), you measure "tonic" conductance. Tonic skin conductance is considered the be, "conductance activity encountered in the absence of any discrete environmental event or external stimuli. A participant's tonic skin conductance level can slowly vary over time depending upon psychological state, hydration, skin dryness, and autonomic regulation. Tonic changes in the skin conductance level typically occur

in a period of from tens of seconds to minutes. The measure of this slow-changing level is referred to as skin conductance level (BIOPAC Systems Inc., n.d., Introduction to EDA, Tonic section)."

ECG is used to measure PR intervals (time from beginning of P wave [atrial depolarization] to beginning of the QRS complex), QRS complex (ventricular depolarization), QT interval (time from beginning of the QRS complex to the end of the T wave; time for electrical system to fire an impulse through the ventricles and recharge), ST segment (time between ventricular depolarization and repolarization), rate, regularity, wave form alterations, and rhythm (Klabunde, 2019).

Acq*Knowledge* software was loaded on a PC computer and used to follow and record the physiological measures. Acq*Knowledge* is a program that allows you to "view, measure, transform, replay and analyze data" with the ability to "perform complex data acquisition, stimulation, triggering, and analyses" (BIOPAC Systems, Inc., n.d., The Power of Acq*Knowledge* section).

After obtaining consent, the research assistant began the process of applying GSR patches and ECG patches. Researchers used alcohol swabs to wipe the ring and index fingers, and chest to eliminate dead skin cells and debris that may interfere with measurements. The participant was seated in front of the computer. GSR and ECG patches were placed on the pad of left middle and ring fingers, below the first knuckle from the fingertip. The patches were connected to the Biopac system, followed by ECG leads. A baseline was gathered by having the participant relax for 30 sec. Irregularities in measurement were addressed before moving forward with the stimulus phases.

Intake Interview. The researcher or research assistant was seated across the table where the interview, effort, neuropsychological, and psychological measures were administered to the participant. The interview consisted of questions including the participants' gender identity, preferred pronouns, date of birth, ethnicity/race, athletic history (i.e., sport[s] played, and level played), and mental health history. The participants' head injury history was assessed with questions including if they have a history of diagnosed concussion, the number and dates of diagnosed concussions, estimated number of head injuries (with researcher asking them to detail symptoms; e.g., seeing stars, blurry vision, loss of consciousness, emotional dysregulation, etc.), if they received treatment for their head injury, what treatment was received for their head injury, and the date of their last head injury. The researcher or research assistant completed an event record form to note when each sequence occurs, as well as any auditory or visual interruptions during the measurement. The stimulus was presented by the researcher and on the table in front of them. The measurements provided data point from the GSR microsiemens from the skin, and ECG heart rate and rhythm.

Confidentiality was maintained by meeting the participants in the neurocognitive lab of the graduate department for the physiological measures. The location was provided through email or SONA. The informed consent and demographic forms were kept in a locked file cabinet in a locked lab room. The data for the recordings were kept on a password protected computer, also in the locked lab room. All participants were given an identification code to be used for all folders on the computers with data and for all neuropsychological executive functioning measures, and identification codes were deleted for further use. After the participant completed participation, a statistical analysis was conducted on the demographic form, executive functioning measures, and neurophysiological data.

Design and Analysis

In this study, head injury history (e.g., diagnosed head injuries, estimated undiagnosed head injuries, treatment received for head injuries, and time since last head injury), level at which the sport was played, mental health measures (e.g., PHQ-9, GAD-7, and ITQ A & B), and neuropsychological measures (e.g., TOMM, WAIS-IV Digit Span and Coding, D-KEFS Trails Making Test Conditions 2 & 4, Verbal Fluency Test, and Color Word Interference Test, and BRIEF-A self-report form) were used to predict current mental health and neuropsychological functioning following diagnosed and undiagnosed head injuries. Descriptive statistics and alpha coefficients were computed. The relationship between head injury history, mental health functioning, and neuropsychological functioning were computed through a correlational analysis, a K-Means cluster analysis, and one-way analysis of variance (ANOVA).

Not all collected data were used for the analysis. These data included physiological data including EDA and EKG scores. These data were excluded from the analysis because they will be used for future studies following continued data collection due to technical challenges with the production of clean, useable data. Additionally, athletic history (i.e., sports played) and demographic information were excluded with intent to use these data for future studies.

Chapter 3

Results

In this study, the researcher sought to discover if the number of diagnosed and undiagnosed head injuries (including times where the participant was seeing stars, had nausea, blurry vision, pressure in head, sensitivity to light, confusion, memory problems, or had their bell rung) impacts executive functioning and emotional regulation using neuropsychological evaluations and biophysiological data (EKG and EDA). We hypothesized that as the number of head injuries increased, impairment to executive functioning, emotional regulation, and psychological functioning would increase.

Correlational Findings in Neuropsychological Functioning

Level at which the sport was played (high school, college, and professional) was significantly correlated with estimated undiagnosed head injuries ($r = .504$, $p < .05$) and total head injuries ($r = .510$, $p < .01$). Diagnosed concussions were positively correlated with receiving treatment for head injury ($r = -.559$, $p < .01$). Treatment received was positively correlated with previous neuropsychological or ImPACT testing ($r = .481$, $p < .05$).

The number of diagnosed concussions is positively associated with BRIEF-A self-monitoring *T*-scores ($r = .482$, $p < .05$) and percentile rankings ($r = .499$, $p < 0.5$).

Treatment received is negatively correlated with D-KEFS CWIT Condition 4 total errors ($r = -.454$, $p < .05$), indicating that receiving treatment predicted better functioning.

Prior testing is positively correlated with D-KEFS Verbal Fluency Condition 1 ($r = .454$, $p < .05$) and verbal fluency repetition errors ($r = .532$; $p < .05$), positively correlated with BRIEF-A Inhibition *T*-scores ($r = .587$, $p \leq .01$) and percentile rankings ($r = .655$, $p < .01$), positively correlated with BRIEF-A Shifting *T*-scores ($r = .527$, $p < .05$) and percentile rankings

(r = .545, p < .05), positively correlated with BRIEF-A Working Memory *T*-scores (r = .498, p < .05) and percentile rankings (r = .626, p < .01), and positively correlated with BRIEF-A GEC percentile rankings (r = .469, p < .05).

Year of last head injury was positively correlated with D-KEFS TMT set-loss errors (r = .477, p < .05), positively correlated with D-KEFS Verbal Fluency Condition 2 (r = .447, p < .05), positively correlated with D-KEFS CWIT Condition 1 total errors (r = .485, p < .05), and positively correlated with CWIT Condition 4 uncorrected errors (r = .585, p < .01) and total errors (r = .658, p < .01) demonstrating a recency effect.

Time since last head injury was negatively associated with CWIT Condition 1 total errors (r = -.471, p < .05), negatively correlated with CWIT Condition 4 uncorrected errors (r = -.556, p < .01) and total errors (r = -.455, p < .05).

Mental health history (yes or no) was positively correlated with D-KEFS TMT Condition 4 (r = .538, p < .05), Trails Making Test Condition 4 sequencing errors percentile (r = .561, p < .01), positively correlated with D-KEFS CWIT Condition 4 (r = .471, p < .05), positively correlated with BRIEF-A Inhibition *T*-scores (r = .575, p < .05). Conversely, mental health history was negatively correlated with BRIEF-A Shifting *T*-scores (r = -.567, p < .05) and percentile rankings (r = -.512, p < .05), negatively correlated with BRIEF-A Behavior Rating Index *T*-scores (r = -.518, p < .05) and percentile rankings (r = -.513, p < .05), negatively correlated with BRIEF-A Initiation *T*-scores (r = -.532, p <.05), negatively correlated with BRIEF-A Planning and Organization *T*-scores (r = -.695, p < .01) and percentile rankings (r = .545, p < .05), negatively correlated with BRIEF-A Time Management *T*-scores (r = -.721, p < .01) and percentile rankings (r = -.592, p < .01), negatively correlated BRIEF-A Organization of Materials *T*-scores (r = -.545, p < .05) and percentile rankings (r = -.490, p < .05), negatively

correlated with BRIEF-A Metacognitive Index *T*-scores (r = -.628, $p < .01$) and percentile rankings (r = -.519, $p < .05$), and negatively correlated with BRIEF-A GEC *T*-scores (r = -.704, $p < .01$; r = -.514, $p < .05$).

K-Means Cluster Analysis Findings

A K-Means Cluster analysis was run to analyze data collected from participants pertaining to the GAD-7, PHQ-9, and ITQ to gain perspective on mental health functioning in athletes. The analysis converged in three iterations into two groups. The analysis revealed two distinct groups with very dissimilar participants with respect to mental health functioning (e.g., anxiety, depression, and trauma-related symptoms). The first group, with 13 individuals, represents participants who are psychologically healthy based on mental health indices with scores well below the cutoff for clinical significance. The second group, with eight individuals, represents participants who are psychologically distressed based on mental health indices with scores well above the cutoff for clinical significance. Differences between these two groups were highly significant ($p < .001$) with very large effect sizes (Table 4).

Table 4

Effect Sizes of One-Way Analyses of Variance of Effects of Diagnosed and Undiagnosed Head Injuries on the International Trauma Questionnaire (ITQ), Patient Health Questionnaire-9 Item (PHQ-9), and Generalized Anxiety Disorder-7 (GAD-7)

Measures		Point estimate	95% CI	
			Lower	Upper
ITQ A	η^2	0.1	0	0.37
	ω^2 Fixed-effect	0.05	-0.05	0.32
	ω^2 Random-effect	0.05	-0.05	0.32
ITQ B	η^2	0.68	0.36	0.8
	ω^2 Fixed-effect	0.65	0.32	0.78
	ω^2 Random-effect	0.65	0.32	0.78
PHQ-9	η^2	0.36	0.05	0.58
	ω^2 Fixed-effect	0.31	-0.01	0.55
	ω^2 Random-effect	0.31	-0.01	0.55
GAD-7	η^2	0.4	0.07	0.62
	ω^2 Fixed-effect	0.36	0.02	0.58
	ω^2 Random-effect	0.36	0.02	0.58

ANOVA Findings in Neuropsychological Functioning

TOMM

A one-way ANOVA revealed that the two mental health groups did not differ in their responses on the TOMM (see Tables, 5–8).

WAIS-IV

A one-way ANOVA was performed to compare the effect of diagnosed and undiagnosed head injuries on neuropsychological functioning. A one-way ANOVA revealed that there was a one-way statistically significant difference in WAIS-IV Digit Span sequencing between the two mental health groups, F (1, 19) = 6.31, p = .02. ANOVA revealed that there was a statistically significant difference in WAIS-IV Digit Span total score between the two mental health groups, F (1, 19) = 4.21, p = .05. A one-way ANOVA revealed that there was a statistically significant difference in WAIS-IV Coding scores between the two mental health groups F (1,19) = 5.30, p = .033 (see Tables, 5–8).

Table 5

Descriptive Data for Effects of Diagnosed and Undiagnosed Head Injuries on the TOMM and Wechsler Adult Intelligence Scale-4th Edition (WAIS-IV; Digit Span and Coding)

Measures		*N*	*M*	*SD*	*SE*
TOMM	1*	8	96.5	4.14	1.46
	2*	13	98	2.73	0.76
	Total	21	97.43	3.32	0.72
WAIS-IV Digit Span Forward	1	8	7.50	2.67	0.94
	2	13	7.92	1.80	0.50
	Total	21	7.76	2.12	0.46
WAIS-IV Digit Span Backwards	1	8	8.25	1.75	0.62
	2	13	8.69	1.25	0.35
	Total	21	8.52	1.44	0.31
WAIS-IV Digit Span Sequencing	1	8	6.75	2.12	0.75
	2	13	9	1.92	0.53
	Total	21	8.14	2.24	0.49
WAIS-IV Digit Span Total Score	1	8	6.75	1.67	0.59
	2	13	8.31	1.70	0.47
	Total	21	7.71	1.82	0.40
WAIS-IV Digit Span	1	8	8.38	2.50	0.89
	2	13	10.54	1.81	0.50
	Total	21	9.71	2.31	0.50

*Group 1 is the psychologically distressed group and group 2 is the psychologically healthy group

Table 6

One-Way Analyses of Variance of Effects of Diagnosed and Undiagnosed Head Injuries on the TOMM and Wechsler Adult Intelligence Scale-4th Edition (WAIS-IV; Digit Span and Coding)

Measures		*SS*	*MS*	*F* (1,19)	Sig.
TOMM	Between groups	11.14	11.14	1.01	0.33
	Within groups	210	11.05		
	Total	221.14			
WAIS-IV Digit Span Forward	Between groups	0.89	0.89	0.20	0.67
	Within groups	88.92	4.68		
	Total	89.81			
WAIS-IV Digit Span Backwards	Between groups	0.97	0.97	0.46	0.51
	Within groups	40.27	2.12		
	Total	41.24			
WAIS-IV Digit Span Sequencing	Between groups	25.07	25.07	6.31	0.02
	Within groups	75.5	3.97		
	Total	100.57			
WAIS-IV Digit Span Total Score	Between groups	12.02	12.02	4.21	0.05
	Within groups	54.27	2.86		
	Total	66.29			
WAIS-IV Coding	Between groups	23.18	23.18	5.30	0.03
	Within groups	83.11	4.37		
	Total	106.29			

Table 7

Effect Sizes of One-Way Analyses of Variance of Effects of Diagnosed and Undiagnosed Head Injuries on the TOMM and Wechsler Adult Intelligence Scale-4th Edition (WAIS-IV; Digit Span and Coding)

Measures	Effect size	Point estimate	95% CI	
			Lower	Upper
TOMM	η^2	0.05	< 0.00	0.30
WAIS-IV Digit Span Forward	η^2	0.01	< 0.00	0.21
WAIS-IV Digit Span Backwards	η^2	0.02	< 0.00	0.25
WAIS-IV Digit Span Sequencing	η^2	0.25	< 0.00	0.50
WAIS-IV Digit Span Total Score	η^2	0.18	< 0.00	0.44
WAIS-IV Coding	η^2	0.22	< 0.00	0.48

Table 8

One-Way Analyses of Variance Effect Sizes of Effects of Diagnosed and Undiagnosed Head Injuries on Neuropsychological Functioning

Measures	Effect size	Point estimate	95% CI	
			Lower	Upper
TOMM	ω^2 Fixed-effect	0.00		
	ω^2 Random-effect	0.00	-0.05	0.25
WAIS-IV Digit Span Forward	ω^2 Fixed-effect	-0.04	-0.05	0.16
	ω^2 Random-effect	-0.04	-0.05	0.16
WAIS-IV Digit Span Backwards	ω^2 Fixed-effect	-0.03	-0.05	0.2
	ω^2 Random-effect	-0.03	-0.05	0.2
WAIS-IV Digit Span Sequencing	ω^2 Fixed-effect	0.20	-0.047	0.46
	ω^2 Random-effect	0.20	-0.047	0.46
Digit Span Total	ω^2 Fixed-effect	0.13	-0.05	0.40
	ω^2 Random-effect	0.13	-0.05	0.40
WAIS-IV Coding	ω^2 Fixed-effect	0.17	-0.05	0.44
	ω^2 Random-effect	0.17	-0.05	0.44

D-KEFS

A one-way ANOVA showed that the two mental health groups did not differ in their responses on the D-KEFS (see Tables, 9–20).

Table 9

Descriptive Data for Effects of Diagnosed and Undiagnosed Head Injuries on The Delis-Kaplan Executive Functioning System (D-KEFS) Trails Making Test (TMT)

Measures		*N*	*M*	*SD*	*SE*
D-KEFS TMT Condition 2	1*	8	9.25	3.77	1.33
	2*	13	10.15	2.34	0.65
	Total	21	9.81	2.91	0.64
D-KEFS TMT Condition 4	1	8	7.63	4.14	1.46
	2	12	9.42	1.73	0.50
	Total	20	8.7	2.98	0.67
D-KEFS TMT Condition 4 set loss errors percentile	1	8	88.38	32.88	11.63
	2	13	80.08	38.12	10.57
	Total	21	83.24	35.60	7.77
D-KEFS TMT Condition 4 sequencing errors percentile	1	8	68.5	43.51	15.38
	2	13	76.69	36.65	10.17
	Total	21	73.57	38.54	8.41
D-KEFS TMT Condition 4 total errors	1	8	10.5	2.27	0.80
	2	13	10.54	1.76	0.49
	Total	21	10.52	1.91	0.42

*Group 1 is the psychologically distressed group and Group 2 is the psychologically healthy group

Table 10

One-Way Analyses of Variance of Effects of Diagnosed and Undiagnosed Head Injuries on The Delis-Kaplan Executive Functioning System (D-KEFS) Trails Making Test (TMT)

Measures		*SS*	*MS*	*F* (1,19)	Sig.
D-KEFS TMT Condition 2	Between Groups	4.05	4.05	0.47	0.50
	Within Groups	165.19	8.69		
	Total	169.24			
D-KEFS TMT Condition 4	Between Groups	15.41	15.41	1.82	0.20
	Within Groups	152.79	8.49		
	Total	168.20			
D-KEFS TMT Condition 4 set loss errors percentile	Between Groups	341.01	341.01	0.26	0.62
	Within Groups	25008.80	1316.25		
	Total	25349.81			
D-KEFS TMT Condition 4 sequencing errors percentile	Between Groups	332.37	332.37	0.22	0.65
	Within Groups	29372.77	1545.94		
	Total	29705.14			
D-KEFS TMT Condition 4 total errors	Between Groups	0.01	0.01	0.00	0.97
	Within Groups	73.23	3.85		
	Total	73.24			

Table 11

Effects Sizes of One-Way Analyses of Variance of Effects of Diagnosed and Undiagnosed Head Injuries on The Delis-Kaplan Executive Functioning System (D-KEFS) Trails Making Test (TMT)

Measures		Point estimate	95% CI	
			Lower	Upper
D-KEFS TMT Condition 2	η^2	0.02	< 0.00	0.25
D-KEFS TMT Condition 4	η^2	0.09	< 0.00	0.36
D-KEFS TMT Condition 4 set loss errors percentile	η^2	0.01	< 0.00	0.22
D-KEFS TMT Condition 4 sequencing errors percentile	η^2	0.01	< 0.00	0.21
D-KEFS TMT Condition 4 total errors	η^2	0.00	< 0.00	0.03

Table 12

Effects Sizes of One-Way Analyses of Variance of Effects of Diagnosed and Undiagnosed Head Injuries on The Delis-Kaplan Executive Functioning System (D-KEFS) Trails Making Test (TMT)

Measures	Effect size	Point estimate	95% CI	
			Lower	Upper
D-KEFS TMT Condition 2	ω^2 fixed-effect	-0.03	-0.05	0.20
	ω^2 random-effect	-0.03	-0.05	0.20
D-KEFS TMT Condition 4	ω^2 fixed-effect	0.04	-0.05	0.31
	ω^2 random-effect	0.04	-0.05	0.31
D-KEFS TMT Condition 4 set loss errors percentile	ω^2 fixed-effect	-0.04	-0.05	0.17
	ω^2 random-effect	-0.04	-0.05	0.17
D-KEFS TMT Condition 4 sequencing errors percentile	ω^2 fixed-effect	-0.04	-0.05	0.17
	ω^2 random-effect	-0.04	-0.05	0.17
D-KEFS TMT Condition 4 total errors	ω^2 fixed-effect	-0.05	-0.05	-0.02
	ω^2 random-effect	-0.05	-0.05	-0.02

Table 13

Descriptive data for Effects of Diagnosed and Undiagnosed Head Injuries on The Delis-Kaplan Executive Functioning System (D-KEFS) Verbal Fluency

Measures		*N*	*M*	*SD*	*SE*
D-KEFS Verbal Fluency Condition 1	1*	8	9	3.21	1.13
	2*	13	9.77	2.74	0.76
	Total	21	9.48	2.87	0.63
D-KEFS Verbal Fluency Condition 2	1	8	9.25	4.46	1.58
	2	13	10.54	3.82	1.06
	Total	21	10.05	4.02	0.88
D-KEFS Verbal Fluency Condition 3 total	1	8	9.5	4.14	1.46
	2	13	10.77	2.65	0.74
	Total	21	10.29	3.26	0.71
D-KEFS Verbal Fluency Condition 3 accuracy	1	8	10.5	3.74	1.32
	2	13	11.77	2.13	0.59
	Total	21	11.29	2.83	0.62
D-KEFS Verbal Fluency set loss error	1	8	12	1.51	0.54
	2	13	10.38	3.57	0.99
	Total	21	11	3.02	0.66
D-KEFS Verbal Fluency repetition error	1	8	8.38	3.96	1.40
	2	13	8.38	3.23	0.90
	Total	21	8.38	3.43	0.75

*Group 1 is the psychologically distressed group and Group 2 is the psychologically healthy group

Table 14

One-Way Analyses of Variance of Effects of Diagnosed and Undiagnosed Head Injuries on The Delis-Kaplan Executive Functioning System (D-KEFS) Verbal Fluency

Measures		*SS*	*MS*	*F* (1,19)	Sig.
D-KEFS Verbal Fluency Condition 1	Between groups	2.93	2.93	0.34	0.57
	Within groups	162.31	8.54		
	Total	165.24			
D-KEFS Verbal Fluency Condition2	Between groups	8.22	8.22	0.50	0.49
	Within groups	314.73	16.57		
	Total	322.95			
D-KEFS Verbal Fluency Condition 3 total	Between groups	7.98	7.98	0.74	0.40
	Within groups	204.31	10.75		
	Total	212.29			
D-KEFS Verbal Fluency Condition 3 accuracy	Between groups	7.98	7.98	1.00	0.33
	Within groups	152.31	8.02		
	Total	160.29			
D-KEFS Verbal Fluency set loss error	Between groups	12.92	12.92	1.45	0.24
	Within groups	169.08	8.90		
	Total	182.00			
D-KEFS Verbal Fluency repetition error	Between groups	0.00	0.00	0.00	1.00
	Within groups	234.95	12.37		
	Total	234.95			

Table 15

Effect Sizes of One-Way Analyses of Variance of Effects of Diagnosed and Undiagnosed Head Injuries on The Delis-Kaplan Executive Functioning System (D-KEFS) Verbal Fluency

Measures		Point estimate	95% CI	
			Lower	Upper
D-KEFS Verbal Fluency Condition 1	η^2	0.02	< 0.00	0.23
D-KEFS Verbal Fluency Condition 2	η^2	0.03	< 0.00	0.25
D-KEFS Verbal Fluency Condition 3 total	η^2	0.04	< 0.00	0.28
D-KEFS Verbal Fluency Condition 3 accuracy	η^2	0.05	< 0.00	0.30
D-KEFS Verbal Fluency set loss error	η^2	0.07	< 0.00	0.33
D-KEFS Verbal Fluency repetition error	η^2	< 0.00	< 0.00	< 0.00

Table 16

Effect Sizes of One-Way Analyses of Variance of Effects of Diagnosed and Undiagnosed Head Injuries on The Delis-Kaplan Executive Functioning System (D-KEFS) Verbal Fluency

Measure	Effect size	Point estimate	95% CI	
			Lower	Upper
D-KEFS Verbal Fluency Condition 1	ω^2 Fixed-effect	-0.03	-0.05	0.19
	ω^2 Random-effect	-0.03	-0.05	0.19
D-KEFS Verbal Fluency Condition 2	ω^2 Fixed-effect	-0.03	-0.05	0.21
	ω^2 Random-effect	-0.03	-0.05	0.21
D-KEFS Verbal Fluency Condition 3 total	ω^2 Fixed-effect	-0.01	-0.05	0.23
	ω^2 Random-effect	-0.01	-0.05	0.23
D-KEFS Verbal Fluency Condition 3 accuracy	ω^2 Fixed-effect	0	-0.05	0.23
	ω^2 Random-effect	0	-0.05	0.23
D-KEFS Verbal Fluency set loss error	ω^2 Fixed-effect	0.02	-0.05	0.28
	ω^2 Random-effect	0.02	-0.05	0.28
D-KEFS Verbal Fluency repetition error	ω^2 Fixed-effect	-0.05	-0.05	-0.05
	ω^2 Random-effect	-0.05	-0.05	-0.05

Table 17

Descriptive data for Effects of Diagnosed and Undiagnosed Head Injuries on The Delis-Kaplan Executive Functioning System (D-KEFS) Color Word Interference Test (CWIT)

Measures		*N*	*M*	*SD*	*SE*
D-KEFS CWIT Condition 1	1*	8	8	3.89	1.38
	2*	13	10.23	2.59	0.72
	Total	21	9.38	3.25	0.71
D-KEFS CWIT Condition 2	1	8	8.88	4.36	1.54
	2	13	10.46	2.33	0.65
	Total	21	9.86	3.26	0.71
D-KEFS CWIT Condition 3	1	8	9.5	3.74	1.32
	2	13	11.38	2.47	0.68
	Total	21	10.67	3.07	0.67
D-KEFS CWIT Condition 4	1	8	8.75	3.06	1.08
	2	13	10.92	1.85	0.51
	Total	21	10.1	2.55	0.56
D-KEFS CWIT Condition 1 total errors	1	8	65.38	48.13	17.02
	2	13	65.46	45.77	12.70
	Total	21	65.43	45.47	9.92
D-KEFS CWIT Condition 2 total errors	1	8	78.38	40.05	14.16
	2	13	86.92	31.92	8.85
	Total	21	83.67	34.51	7.53
D-KEFS CWIT Condition 3 corrected errors percentile	1	8	43.75	35.43	12.53
	2	13	46.15	38.36	10.64
	Total	21	45.24	36.38	7.94
D-KEFS CWIT Condition 3 uncorrected errors corrected errors percentile	1	8	56.75	46.77	16.54
	2	13	71.69	38.03	10.55
	Total	21	66	41.09	8.97

Measures		*N*	*M*	*SD*	*SE*
D-KEFS CWIT Condition 3 total errors	1	8	8.38	3.78	1.34
	2	13	9.69	2.43	0.67
	Total	21	9.19	2.99	0.65
D-KEFS CWIT Condition 4 corrected errors percentile	1	8	59	45.07	15.93
	2	13	50.38	35.91	9.96
	Total	21	53.67	38.77	8.46
D-KEFS CWIT Condition 4 uncorrected errors corrected errors percentile	1	8	64.75	38.66	13.67
	2	13	76.15	37.63	10.44
	Total	21	71.81	37.48	8.18
D-KEFS CWIT Condition 4 total errors	1	8	10.63	1.92	0.68
	2	13	10.69	2.56	0.71
	Total	21	10.67	2.29	0.50

*Group 1 is the psychologically distressed group and Group 2 is the psychologically healthy group

Table 18

One-Way Analyses of Variance of Effects of Diagnosed and Undiagnosed Head Injuries on The Delis-Kaplan Executive Functioning System (D-KEFS) Color Word Interference Test (CWIT)

Measures		*SS*	*MS*	*F* (1,19)	Sig.
D-KEFS CWIT Condition 1	Between groups	24.66	24.65	2.51	0.13
	Within groups	186.31	9.81		
	Total	210.95			
D-KEFS CWIT Condition 2	Between groups	12.47	12.47	1.20	0.30
	Within groups	198.11	10.43		
	Total	210.57			
D-KEFS CWIT Condition 3	Between groups	17.59	17.59	1.95	0.18
	Within groups	171.08	9.01		
	Total	188.67			
D-KEFS CWIT Condition 4	Between groups	23.39	23.39	4.18	0.06
	Within groups	106.42	5.60		
	Total	129.81			
D-KEFS CWIT Condition 1 total errors	Between groups	0.04	0.04	0.00	1.00
	Within groups	41357.11	2176.69		
	Total	41357.14			
D-KEFS CWIT Condition 2 total errors	Between groups	361.87	361.87	0.29	0.60
	Within groups	23454.80	1234.46		
	Total	23816.67			
D-KEFS CWIT Condition 3 corrected errors percentile	Between groups	28.62	28.62	0.02	0.89
	Within Groups	26445.19	1391.85		
	Total	26473.81			
D-KEFS CWIT Condition 3 uncorrected errors corrected errors percentile	Between groups	1105.73	1105.73	0.64	0.43
	Within groups	32666.27	1719.28		
	Total	33772.00			

Measures		*SS*	*MS*	*F* (1,19)	Sig.
D-KEFS CWIT Condition 3 total errors	Between groups	8.59	8.60	0.96	0.34
	Within groups	170.64	8.98		
	Total	179.24			
D-KEFS CWIT Condition 4 corrected errors percentile	Between groups	367.59	367.59	0.24	0.63
	Within groups	29691.08	1562.69		
	Total	30058.67			
D-KEFS CWIT Condition 4 uncorrected errors corrected errors Percentile	Between groups	644.05	644.05	0.45	0.51
	Within groups	27457.19	1445.12		
	Total	28101.24			
D-KEFS CWIT Condition 4 total errors	Between groups	0.02	0.02	0.00	0.95
	Within groups	104.64	5.51		
	Total	104.67			

Table 19

Effect Sizes of One-Way Analyses of Variance of Effects of Diagnosed and Undiagnosed Head Injuries on The Delis-Kaplan Executive Functioning System (D-KEFS) Color Word Interference Test (CWIT)

Measures		Point estimate	95% CI	
			Lower	Upper
D-KEFS CWIT Condition 1	η^2	0.12	< 0.00	0.38
D-KEFS CWIT Condition 2	η^2	0.06	< 0.00	0.31
D-KEFS CWIT Condition 3	η^2	0.09	< 0.00	0.35
D-KEFS CWIT Condition 4	η^2	0.18	< 0.00	0.44
D-KEFS CWIT Condition 1 total errors	η^2	0.00	<0 .00	0.00
D-KEFS CWIT Condition 2 total errors	η^2	0.02	< 0.00	0.23
D-KEFS CWIT Condition 3 corrected errors percentile	η^2	0.00	< 0.00	0.13
D-KEFS CWIT Condition 3 uncorrected errors corrected errors percentile	η^2	0.03	< 0.00	0.23
D-KEFS CWIT Condition 3 total errors	η^2	0.05	< 0.00	0.29
D-KEFS CWIT Condition 4 corrected errors Percentile	η^2	0.01	< 0.00	0.22
D-KEFS CWIT Condition 4 uncorrected errors corrected errors percentile	η^2	0.02	< 0.00	0.25
D-KEFS CWIT Condition 4 total errors	η^2	0.00	< 0.00	0.06

Table 20

Effect Sizes of One-Way Analyses of Variance of Effects of Diagnosed and Undiagnosed Head Injuries on The Delis-Kaplan Executive Functioning System (D-KEFS) Color Word Interference Test (CWIT)

Measures		Point estimate	95% CI	
			Lower	Upper
D-KEFS CWIT Condition 1	ω^2 Fixed-effect	0.07	-0.05	0.34
	ω^2 Random-effect	0.07	-0.05	0.34
D-KEFS CWIT Condition 2	ω^2 Fixed-effect	0.01	-0.05	0.26
	ω^2 Random-effect	0.01	-0.05	0.26
D-KEFS CWIT Condition 3	ω^2 Fixed-effect	0.04	-0.05	0.31
	ω^2 Random-effect	0.04	-0.05	0.31
D-KEFS CWIT Condition 4	ω^2 Fixed-effect	0.13	-0.05	0.40
	ω^2 Random-effect	0.13	-0.05	0.40
D-KEFS CWIT Condition 1 total errors	ω^2 Fixed-effect	-0.05	-0.05	-0.05
	ω^2 Random-effect	-0.05	-0.05	-0.05
D-KEFS CWIT Condition 2 total errors	ω^2 Fixed-effect	-0.04	-0.05	0.18
	ω^2 Random-effect	-0.04	-0.05	0.18
D-KEFS CWIT Condition 3 Corrected errors percentile	ω^2 Fixed-effect	-0.05	-0.05	0.08
	ω^2 Random-effect	-0.05	-0.05	0.08
D-KEFS CWIT Condition 3 uncorrected errors corrected errors percentile	ω^2 Fixed-effect	-0.02	-0.05	0.22
	ω^2 Random-effect	-0.02	-0.05	0.22
D-KEFS CWIT Condition 3 total errors	ω^2 Fixed-effect	0.00	-0.05	0.25
	ω^2 Random-effect	0.00	-0.05	0.25
KEFS CWIT Condition 4 corrected errors percentile	ω^2 Fixed-effect	-0.04	-0.05	0.17
	ω^2 Random-effect	-0.04	-0.05	0.17
D-KEFS CWIT Condition 4 uncorrected errors corrected errors percentile	ω^2 Fixed-effect	-0.03	-0.05	0.20
	ω^2 Random-effect	-0.03	-0.05	0.20

Measures		Point estimate	95% CI	
			Lower	Upper
D-KEFS CWIT Condition 4 total errors	ω^2 Fixed-effect	-0.05	-0.05	0.01
	ω^2 Random-effect	-0.05	-0.05	0.01

ANOVA Findings in Behavior Rating Inventory of Executive Functioning-Adult Version (BRIEF-A)

A one-way ANOVA was performed to compare the effect of diagnosed and undiagnosed head injuries on a self-report measure of executive functioning. A one-way ANOVA revealed that there was a statistically significant difference in mean BRIEF-A Emotional Control *T*-scores between the two mental health groups, F (1, 16) = 19.86, p = < .01. A one-way ANOVA revealed that there was a statistically significant difference in scores in mean BRIEF Behavioral Rating Index Composite *T*-scores between the two mental health groups F (1, 16) = 10.94, p = < .01. A one-way ANOVA revealed that there was a statistically significant difference in mean BRIEF-A Initiation *T*-scores between the two mental health groups, F (1, 16) = 5.75, p = 0.03. A one-way ANOVA revealed that there was a statistically significant difference in mean BRIEF-A Global Executive Composite *T*-scores between the two mental health groups F (1, 16) = 4.38, p = 0.05 (see Tables 21–24).

Table 21

Descriptive data for Effects of Diagnosed and Undiagnosed Head Injuries on the Behavior Rating Inventory of Executive Functioning

BREIF-A Subscale		*N*	*M*	*SD*	*SE*
BRIEF-A Inhibition *T*-score	1	7	61.43	13.59	5.14
	2	11	55.82	9.04	2.73
	Total	18	58	11.01	2.60
BRIEF-A Shift *T*-score	1	7	61.43	11.47	4.34
	2	11	52.64	12.09	3.64
	Total	18	56.06	12.32	2.90
BRIEF-A Emotional Control *T*-score	1	7	63.29	10.23	3.87
	2	11	44.55	7.63	2.30
	Total	18	51.83	12.63	2.98
BRIEF-A Self-Monitoring *T*-score	1	7	55.14	13.06	4.94
	2	11	48.73	10.69	3.22
	Total	18	51.22	11.74	2.77
BRIEF-A Behavioral Regulation Index *T*-score	1	7	63.14	10.76	4.08
	2	11	48.91	7.57	2.28
	Total	18	54.44	11.21	2.64
BRIEF-A Initiation *T*-score	1	7	67.43	13.16	4.98
	2	11	54.36	9.88	2.98
	Total	18	59.44	12.71	3.00
BRIEF-A Working Memory *T*-score	1	7	65.43	13.64	5.15
	2	11	64.64	12.66	3.82
	Total	18	64.94	12.65	2.98
BRIEF-A Planning and Organization *T*-score	1	7	64.29	15.54	5.88
	2	11	54.27	10.69	3.22

BREIF-A Subscale		*N*	*M*	*SD*	*SE*
	Total	18	58.17	13.33	3.14
	1	7	60.57	18.00	6.80
BRIEF-A Task Monitoring *T*-score	2	11	53	14.81	4.47
	Total	18	55.94	16.06	3.79
	1	7	56.43	13.35	5.05
BRIEF-A Organization of Materials *T*-score	2	11	50.91	9.33	2.81
	Total	18	53.06	11.04	2.60
	1	7	66.14	15.08	5.70
BRIEF-A Metacognitive Index *T*-score	2	11	56.09	11.13	3.36
	Total	18	60	13.36	3.15
	1	7	64.86	13.77	5.20
BRIEF-A Global Executive Composite *T*-score	2	11	53.36	9.63	2.90
	Total	18	57.83	12.44	2.93

*Group 1 is the psychologically distressed group and Group 2 is the psychologically healthy group

Table 22

One-Way Analyses of Variance of Effects of Diagnosed and Undiagnosed Head Injuries on the Behavior Rating Inventory of Executive Function- Adult Version (BRIEF-A)

BRIEF-A Subscale		*SS*	*MS*	*F* (1,16)	Sig.
BRIEF-A Inhibition *T*-score	Between groups	134.65	134.65	1.12	0.31
	Within groups	1925.35	120.33		
	Total	2060.00			
BRIEF-A Shift *T*-score	Between groups	330.69	330.69	2.35	0.15
	Within groups	2250.26	140.64		
	Total	2580.94			
BRIEF-A Emotional Control *T*-score	Between groups	1502.34	1502.34	19.86	< .01
	Within groups	1210.16	75.634		
	Total	2712.50			
BRIEF-A Self-Monitoring *T*-score	Between groups	176.07	176.07	1.30	0.27
	Within groups	2165.04	135.32		
	Total	2341.11			
BRIEF-A Behavioral Regulation Index *T*-score	Between groups	866.68	866.68	10.94	<.01
	Within groups	1267.77	79.24		
	Total	2134.44			
BRIEF-A Initiation *T*-score	Between groups	730.19	730.19	5.79	0.03
	Within groups	2016.26	126.02		
	Total	2746.44			
BRIEF-A Working Memory *T*-score	Between groups	2.69	2.69	0.02	0.90
	Within groups	2718.26	169.89		
	Total	2720.94			
BRIEF-A Plan/Organize *T*-score	Between groups	428.89	428.89	2.65	0.12
	Within groups	2591.61	161.98		
	Total	3020.50			

BRIEF-A Subscale		*SS*	*MS*	*F* (1,16)	Sig.
BR Task Monitoring *T*-score	Between groups	245.23	245.23	0.95	0.35
	Within groups	4137.71	258.61		
	Total	4382.94			
BRIEF-A Organization of Materials *T*-score	Between groups	130.32	130.32	1.07	0.32
	Within groups	1940.62	121.29		
	Total	2070.94			
BRIEF-A Metacognitive Index *T*-score	Between groups	432.23	432.23	2.66	0.12
	Within groups	2603.77	162.74		
	Total	3036.00			
BRIEF-A Global Executive Composite *T*-score	Between groups	565.10	565.10	4.38	0.05
	Within groups	2063.40	128.96		
	Total	2628.50			

Table 23

One-Way Analyses of Variance Effect Sizes of Effects of Diagnosed and Undiagnosed Head Injuries on the Behavior Rating Index of Executive Functioning- Adult Version (BRIEF-A) T-Scores

BRIEF-A Subscales		Point estimate	95% CI	
			Lower	Upper
BRIEF-A Inhibition *T*-score	η^2	0.07	< 0.00	0.34
BRIEF-A Shift *T*-score	η^2	0.13	< 0.00	0.41
BRIEF-A Emotional Control *T*-score	η^2	0.55	0.17	0.73
BRIEF-A Self-Monitoring *T*-score	η^2	0.08	< 0.00	0.35
BRIEF-A Behavioral Regulation Index *T*-score	η^2	0.41	0.05	0.63
BRIEF-A Initiation *T*-score	η^2	0.27	< 0.00	0.53
BRIEF-A Working Memory *T*-score	η^2	0.00	< 0.00	0.13
BRIEF-A Plan/Organize *T*-score	η^2	0.14	< 0.00	0.42
BRIEF-A Task Monitoring *T*-score	η^2	0.06	< 0.00	0.33
BRIEF-A Organization of Materials *T*-score	η^2	0.06	< 0.00	0.34
BRIEF-A Metacognitive Index *T*-score	η^2	0.14	< 0.00	0.43
BRIEF-A Global Executive Composite *T*-score	η^2	0.22	< 0.00	0.50

Table 24

One-Way Analyses of Variance Effect Sizes of Effects of Diagnosed and Undiagnosed Head Injuries on the Behavior Rating Index of Executive Functioning- Adult Version (BRIEF-A) T-Scores

BRIEF-A Subscales		Point estimate	95% CI	
			Lower	Upper
BRIEF-A Inhibition *T*-score	ω^2 Fixed-effect	0.01	-0.06	0.29
	ω^2 Random-effect	0.01	-0.06	0.29
BRIEF-A Shift *T*-score	ω^2 Fixed-effect	0.07	-0.06	0.36
	ω^2 Random-effect	0.07	-0.06	0.36
BRIEF-A Emotional Control *T*-Score	ω^2 Fixed-effect	0.51	0.11	0.70
	ω^2 Random-effect	0.51	0.11	0.70
BRIEF-A Self-Monitoring *T*-score	ω^2 Fixed-effect	0.02	-0.06	0.30
	ω^2 Random-effect	0.02	-0.06	0.30
BRIEF-A Behavioral Regulation Index *T*-score	ω^2 Fixed-effect	0.36	-0.01	0.59
	ω^2 Random-effect	0.36	-0.01	0.59
BRIEF-A Initiation *T*-score	ω^2 Fixed-effect	0.21	-0.06	0.49
	ω^2 Random-effect	0.21	-0.06	0.49
BRIEF-A Working Memory *T*-score	ω^2 Fixed-effect	-0.06	-0.06	0.08
	ω^2 Random-effect	-0.06	-0.06	0.08
BRIEF-A Plan/Organize *T*-score	ω^2 Fixed-effect	0.08	-0.06	0.38
	ω^2 Random-effect	0.08	-0.06	0.38
BR Task Monitoring *T*-score	ω^2 Fixed-effect	0.00	-0.06	0.27
	ω^2 Random-effect	0.00	-0.06	0.27
	ω^2 Fixed-effect	0.00	-0.06	0.28

BRIEF-A Subscales		Point estimate	95% CI	
			Lower	Upper
BRIEF-A Organization of Materials *T*-score	ω^2 Random-effect	0.00	-0.06	0.28
BRIEF-A Metacognitive Index *T*-score	ω^2 Fixed-effect	0.08	-0.06	0.38
	ω^2 Random-effect	0.08	-0.06	0.38
BRIEF-A Global Executive Composite *T*-score	ω^2 Fixed-effect	0.16	-0.06	0.44
	ω^2 Random-effect	0.16	-0.06	0.44

Chapter 4

Discussion

The purpose of the study aimed to explore how diagnosed head injuries and undiagnosed head injuries predict executive functioning and emotional regulation in current and former athletes.

Correlational Findings

The level at which the sport was played showed significant correlations with estimated undiagnosed head injuries and total head injuries. These findings suggest that higher levels of sports participation are associated with an increased likelihood of sustaining both single and multiple head injuries. This finding aligns with previous research highlighting the elevated risk of head injuries in competitive sports environments with youth injury ratio rate at 1.57 per 1000, high school injuries at an injury ration rate of 1.86 per 1000, and collegiate athletes experiencing 3.74 per 1000 athlete exposures (Dompier et al, 2015)

The positive association between diagnosed concussions and receiving treatment for head injury suggests that individuals with diagnosed concussions were more likely to seek or receive appropriate medical treatment. This finding raises concerns about the underutilization of healthcare resources among individuals with undiagnosed head injuries and highlights the need for increased awareness and education regarding the importance of seeking professional help after head injuries. This is consistent with the Womack et al. (2022) study that found that 50.4% of individuals were not evaluated by a healthcare provider following their most recent concussion, particularly if concussion was sustained from an event other than a motor vehicle collision (e.g., a fall, fight, bike accident).

In terms of neuropsychological evaluation results, increased numbers of diagnosed concussions were positively associated with self-monitoring difficulties. Additional neuropsychological findings include, the year of last head injury demonstrated associations with poorer performance across executive functioning tasks including set-loss errors on a measure of task switching, phonemic verbal fluency, total and uncorrected errors on a measure of interference control and processing speed, challenges with processing speed, and a task of brief auditory attention and working memory. These results highlight that the more recent the head injury, the poorer executive functioning abilities are. These findings underscore the need for ongoing monitoring and rehabilitation to mitigate cognitive deficits following head injuries. Furthermore, time since the last head injury demonstrated that athletes with more recent head injuries made more errors on a measures of processing speed and interference control, indicating that as more time elapses since the last head injury, individuals are likely to exhibit fewer errors in these cognitive tasks. These results highlight that the more time since the head injury, the better executive functioning abilities are, suggesting significant recovery over time. This is consistent with the findings that most patients experience a full recovery within a few weeks to 3 months, with about 10%–15% of patients not recovering within 1-year post injury (Cole & Bailie, 2016).

Athletes who received treatment for head injuries demonstrated better performance. with fewer total errors made on a task of inhibition and switching, indicating that individuals who received treatment for their head injuries may demonstrate less impulsivity and better interference control. This finding suggests that appropriate treatment and interventions may contribute to better cognitive performance in individuals with head injuries. Moreover, participants with previous testing showed higher scores on measures of phonemic verbal fluency,

inhibition, shifting and working memory abilities, and global executive functioning. This indicates that individuals who had previous neuropsychological testing performed better in certain cognitive domains. It suggests that prior testing may enhance cognitive functioning through increased awareness, intervention, or cognitive training. Additionally, these findings may be attributed to practice effects on neuropsychological testing. Overall, these findings underscore that diagnosis, treatment, and previous neuropsychological testing result in better executive functioning abilities.

Lastly, mental health history was associated with lower scores on self-report measures of executive functioning in individuals' day-to-day environment. This was particularly pertinent on the BRIEF-A Shifting, Planning and Organization, Time Management, Organization of Materials, overall behavioral regulation, and overall executive skills. These results demonstrate that individuals experiencing current or previous mental health diagnoses show poorer executive functioning abilities. The findings highlight the need for comprehensive neuropsychological assessments that consider both cognitive functioning and mental health status in individuals with head injuries.

Group Comparisons

Overall, athletes clustered in two groups, ones who were doing well psychologically and ones who were psychologically distressed with respect to anxiety, depression, and complex PTSD symptoms, with 13 and eight members respectively.

Consistent with hypotheses and Fleminger's (2008) research on the short- and long-term effects on executive functioning and personality following head injuries, athletes who have experienced diagnosed and undiagnosed head injuries have lower scores on several domains of executive functioning, emotional regulation, and psychological functioning. Participants

demonstrated greater difficulty with overall behavioral regulation, emotional control, and overall self-reported executive functioning difficulties between the two mental health groups. This suggests that there are significant differences that individuals may experience challenges in monitoring and regulating their cognitive, behavioral, and emotional regulation dependent on if they are experiencing psychological distress. These difficulties may have implications for their overall functioning and may warrant targeted interventions to improve self-monitoring, behavioral regulation, and emotional regulation skills. This is significant because these challenges can interfere with individuals' abilities to engage in rehabilitative care. These findings are consistent with previous research stating emotional regulation and modulation are impacted by the frontal lobe functions associated with executive functioning and that emotional regulation refers to the neuropsychological processes that influence which emotions we have, when we have them, how we experience them, and how we express them (Brown, 2005;-Gross, 1998). Additionally, these findings align with prior research stating emotional regulation deficits following a TBI may be failures in executive functioning, emotional and behavioral disinhibition, diminished working memory, and/or reduced emotional awareness and expression (Tsaousides et al., 2017). However, results indicate that athletes' neuropsychological functioning is particularly resilient when given time to heal from injury. When comparing psychologically healthy and psychologically distressed participants, many domains of functioning eventually did not differ between psychologically distressed and non-distressed participant groups.

Overall, the findings in this study shed light on the complex relationships among head injuries, mental health, and cognitive functioning. These findings provide valuable insights for clinicians, researchers, and healthcare professionals involved in the assessment and management of individuals with head injuries.

Limitations & Implications

The current study contains several potential limitations that need to be considered. Given the large number of statistical tests, there likely are a number of false-positive findings. The number of participants is small and may limit the capacity to discover weaker effects, thus resulting in a number of "misses." In addition, generalizability of the results remains weak and confidence limits also are broad. Individual variability in cognitive skillsets can potentially affect results in significant ways. However, plans for continued data collection are in place to address this concern. Furthermore, continued research with a control group may strengthen comparisons made from the experimental group to increase confidence in conclusions drawn. Additionally, several of the participants have undergone neuropsychological evaluation in the past which may lead to a practice effect influencing their results. Future studies may benefit from analyzing the ECG and EDA data in addition to psychological data to strengthen conclusions on emotional regulation and psychological functioning. Demographic factors were not controlled for in data analysis due to small sample size which can additionally impact results. Further research may benefit from replicating the current study with a larger sample size and a wider demographic group. This would allow for greater reliability in the data.

Conclusion

This study analyzed the neuropsychological and emotional regulation functioning (with focus on executive functioning) of athletes who have experienced diagnosed and undiagnosed head injuries.

Athletes with diagnosed concussions demonstrated associations with greater difficulty in domains of self-monitoring, emotional control, and overall behavioral regulation, and athletes who more recently experienced a diagnosed or undiagnosed head injury demonstrated lower

functioning on measures of executive functioning, including phonemic verbal fluency, and more error-prone performance on measures of task switching, interference control, and processing speed.

Athletes who received treatment for head injuries demonstrated less impulsivity, and better interference control, phonemic verbal fluency, inhibition, set shifting, working memory, and global executive functioning abilities. Psychological and neuropsychological functioning is most greatly impacted in the acute phases of recovery, demonstrating the recovery and resilience of athletes' brain health over time, even with increasing numbers of diagnosed and undiagnosed head injuries.

There were significant differences in athletes with or without current psychological distress in domains of self-monitoring, emotional control, overall behavioral regulation, overall executive functioning, processing speed, and a task of brief auditory attention and working memory. Time since the most recent injury, previous mental health diagnoses, previous diagnosed concussions, and previous treatment of concussions appear to be the greatest predictors of neuropsychological functioning in this sample.

References

Anderson, V., Levin, H., & Jacobs, R. (2002). *Principles of frontal lobe function*. (pp. 504–527). Oxford University Press.

Arioli, M., Crespi, C., & Canessa, N. (2018). Social cognition through the lens of cognitive and clinical neuroscience. *BioMed Research International, 2018*, 1–18. https://doi.org/10.1155/2018/4283427

Atkinson, R. C., & Shiffrin, R. M. (1968). Human memory: A proposed system and its control processes. In Spence, K. W., & Spence, J. T. (Eds.), *The psychology of learning and motivation* (Volume 2, pp. 89–195). Academic Press.

Baddeley, A. D. (1986). *Working memory*. Oxford University Press.

Baddeley, A. D., & Hitch, G. (1974). *Working memory*. In G.H. Bower (Ed.), *The psychology of learning and motivation: Advances in research and theory* (Vol. 8, pp. 47–89). Academic Press.

Barkley, R. A., & Murphy, K. R. (2011). The nature of executive function (EF) deficits in daily life activities in adults with ADHD and their relationship to performance on executive tests. *Journal of Psychopathology and Behavioral Assessment, 33*, 137–158. doi:10.1007/s10862-011-9217-x

Barkley, R. A., Murphy, K. R., & Fischer, M. (2008). *ADHD in adults: What the science says* (pp. 171–175). Guilford Press.

Bettcher, B. M., Mungas, D., Patel, N., Elofson, J., Dutt, S., Wynn, M., Watson, C., Stephens, M., Walsh, C., & Kramer, J. (2016). Neuroanatomical substrates of executive functions: Beyond prefrontal structures. *Neuropsychologia, 85*, 100–109.

BIOPAC Systems, Inc., (n.d.). *ACQKNOWLEDGE data acquisition and Analysis Software - win: ACK100W, ACK100M: Research: BIOPAC*. Retrieved February 8, 2022, from https://www.biopac.com/product/acqknowledge-software/

Bombardier, C. H., Fann, J. R., Temkin, N., Esselman, P. C., Pelzer, E., Keough, M., & Dikmen, S. (2006). Posttraumatic stress disorder symptoms during the first six months after traumatic brain injury. *The Journal of Neuropsychiatry and Clinical Neurosciences*, *18*(4), 501–508. https://doi.org/10.1176/jnp.2006.18.4.501

Bowlby J. (1969). *Attachment and loss: Attachment.* Basic Books.

Brown, T. E. (2005). *Attention deficit disorder: The unfocused mind in children and adults* (pp 20–58). Yale University Press Health and Wellness.

Cloitre, M., Hyland, P., Prins, A., & Shevlin, M. (2021). The International Trauma Questionnaire (ITQ) measures reliable and clinically significant treatment-related change in PTSD and Complex PTSD. *European Journal of Psychotraumatology, 12*(1). https://doi.org/10.1080/20008198.2021.1930961

Cole, W. R., & Bailie, J. M. (2016). Neurocognitive and psychiatric symptoms following mild traumatic brain injury. *Translational Research in Traumatic Brain Injury*, 402–417. https://doi.org/10.1201/b18959-24

Collins, A., & Koechlin, E. (2012). Reasoning, learning, and creativity: Frontal lobe function and human decision-making. *PLoS Biology*, *10*(3). https://doi.org/10.1371/journal.pbio.1001293

Cudmore, L. J. (1999). *Behavioral and electrophysiological investigation of attention and executive functions with and without minor head injury* [Doctoral dissertation, University of Waterloo]. UWSpace. http://hdl.handle.net/10012/466

Dawson, M. E., Schell, A. M., Filion, D. L. (2017) The electrodermal system. *Handbook of Psychophysiology,* 217–243. https://doi.org/10.1017/9781107415782.010

Delis, D., Kaplan, E., & Kramer, J. (2001). *Delis-Kaplan Executive Function Scale.* The Psychological Corporation

Diamond, A. (2020). Executive functions. *Handbook of Clinical Neurology,* 225–240. doi:10.1016/b978-0-444-64150-2.00020-4

Dompier, T. P., Kerr, Z. Y., Marshall, S.W., Hainline, B., Snook, E.M., Hayden, R., & Simon, J.E. (2015). Incidence of concussion during practice and games in youth, high school, and collegiate American football players. *JAMA Pediatrics, 169*(7), 659–665. doi:10.1001/jamapediatrics.2015.0210

Center on the Developing Child at Harvard University, (2020, March 24). *Executive function & self-regulation*. Retrieved February 9, 2022, https://developingchild.harvard.edu/science/key-concepts/executive-function/

Faria, C. de, Alves, H. V., & Charchat-Fichman, H. (2015). The most frequently used tests for assessing executive functions in aging. *Dementia & Neuropsychologia*, *9*(2), 149–155. https://doi.org/10.1590/1980-57642015dn92000009

Freud, S. (2018). Inhibitions, symptoms and anxiety (1926d). *On Freud's "inhibitions, symptoms and anxiety,"* (1st Ed., pp. 9–99). Routledge. https://doi.org/10.4324/9780429477836

Fleminger, S. (2008). Long-term psychiatric disorders after traumatic brain injury. *European Journal of Anaesthesiology*, *25*, 123–130. https://doi.org/10.1017/s0265021507003250

Gross, J. J. (1998). The emerging field of emotion regulation: An integrative review. *Review of General Psychology*, *2*(3), 271–299. https://doi.org/10.1037/1089-2680.2.3.271

Kane, M. J., & Engle, R. W. (2003). Working-memory capacity and the control of attention: The contributions of goal neglect, response competition, and task set to Stroop interference. *Journal of Experimental Psychology: General, 132*(1), 47–70. https://doi.org/10.1037/0096-3445.132.1.47

Lazarus, R. S. (1966). *Psychological stress and the coping process*. McGraw-Hill.

Lehto, J. E., Juujärvi, P., Kooistra, L., & Pulkkinen, L. (2003). Dimensions of executive functioning: Evidence from children. *British Journal of Developmental Psychology*, *21*(1), 59–80. https://doi.org/10.1348/026151003321164627

Lunt, L., Bramham, J., Morris, R. G., Bullock, P. R., Selway, R. P., Xenitidis, K., David, A. S. (2011). Prefrontal cortex dysfunction and 'jumping to conclusions': Bias or deficit? *Journal of Neuropsychology*, *6*(1), 65–78. https://doi.org/10.1111/j.1748-6653.2011.02005.x

Johnson, S., Blum, R., & Giedd, J. (2009). Adolescent maturity and the brain: The promise and pitfalls of neuroscience research in adolescent health policy. *Journal of Adolescent Health. 45*(3), 216–221. 10.1016/j.jadohealth.2009.05.016

Kashluba, S. Paniak, C., Blake, T., Reynolds, S., Toller-Lobe, G., Nagy, J. (2004). A longitudinal, controlled study of patient complaints following treated mild traumatic brain injury. *Archives of Clinical Neuropsychology. 19*(6), 805–816.

Klabunde, R. E. (2019, December 8). *Electrocardiogram (EKG, ECG)*. Image for Cardiovascular Physiology Concepts, Richard E Klabunde PhD. Retrieved February 8, 2022, from https://www.cvphysiology.com/Arrhythmias/A009

McCloskey, G., Perkins, L., & Diviner, B. (2008). *Assessment and intervention for executive function difficulties*. Routledge.

Mischel W, Shoda Y, Rodriguez ML. (1989) Delay of gratification in children. *Science.244*, 933–938.

Mittenberg, W., Patton, C., Canyock, E. M., & Condit, D. C. (2002). Base rates of malingering and symptom exaggeration. *Journal of Clinical and Experimental Neuropsychology*, *24*(8), 1094–1102. https://doi.org/10.1076/jcen.24.8.1094.8379

Miyake, A., Friedman, N. P., Emerson, M. J., Witzki, A. H., Howerter, A., & Wager, T. D. (2000). The unity and diversity of executive functions and their contributions to complex "frontal lobe" tasks: A latent variable analysis. *Cognitive Psychology*, *41*(1), 49–100. https://doi.org/10.1006/cogp.1999.0734

Risk, M. R., Bruno, J. S., Llamedo Soria, M., Arini, P. D., & Taborda, R. A. M. (2005). Measurement of QT interval and duration of the QRS complex at different ECG sampling rates. *Computers in Cardiology, 2005*. https://doi.org/10.1109/cic.2005.1588146

Robinson, L. K., & McFadden, S. L. (2020). Distinguishing TBI malingering and fatigue using event-related potentials. *Journal of Psychophysiology*, *34*(4), 203–213. https://doi.org/10.1027/0269-8803/a000248

Roth, R. M., Isquith, P. K., & Gioia, G. A. (2005). *Behavior Rating Inventory of Executive Function, Adult Version (BRIEF-A)*. APA PsycTests. https://doi.org/10.1037/t86244-000

Shao, Z., Janse, E., Visser, K., & Meyer, A. (2014). What do verbal fluency tasks measure? Predictors of verbal fluency performance in older adults. *Frontiers in Psychology*, *5*, Article 772. https://doi.org/10.3389/fpsyg.2014.00772

Spitzer, R. L., Kroenke, K., Williams, J. B., & Löwe, B. (2006). Generalized Anxiety Disorder 7. *PsycTESTS Dataset*. https://doi.org/10.1037/t02591-000

Stroop, J.R. (1935). Studies of interference in serial verbal reactions. *Journal of Experimental Psychology, 18*, 643-662.

Suchy, Y. (2009). Executive functioning: Overview, assessment, and research issues for non-neuropsychologists. *Annals of Behavioral Medicine*, *37*(2), 106–116. https://doi.org/10.1007/s12160-009-9097-4

Tanielian, T., & Jaycox, L. H. (2008). Invisible wounds of war psychological and cognitive injuries, their consequences, and services to assist recovery: Summary. *PsycEXTRA Dataset.* https://doi.org/10.1037/e527612010-001

Tombaugh, T. N. (1996). *Test of memory malingering*. TOMM. Retrieved February 22, 2022, from https://www.pearsonassessments.com/store/usassessments/en/Store/Professional-Assessments/Cognition-%26-Neuro/Test-of-Memory-Malingering/p/100000191.html

Tsaousides, T., Spielman, L., Kajankova, M., Guetta, G., Gordon, W., & Dams-O'Connor, K. (2017). Improving emotion regulation following web-based group intervention for individuals with traumatic brain injury. *Journal of Head Trauma Rehabilitation*, *32*(5), 354–365. https://doi.org/10.1097/HTR.0000000000000345

Wechsler, D. (2008). *Wechsler Adult Intelligence Scale: Fourth edition*. WAIS-IV Wechsler Adult Intelligence Scale 4th Edition. Retrieved February 23, 2022, from https://www.pearsonassessments.com/store/usassessments/en/Store/Professional-Assessments/Cognition-%26-Neuro/Wechsler-Adult-Intelligence-Scale-%7C-Fourth-Edition/p/100000392.html?gclid=CjwKCAiAsNKQBhAPEiwAB-I5zfFBiWB5tFKSda72vZgcmyog2XYsTB6RukJpMZPizGjaP_229wVcLBoCa3IQAvD_BwE

Westerhof-Evers, H., Visser-Keizer, A., Fasotti, L., & Spikman, J. (2019). Social cognition and emotion regulation: a multifaceted treatment (T-ScEmo) for patients with traumatic brain injury. *Clinical Rehabilitation 33* (5), 820–833. DOI: 10.1177/0269215519829803

Womack, L., Daugherty, J., & Breiding, M. (2022). Concussion evaluation patterns among US adults. *Journal of Head Trauma Rehabilitation 37*(5), 303–310. doi: 10.1097/HTR.0000000000000756

Appendix A

Informed Consent

Thank you for volunteering for this project. We appreciate your willingness and your time. Before we begin with the assessment and physiological measurements (ECG and EDA) I want to review the protocol and I will ask you to sign a consent form.

You will have four electrodes on your left hand. The task today is to complete the assessment provided. Today will take about 1.5 hours.

It is important for you to know that this is voluntary. Your coach will not be informed by us of your participation. You can withdraw at any point if this becomes uncomfortable. We do not anticipate any negative effects of this study.

If you are willing, please read the consent form and sign it where indicated. Please let me know if you have any questions.

Appendix B

Interview

Please answer each of the following questions as completely as possible.

1. What is your gender?
    a. Male
    b. Female (circle one)
    c. Other: (please write in) _____
2. Preferred pronouns: _____
3. What is your age in years: _____
4. What best describes your ethnicity?
    a. White __
    b. Black __
    c. Latine´__
    d. Middle Eastern __
    e. Native American/Indigenous__
    f. Asian__
    g. Pacific Islander __
    h. Mixed Race __
    i. Other __
5. What principle sport do/have you played? _____
6. What is/was your position?_____
7. Were/are you involved in a second sport?
    a. YES
    b. NO
8. If yes, which sport?_____
9. Were/are you involved in a third sport?
    a. YES

b. NO

10. If yes, which sport? _____

11. Do you have a history of head injury?

a. YES

b. NO

12. Estimated number of diagnosed head injuries/concussions _____

a. Describe the symptoms associated with the head injury/concussion._____

_____

13. Estimated number of unreported/undiagnosed head injuries_____

a. Describe the symptoms associated with the head injury _____

_____

14. Did you receive medical treatment for any head injuries?

a. YES

b. NO

15. If so, what treatment did you receive?

_____

_____

16. Have you had a previous neuropsychological evaluation or ImPACT testing?

_____

_____

Appendix C

Generalized Anxiety Disorder Questionnaire–7

Over the last 2 weeks, how often you have been bother by any of the following problems?

1. Feeling nervous, anxious, or on edge
0- Not at all 1. Several Days 2. More than half the days 3- Nearly Every Day

2. Not being able to stop or control worrying
0- Not at all 1. Several Days 2. More than half the days 3- Nearly Every Day

3. Worrying too much about different things
0- Not at all 1. Several Days 2. More than half the days 3- Nearly Every Day

4. Trouble relaxing
0- Not at all 1. Several Days 2. More than half the days 3- Nearly Every Day

5. Being so restless that it is hard to sit still
0- Not at all 1. Several Days 2. More than half the days 3- Nearly Every Day

6. Becoming easily annoyed or irritable
0- Not at all 1. Several Days 2. More than half the days 3- Nearly Every Day

7. Feeling afraid, as if something awful might happen
0- Not at all 1. Several Days 2. More than half the days 3- Nearly Every Day

Appendix D

Patient Health Questionnaire–9

Over the last 2 weeks, how often you have been bother by any of the following problems?

1. Little interest of pleasure in doing things

0- Not at all 1. Several Days 2. More than half the days 3- Nearly Every Day

2. Feeling down, depressed, or hopeless

0- Not at all 1. Several Days 2. More than half the days 3- Nearly Every Day

3. Trouble falling or staying asleep, or sleeping too much

0- Not at all 1. Several Days 2. More than half the days 3- Nearly Every Day

4. Feeling tired or having little energy

0- Not at all 1. Several Days 2. More than half the days 3- Nearly Every Day

5. Poor appetite or overeating

0- Not at all 1. Several Days 2. More than half the days 3- Nearly Every Day

6.Feeling bad about yourself—or that you are a failure or have let yourself or your family down

0- Not at all 1. Several Days 2. More than half the days 3- Nearly Every Day

7. Trouble concentrating on things, such as reading the newspaper or watching television

0- Not at all 1. Several Days 2. More than half the days 3- Nearly Every Day

8. Moving or speaking so slowly that other people could have noticed? Or the opposite -being so fidgety or restless that you have been moving around a lot more than usual

0- Not at all 1. Several Days 2. More than half the days 3- Nearly Every Day

9. Thoughts that you would be better off dead or of hurting yourself in some way

0- Not at all 1. Several Days 2. More than half the days 3- Nearly Every Day

Appendix E

International Trauma Questionnaire

Instructions: Please identify the experience that troubles you the most and answer the questions in relation to this experience.

Brief description of the experience head injury_____

When did the experience occur? (circle one or more)

a) Less than 6 months ago
b) 6 to 12 months ago
c) 1 to 5 years ago
d) 5 to 10 years ago
e) 10 to 20 years ago
f) More than 20 years ago

Below are a number of problems that people sometimes report in response to traumatic or stressful life events. Please read each item carefully, then circle one of the numbers to the right to indicate how much you have been bothered by that problem in the past month.

P1. Having upsetting dreams that replay part of the experience or are clearly related to the experience
0- not at all 1- a little bit 2- moderately 3. quite a bit 4. extremely

P2. Having powerful images or memories that sometimes come into your mind in which you feel the experience is happening again in the here and now?
0- not at all 1- a little bit 2- moderately 3. quite a bit 4. extremely

P3. Avoiding internal reminders of the experience (for example, thoughts, feelings, or physical sensations)?
0- not at all 1- a little bit 2- moderately 3. quite a bit 4. extremely

P4. Avoiding external reminders of the experience (for example, people, places, conversations, objects, activities, or situations)?
0- not at all 1- a little bit 2- moderately 3. quite a bit 4. extremely

P5. Being "super-alert," watchful, or on guard?
0- not at all 1- a little bit 2- moderately 3. quite a bit 4. extremely

In the past month have the above problems:

P7. Affected your relationships or social life?
0- not at all 1- a little bit 2- moderately 3. quite a bit 4. extremely

P8. Affected your work or ability to work?
0- not at all 1- a little bit 2- moderately 3. quite a bit 4. extremely

P9. Affected any other important part of your life such as parenting, or school or college work, or other important activities?
0- not at all 1- a little bit 2- moderately 3. quite a bit 4. extremely

Below are problems that people who have had stressful or traumatic events sometimes experience. The questions refer to ways you typically feel, ways you typically think about yourself and ways you typically relate to others. Answer the following thinking about how true each statement is of you

How true is this of you?

C1. When I am upset, it takes me a long time to calm down.
0- not at all 1- a little bit 2- moderately 3. quite a bit 4. extremely

C2. I feel numb or emotionally shut down.
0- not at all 1- a little bit 2- moderately 3. quite a bit 4. extremely

C3. I feel like a failure.
0- not at all 1- a little bit 2- moderately 3. quite a bit 4. extremely

C4. I feel worthless.
0- not at all 1- a little bit 2- moderately 3. quite a bit 4. extremely

C5. I feel distant or cut off from people.
0- not at all 1- a little bit 2- moderately 3. quite a bit 4. extremely

C6. I find it hard to stay emotionally close to people.
0- not at all 1- a little bit 2- moderately 3. quite a bit 4. extremely

In the past month, have the above problems in emotions, in beliefs about yourself and in relationships:

C7. Created concern or distress about your relationships or social life?
0- not at all 1- a little bit 2- moderately 3. quite a bit 4. extremely

C8. Affected your work or ability to work?
0- not at all 1- a little bit 2- moderately 3. quite a bit 4. extremely

C9. Affected any other important parts of your life such as parenting, or school or college work, or other important activities?
0- not at all 1- a little bit 2- moderately 3. quite a bit 4. extremely

Kaitlin E. (Morgan) Allison, MA

Email: kallison@georgefox.edu | kaitlin.morgan21@gmail.com

Education

George Fox University, Newberg, OR
Psy.D. in Clinical Psychology *(APA Accredited)* Expected Graduation June 2024
Neuropsychological Assessment Track
Dissertation: Dissertation: The Physiological and Neuropsychological Impact of Head Injuries on Executive Functioning with Emphasis on Emotional Regulation
Committee: Roger Bufford, PhD (Chair), Freeman Chakara, PsyD; ABPP-CN; ABN-FACPN, and Lane Weeks Dewan, PsyD

George Fox University, Newberg, OR May 2022
Master of Arts in Clinical Psychology, MA

North Dakota State University, Fargo, ND December 2018
Bachelor of Science in Psychology, BS, Natural Science Track
Minor, Human Development and Family Sciences
Student in Bachelor of Science, Nursing Program, BSN
Left program in good standing in pursuit of PsyD.

Minnesota State Community and Technical College, Detroit Lakes, MN May 2016
Associate of Arts Degree
Post-Secondary Education Option (PSEO)

Supervised Clinical Experience

Neuropsychology Postdoctoral Residency (Anticipated) September 2024-August 2026
Emory University School of Medicine
Atlanta, GA
APPCN Member
Status: Matched

Pre-doctoral Intern July 2023-June 2024
Sioux Falls VA Health Care System
Sioux Falls, SD
APA Accredited; Meets Houston Conference and Division 40 Guidelines

Neuropsychology Experiences
Neuropsychological Assessment Major Rotation
Four days per week; 6-month rotation
Supervisor: Kristi Wall, PsyD
- Provide inpatient outpatient neuropsychological, neurobehavioral, neurodiagnostic, and psychological evaluations and intakes from referral sources including primary care, neurology, rehabilitation and extended care (REC), and mental health.

- Address referral questions of neurodegenerative disorders, movement disorders, traumatic and acquired brain injury, acute comorbid medical events, delirium, neurodevelopmental disorders, re-evaluations, and capacity, transplant, pain device implantation evaluations.
- Develop evaluation battery, interpret outcomes, write integrated reports, and independently provide feedback to patients, caregivers, and multidisciplinary medical team.

Neuropsychological Assessment Expanded Minor Rotation

2.5 days per week; 6-month rotation

Supervisor: Emily Blegen, ABN

- Same activities as major rotation.

Neuropsychological Assessment

12-month minor rotation

Supervisors: Emily Blegen, PsyD, ABN and Kristi Wall, PsyD

- Participate in Didactics, topics include: Neuroanatomy, Multicultural Neuropsychology Considerations, Psychopharmacology, Geriatric Psychopharmacology, Forensic Neuropsychology, Neuroimaging, The Art & Science of Delivering Feedback, Amyloid-Targeting Therapies, Chronic Complications of Traumatic Brain Injury, The Effect of Opioid Use and Treatment on Cognition, Validity Assessment – Delineating Malingering From Factitious Disorder, Validity Assessment & Functional Movement.
- Participate in fact-findings and board-certification preparation.

Rehabilitation Experiences

Rehabilitation and Extended Care (REC)

One day per week; 6-month rotation

Supervisors: Summer Nelson, PhD and Rachel McClure, PhD

- Provide physical and medical care, rehabilitation, transitional care, and palliative and hospice care for Veterans staying on the inpatient unit.
- Provide mental health services, neurobehavioral and neuropsychological assessment, treatment planning, family education and consultation to Veteran's medical team.

Polytrauma Clinic

Adjunctive experience

Supervisors: Summer Nelson, PhD and Desiree Poppens, PsyD

- Conduct polytrauma assessments to patients who have experienced traumatic brain injuries, strokes, seizures, neuro-oncological presentations and other multisystem physical injuries. Provide immediate feedback to patient and medical team and write reports.
- Complete evaluations with embedded in Physical Medicine and Rehabilitation (PM&R) interdisciplinary team including Physiatry, Occupational Therapy, Physical Therapy, and Social Work.

Psychotherapy Experiences

Posttraumatic Stress Disorder and Dialectic Behavior Group Therapy

Two and a half days per week; 6-month rotation

Supervisor: Kari Leiting, PhD and Desiree Poppens, PsyD

- Provide semi-structured and structed diagnostic interviews using the Clinician Administered PTSD Scale for DSM-5 (CAPS-5) and assisted in treatment planning.

- Provide evidence-based psychotherapy modalities including Cognitive Processing Therapy (CPT) and Prolonged Exposure Therapy (PE) for Veterans experiencing Posttraumatic Stress Disorder (PTSD) and sub-threshold symptoms of PTSD related to various types of traumatic events (e.g., Combat Exposure, Military Sexual Trauma, accidents, injuries, and childhood trauma). Measure outcomes utilizing the PTSD Checklist (PCL-5) and Patient Health Questionairre-9 (PHQ-9).
- Co-facilitate Emotional Regulation Group, a DBT Skills training group.

Hormone Replacement Therapy (HRT) Evaluation
Adjunctive Experience
Supervisor: Kari Leiting, PhD and Summer Nelson, PhD

- Conduct semi-structured diagnostic interviews for gender non-conforming patients to determine suitability for Hormone Replacement Therapy (HRT). Write reports and communicate results to interdisciplinary treatment team.

Pre-internship: Neuropsychological Evaluator & Neurorehabilitation July 2022-June 2023
Randall Children's Hospital at Legacy Emanuel
Inpatient Rehabilitation Unit
Supervisor: Corey Anderson, PsyD

- Provide neuropsychologically informed care for patients 2.1-18 years of age with complex medical presentations (i.e., severe Traumatic, Acquired, and Anoxic Brain Injury, Polytrauma, Strokes, Spinal Cord Injury, Paraplegia, Multi-System Injuries, Amputations, Cranial Nerve Injury, various neuro-oncologies [i.e., Medulloblastoma, Puffy Potts Tumor], Encephalitis, Arteriovenous Malformation, Guillain-Barre´ Syndrome, Soto's Syndrome, Lennox Gastauat Syndrome, Russel Silver Syndrome, Neurofibromatosis type 1, Wallerian Nerve Degeneration, Reflex Neurovascular Dystrophy, and post-craniotomy patients).
- Administer neuropsychological assessments, interpret outcomes, and write integrated reports in the developmental rehabilitation inpatient unit and in outpatient settings. Review and interpret neuroimaging findings (i.e., MRI, CT, EEG) while consulting with neurology reports.
- Perform cognitive rehabilitation therapy and cognitive behavioral therapy on an inpatient rehabilitation unit. Provide clinical rehabilitative intervention skills to assist in coping and adjustment to neurologic and physiologic injury.
- Provide individual therapy with caregivers, in addition to family conferences involving treatment planning, providing updates to patients, caregivers, and interdisciplinary team.
- Deliver care to patients and families throughout the rehabilitation continuum of care, from early injury through recovery and transitioning into adulthood (e.g., outpatient neuropsychological re-evaluations).
- Work collaboratively within the rehabilitation team including Neurology, Speech and Language Pathology, Physical Therapy, Occupational Therapy, and nursing staff.

Practicum II: Neuropsychological Evaluator & Program Development Sept. 2021-June 2022
Portland State University Student Health and Counseling—Assessment
Supervisor: Lane Weeks DeWan, PsyD

Assessment

- Provide comprehensive trauma informed, therapeutic neuropsychological and psychodiagnostic assessments to traditional and non-traditional undergraduate and graduate students ages 18-35.
- Interpret outcomes and write integrated reports for patients with concerns about executive dysfunction, attention difficulties, and concerns surrounding complex learning disabilities.
- Provided culturally competent assessment to racially, ethnically, sexually, and gender diverse populations.
- Reviewed charts, interviewed patients, administered assessments, completed scoring, provided conceptualization, and wrote integrated reports.

Program Development

- Worked with assessment team to restructure testing procedures to maximize patient needs and efficiency.
- Developed a remote battery and triage procedures to assess noncomplex presentations via telehealth to serve patients through COVID-19.
- Created an executive functioning workshop providing psychoeducation around George McCloskey's seven executive functioning clusters and skills to manage executive dysfunction.

Practicum I: Neuropsychological Evaluator & Psychotherapist June 2020-July 2021
Willamette Valley Medical Center; McMinnville, Oregon.
Supervisor: Luann Foster, PsyD

Senior Behavioral Health Unit (Inpatient Psychiatric Unit)

- Inpatient psychiatric unit for patients 60+ years of age experiencing complex presentations consisting of a combination of trauma, psychotic disorders (i.e., schizophrenia, suicidal and homicidal ideation, delirium), mood disorders (i.e., bipolar disorder, major depressive disorder), Probable major neurocognitive disorders due to (Alzheimer's disease, frontotemporal lobe degeneration, Wernicke-Korsakoff Syndrome, Lewy body dementia, Vascular dementia), traumatic and atraumatic brain injury (TBI), mild cognitive impairment, and other neurological disorders (i.e., Parkinson's disease, Meningitis).
- Provide neuropsychological assessments, interpret outcomes, and write integrated reports for patients demonstrating cognitive difficulties. Communicated results to referring provider and delivered feedback independently to patients.
- Administer, score, and interpret neuropsychological screener on admission and discharge. Utilize results of screener and intake interview to structure neuropsychological battery of assessments for patients.
- Stood as an expert witness in court evaluations (i.e., capacity, commitment, and guardianship).
- Provide individual, milieu, and group psychotherapy to patients on the unit.
- Work closely on interdisciplinary team with psychiatrist, social worker, and nursing staff. Assist in case management among interdisciplinary team.
- Work with an underserved and underinsured population, veterans, and houseless individuals.

McMinnville Surgical Associates (Outpatient Bariatric Consult)

- Conduct psychological evaluation and psychodiagnostic assessment in order to determine candidacy for bariatric surgery for patients ages 18+. Wrote integrated reports and made recommendations to clients and referring provider.
- Provide individualized outpatient and telehealth psychotherapy for patients undergoing psychological assessment before Bariatric Weight Loss Surgery (WLS) utilizing Solution Focused Therapy.
- Program development to integrate brief neuropsychological battery to administer on intake.
- Provide group therapy for pre and post-operative patients designed to diminish and discourage harmful eating habits and behaviors.
- Work collaboratively on interdisciplinary team with dietician and bariatric surgeon to assess the progress and psychological fitness of patients to engage in bariatric WLS.
- Worked with an underserved and underinsured population in addition to veterans.

Supplemental Practicum: Neuropsychological Evaluator

West Hills Health Care Clinic May 2021—November 2022
Supervisor: Joy Mauldin, PsyD

- Provide neuropsychological and comprehensive assessments, interpret outcomes, and write integrated reports for various neuropsychological presentations (i.e., Autism Spectrum Disorder, Processing Disorder, Attention Deficit-Hyperactivity Disorder, Head Injuries, Complex PTSD Differential Diagnoses) for patients across the lifespan.
- Administer and interpret neuropsychological, psychodiagnostic, personality, and projective measures.
- Work within an interdisciplinary team (i.e., Physician, Psychologist, nursing staff).

Supplemental Practicum: Psychological Evaluator

Friendsview Retirement Community September 2020—July 2023
Supervisor: Glena Andrews, PhD; MSCP; ABPP-CN; Kenneth Logan, PsyD

- Provide in-person and telehealth psychological evaluation to determine acceptance of residency into a new building located at Friendsview retirement community for patients 60 years and older.
- Administer psychological assessments, interpret outcomes, and write a report indicating acceptance or denial of residency.

Pre-Practicum Therapist

George Fox University Graduate School of Clinical Psychology
January 2020-April 2020
Supervisor: Glena Andrews, PhD; MCSP; ABPP-CN, Jo Crowl, MA

- Provided 10 outpatient individual therapy sessions to volunteer undergraduate students in a university counseling setting.
- Conducted intake interviews, prepared treatment plans, and maintained proper documentation.
- Transitioned to telehealth with the onset of COVID-19.
- Wrote reports and presented case conceptualizations.

Journal and Abstract Publications

Larson, K., **Morgan, K.,** Kessler, R., Chakara., F. & Adams, W. (2022). Validation of Wide Range Assessment of Memory and Learning, Third Edition (WRAML3) Recognition Subtest in an Adult Population. Publication in progress.

Morgan, K., Kessler, R.W., Larson, K., Marvin, L., Carlson, K., Lange, M., Chakara, F. (2022). Impact of Depressive Symptoms on Memory Scores in Older Adults. Published Abstract. *Archives of Clinical Neuropsychology,* 37(6), 1360.

Kessler, R.W., **Morgan, K.,** Larson, K., Marvin, L., Lange, M., Carlson, K., Chakara, F. (2022). Evaluating Older Adults' Subjective Attitudes Towards Using Virtual Telecommunication Technology for Remote Neuropsychological Assessment. Published Abstract. *The Clinical Neuropsychologist,* 36(4), 63-S.

Larson, K., Carlson, K., **Morgan, K.,** Kessler, R., Marvin, L., & Andrews, G. (2021, December). Behavioral Survey of Traits; Reliability with a Neurotypical Sample. Published Abstract. *Archives of Clinical Neuropsychology,* 36(6), 1227. doi: 10.1093/arclin/acab062/190.

Cherry, N., **Morgan, K.,** & Larson, K. (2020, October) Sports Anxiety Scale—2: More Sensitive to College Athlete Anxiety. Published Abstract. *Archives of Clinical Neuropsychology*, 35(6), 878. doi: 10/1093/arclin / acaa068.085

Invited Lectures, Presentations, and Conference Presentations

Allison, K., Speer, A., Bufford, R., Chakara, F., & Weeks DeWan, L. (2024). The Impact of Head Injuries on Neuropsychological Measures of Executive Functioning. Accepted to be presented at the American Academy of Clinical Neuropsychology (AACN) Conference, June 2024, Scottsdale, Arizona.

Allison, K., Speer, A., Bufford, R., Chakara, F., & Weeks DeWan, L. (2024). The Impact of Head Injuries on the Behavior Rating Inventory of Executive Function – Adult Version. Accepted to be presented at the American Academy of Clinical Neuropsychology (AACN) Conference, June 2024, Scottsdale, Arizona.

Allison, K., Greenwood, K. (2024). The Intersectionality of Ageism in the Department of Veteran's Affairs Health Care Systems. Accepted to be presented at the South Dakota Psychological Association (SDPA) Conference, April 2024, Sioux Falls, South Dakota.

Allison, K. (2024). Assessing and Treating Disorders of Consciousness. Invited Presentation at the Sioux Falls VA Health Care System to the Department of Psychology. Anticipated June 2024.

Allison, K. (2024). The Assessment of Individuals with Low Vision or Blindness. Invited Presentation at the Sioux Falls VA Health Care System to the Department of Psychology. Anticipated May 2024.

Allison, K. (2024). The Impact of Cannabis on Cognition. Invited Presentation at the Sioux Falls VA Health Care System to the Department of Psychology. Anticipated March 2024.

Allison, K., Blegen, E. (2023). Cognitive Screening Training. Invited Presentation at the Sioux Falls VA Health Care System to the Mental Health Intensive Case Management Team, December 2023.

Allison, K. (2023). An Overview on Amyotrophic Lateral Sclerosis (ALS). Invited Presentation at the Sioux Falls VA Health Care System to the Department of Psychology. September 2023.

Morgan, K., Kessler, R.W., Larson, K., Marvin, L., Carlson, K., Lange, M., Chakara, F. (2022). Impact of Depressive Symptoms on Memory Scores in Older Adults. Submitted to the National Academy of Neuropsychology (NAN) Conference, October 2022, Denver, Colorado.

Kessler, R.W., **Morgan, K.,** Larson, K., Marvin, L., Lange, M., Carlson, K., Chakara, F. (2022). Evaluating Older Adults' Subjective Attitudes Towards Using Virtual Telecommunication Technology for Remote Neuropsychological Assessment. Presented at the American Academy of Clinical Neuropsychology (AACN) Conference, June 2022, Minneapolis, Minnesota.

Kessler, R.W., Larson, K., **Morgan, K.,** Carlson, K., Marvin, L., Lange, M., & Andrews, G. (2022). Assessing Older Adults' Confidence in Remote Neuropsychological Assessment. Presented at the Richter Scholar Virtual Research Symposium, January 2022.

Larson, K., Carlson, K., **Morgan, K.,** Kessler, R., Marvin, L., & Andrews, G. (2021, December). Behavioral Survey of Traits; Reliability with a Neurotypical Sample. Presented at the National Academy of Neuropsychology, October 2021, Virtual Conference.

Morgan, K., Cao, T. (2021). Managing Performance and Test Anxiety. Invited Lecture at Portland State University, November 2021; January & April 2022.

Morgan, K. A Comprehensive Training on Intake Interviewing (2021). Invited Didactic Presentation at Portland State University, September 2021.

Cherry, N., **Morgan, K.,** & Larson, K. (2020, October) Sports Anxiety Scale—2: More Sensitive to College Athlete Anxiety. Presented at the National Academy of Neuropsychology, October 2020, Virtual Conference.

Research

Research Interests

- Specific area of interest: Neuropsychology; Cognitive Psychology
- Area of focus: The biophysiological and neuropsychological impacts which brain injuries impact executive functioning with emphasis in past and present athletes. My research has and continues to utilize physiological methods including eye tracking,

electroencephalogram (EEG), electrodermal activity (EDA; also known as Galvanic Skin Response, or GSR), and electrocardiogram (ECG). Further interests include test development, capacity evaluations, utility and reliability of remote geriatric assessments, and performance anxiety in athletes. Additionally, I specialize in conducting the statistical analysis pertinent to understanding data sets.

Research Vertical Team Member 2020-Present
Graduate School of Clinical Psychology
George Fox University, Newberg, OR
Chairs: Dr. Roger Bufford, Dr. Freeman Chakara, PsyD; ABPP-CN; ABN-FACPN, Glena Andrews, PhD; MSCP; ABPP-CN

- Research: meet bi-monthly to discuss and evaluate progress, methodology, and design of group and individual research projects, including dissertation.

Researcher for the Intersectionality of Ageism in the Department of Veteran's Affairs Health Care Systems
Sioux Falls VA Health Care System, Sioux Falls, SD. 2023-Present
Supervisor: Dr. Kari Leiting, PhD

- Conduct literature review on agism and intersecting diversity factors from a provider perspective in the Department of Veteran's Affairs Health Care Systems.
- Compile and analyze data.
- Present findings to interdisciplinary teams to help guide future practice.

Primary Researcher for The Physiological and Neuropsychological Impact of Head Injuries on Executive Functioning with Emphasis on Emotional Regulation

George Fox University, Newberg OR. 2022-Present

Supervisor: Roger Bufford, PhD, Freeman Chakara, PsyD; ABPP-CN; ABN-FACPN, and Lane Weeks Dewan, PsyD

Richter Scholar's Grant Recipient

- Primary researcher in the design, data collection, statistical analysis, and defense of understanding the neuropsychological and physiological data among collegiate athletes to assess executive functioning with an emphasis on emotional regulation following head injury.
- Physiological data collected using electrodermal activity (EDA) and electrocardiogram (ECG).
- Measured neuropsychological abilities using the Behavior Rating Inventory of Executive Functioning for Adults (BRIEF-A), Delis Kaplan Executive Function System (DKEFS: Trail Making Test, Verbal Fluency Test, Color Word Interference), Generalized Anxiety Disorder-7 (GAD-7), International Trauma Questionnaire (ITQ), Patient Health Questionnaire-9 (PHQ-9), Test of Memory Malingering (TOMM), Wechsler Adult Intelligence Scale – Fourth Edition (WAIS-IV; Digit Span, Symbol Search, and Coding).
- Trained research assistants to assist in and continue data collection.

Researcher for Wide Range Assessment of Memory and Learning, Third Edition

(WRAML-3), George Fox University, Newberg OR. 2021-2022
Supervisor: Dr. Wayne Adams, PhD, ABPP-CN, Dr. Freeman Chakara, PsyD; ABPP-CN; ABN-FACPN

- Developed an adult normative group for the validation of the WRAML-3.
- Trained and supervised peers in the administration and scoring of the WRAML-3.
- Publication in process.

Statistician for the Evaluation of Neurodegenerative Disorders in Older Adults using Remote Assessment, George Fox University, Newberg, OR.
Neuropsychology EEG Lab 2021-Present
Supervisor: Dr. Freeman Chakara, PsyD; ABPP-CN; ABN-FACPN,
Richter Scholars Grant

- Completed the statistical analyses of objective and subjective data collected for the Evaluation of Neurodegenerative Disorders in Older Adults using Remote Assessment. Responsible for conducting the statistical analysis for projects and dissertation completed by Robert Kessler, MA, MDiv, SSP.
- Presented research at the 2022 American Academy of Clinical Neuropsychology (AACN) Conference in Minneapolis, MN and the 2022 Richter Scholar Virtual Research Symposium. Scheduled to present additional research at the 2022 National Academy of Neuropsychology Conference in Denver, CO.

Researcher for Behavioral Survey of Traits; Reliability with a Neurotypical Sample
George Fox University, Newberg, OR. 2021-2022
Neuropsychology EEG Lab
Supervisor: Glena Andrews, PhD; MSCP; ABPP-CN

- Recruited neurotypical adults for the administration of the Behavioral Survey of Traits (BeST; Andrews & Robins, 2010), a measure used to detect behavior profiles consistent with prenatal alcohol exposure in children.
- Adults participated in a cross-sectional study to assess the reliability of the adapted BeST Adult-Self-Report (BeST-ASR) and Adult-Other (BeST-AO).
- Assisted with data collection and the statistical analysis.
- Presented research findings at the 2021 National Academy of Neuropsychology, Virtual Conference.

Researcher for Sports Anxiety Scale—2: More Sensitive to College Athlete Anxiety
George Fox University, Newberg, OR. 2019-2020
Neuropsychology EEG Lab
Supervisor: Glena Andrews, PhD, MSCP; ABPP-CN

- Investigated neural and physiological responses to performance anxiety within college athletes who have experienced concussion using EEG, electrodermal activity (EDA), and electrocardiogram (ECG).
- Measured performance anxiety using General Anxiety Disorder-7 (GAD-7) and Sports Anxiety Scale-2 (SAS-2).
- Led the implementation of SONA software for scheduling, recruiting, and awarding credit to participants at George Fox University.
- Trained students in the administration, implementation, and use of EEG, EDA, and

ECG.
- Presented research findings at the 2020 National Academy of Neuropsychology, Virtual Conference.

Researcher for Change Detection for Real-World Objects in Perihand Space
North Dakota State University, Fargo, ND. 2018
Center for Visual and Cognitive Neuroscience
Supervisor: Laura Thomas, PhD; Stephen Agauas, PhD
- Administered studies using Eyelink Software to investigate how action affordances may influence reading processes.
- Coordinated multiple studies investigating how visual processing changes as objects are near or far from the hands.

Researcher for Near-hand Effects are Robust: Three OSF Pre-registered Replications of Visual Biases in Perihand Space
North Dakota State University, Fargo, ND. 2018.
Center for Visual and Cognitive Neuroscience
Supervisor: Laura Thomas, PhD, Stephen Agauas, PhD, Morgan Jacoby, MS
- Used Matlab Psychophysics Toolbox to investigate if observers experience biases in visual processing when they view stimuli in perihand space.
- Accurately set up, administered, and recorded target detection trials in a sample of 95 collegiate students.

Researcher for Immobilization does not Disrupt Near-Hand Attentional Biases
North Dakota State University, Fargo, ND. 2018.
Center for Visual and Cognitive Neuroscience
Supervisor: Laura Thomas, PhD, Robert McManus MS
- Investigated how attentional biases change when viewing objects within verses outside of their hands grasping space.
- Investigated links between action affordances and covert visual attention.
- Examined relative contributions of proximity and affordances in introducing attentional biases in peripersonal space; measured target detection near vs. far from hands.

ACADEMIC APPOINTMENT AND SUPERVISION EXPERIENCE

Advanced Assessment Peer Supervisor March 2023-Current
George Fox University Behavioral Health Center
Supervisor: Ryan Thompson, PsyD
- Provide tiered supervision to 3rd and 4th year practicum student neuropsychological and neurodevelopmental assessments.
- Assist in tailoring interview to referral question, battery selection, case conceptualization, and integrated report writing. Review protocols for scoring accuracy.
- Meet weekly with clinic director to provide updates on practicum students' progress and cases.

Clinical Team August 2022-May 2023
George Fox University
Supervisor: Daniel Rodriguez, PsyD

- Fourth year oversight of clinical work, neuropsychological assessments, and professional development to 2nd year doctoral students.
- Assist in battery selection, case conceptualization, and integrated report writing.

Child and Adolescent Cognitive Assessment Teaching Assistant. January 2022-May 2022
George Fox University
Supervisors: Freeman Chakara, PsyD; ABPP-CN; ABN-FACPN and Celeste Jones, PsyD; ABPP; ABCCAP

- Facilitated a weekly lab group with nine second-year students taking the child and adolescent cognitive assessment course to explain concepts, practice administering subtests, and answer questions as needed. Provided weekly demonstration and instruction on the administration and scoring of the Wechsler Intelligence Scale for Children—Fifth Edition (WISC-V) and Wechsler Individualized Achievement Test—Fourth Edition (WIAT-4).
- Provided supervision and instruction to students learning cognitive assessment administration and scoring and participated in a weekly supervision with the course instructor and program director. For the two term projects, I spent 40 hours a week grading and reviewing videos of assessment administrations and providing individualized constructive feedback.

Adult Cognitive Assessment Teaching Assistant August 2021-December 2021
George Fox University
Supervisor: Freeman Chakara, PsyD; ABPP-CN; ABN-FACPN

- Facilitated a weekly lab group with eight second-year students taking the adult cognitive assessment course to explain concepts, practice administering subtests, and answer questions as needed. Provided weekly demonstration and instruction on the administration and scoring of the Wechsler Adult Intelligence Scale—Fourth Edition (WAIS-IV) and Wechsler Memory Scale—Fourth Edition (WMS-IV).
- Provided supervision and instruction to students learning cognitive assessment administration and scoring and participated in a weekly supervision with the course instructor. Spent 15-20 hours a week grading assignments, reviewing videos of assessment administrations, and providing individualized constructive feedback.
- Held individual remediation appointments to help students identify growth curves and meet assessment competency.
- Created a comprehensive grading spreadsheet for teaching assistant team and entered grades into gradebook. Collaborated with other teaching assistants to develop and implement a grading guide for the purpose of standardizing grading among future teaching assistants in the course.

Honors

Richter Scholars Grant 2020, 2022

North Dakota State University

Dean's List: Spring 2017, Fall 2017, Summer 2018, Fall 2018

Academic Scholarship: 2016-2017

Minnesota State Community and Technical College; Dean's List: Fall 2014, Fall 2015

Program Development & Evaluation

Program Consultation & Evaluation
George Fox University
Supervisor: Dr. Amber Nelson, PsyD

The Standardization of Tracking Hours using Time2Track
Responsibilities: Consulted with the Director of Clinical Training (DCT) and Program Director to create a standardized training for the use of Time2Track with pre-post surveys to monitor effectiveness of training.

Program Development at Salvation Army
North Dakota State University
Bachelor of Science in Nursing Program
Supervisor: Kolby Schaeffer Fraase, DNP, MSN, RN

Developed and led diabetes education course for houseless and low SES individuals. Worked with the kitchen staff and program managers to coordinate affordable healthy meal planning for the kitchen feeding houseless, low income, or unemployed individuals.

Work Experience

CNA, Sanford Health Fargo 2017- 2018

CNA, Cardiac Intensive Care Unit
CNA, Intensive Care Unit
Telemetry Technician

- Provided direct patient care, and one to one observation for patients at risk for suicide, harming themselves, and/or harming others.
- Monitored telemetry simultaneously for three hospital campuses in ECG monitoring bank. Completed ECG interpretations including PR intervals, QRS, QTI, ST segment, rate, regularity, wave form alterations, and rhythm interpretation with close attention to detail for rhythm or rate changes.
- Assisted in scheduling patients, tests, maintaining patient files, and the admission and discharge process.
- Worked within an interdisciplinary team, including physicians, physical therapy, occupational therapy, respiratory therapy, speech and language pathology, and nursing care team.

CNA, Essentia Health Oak Crossing 2015-2016

CNA, Memory Care Unit
CNA, Transitional Care Unit

- Provided direct patient care primarily on the Memory Care Unit with experience in long term patient care and transitional care.
- Received dementia specific training.

- Worked within an interdisciplinary team, including gerontology, physical therapy, occupational therapy, speech and language pathology (SLP), and nursing care team

Technical Skills

Electroencephalogram (EEG) 2019
Trained in administering EEGs.
Trained in utilizing EEG data.
Worked collaboratively among a research team.
Responsible for training peers in program.

Electrodermal Activity (EDA) 2019
Trained in applying and utilizing EDA data.
Worked collaboratively among a research team.

Eyelink 2018
Trained in conducting studies using the Eyelink software.
Worked intensively coordinating eye-tracking software with computer.

Telemetry Technician 2017
Administered and applied electrocardiogram (ECG) to patients.
Monitored ECGs in monitoring bank for 3 hospital campuses.
Recorded rhythms and measurements every four hours, or as needed.

Professional Organizations

Sports Neuropsychology Society (SNS) 2022- Present
Student Member

American Academy of Clinical Neuropsychology (AACN) 2022-Present
Student Member
Member of Student Mentorship Program with Thomas Deters, PhD, ABPP-CN

National Academy of Neuropsychology (NAN) 2021-Present
Trainee Membership
Volunteer, 2022 Conference. Denver, CO.

American Psychological Association (APA) 2019-Present
Graduate School Affiliate
Division 22, Society for Rehabilitation Psychology
Division 40, Society for Clinical Neuropsychology

Relevant Membership

Neuropsychology Student Interest Group (Leader) 2019-2023
Graduate School of Clinical Psychology
George Fox University, Newberg, OR

Student Wellness Committee (Member) 2019-2020
Graduate School of Clinical Psychology
George Fox University, Newberg, OR

Additional Training Experiences

Neuroanatomy (NAN Online) 2022
Dr. Gregory Lee, PhD

National Academy of Neuropsychology (NAN) 2022 Conference
October 12-15, 2022
Difficult Conversations: Models for Delivering a Diagnosis of Dementia
Dr. Carolyn Parsey, PhD, ABPP

CPT Update
Dr. Niel H. Pilskin, PhD, ABPP & Dr Antonio E. Puente, PhD, ABPP

The Minnesota 2022 Update Conference: History, Process, and Essential Outcomes Regarding Education and Training in Clinical Neuropsychology
Dr. Brad L. Rober, PhD, ABPP-CN

Effective Science Communication is an Essential Part of Modern Science
Dr. Alan I. Leshner, PhD

Oregon Pain Management Commission: Changing the Conversation About Pain
Virtual Access September 2, 2022
Oregon Pain Management Commission

American Academy of Neuropsychology (AACN) Conference 2022
June 22-26, 2022
Presentations Attended:
Neuropsychological Evaluation of Coincident Posttraumatic Stress Disorder (PTSD) and Traumatic Brain Injury (TBI) in Forensic Settings
Dr. Nathaniel W. Nelson, PhD, ABPP & Dr. Paul A. Arbisi, PhD, ABPP

Adolescent Neurobehavioral Development: Typical Trends and Impact of Substance Use on Developmental Trajectories
Dr. Monica Luciana, PhD

Updates on Controversies in Sport-Related Concussion (SCR), Chronic Traumatic Encephalopathy (CTE), and Neuropsychology's Participation in the NFL Baseline Assessment Program (NFL-BAP)
Dr. William B. Barr, PhD, ABPP

Staying Up to Date: An Analysis and Review of the Recently Published Malingering and Validity Assessment Literature Base
Dr. Ryan W. Schroeder, PsyD, ABPP

Neuropsychological Decision Making: Avoiding Medical Errors and Ethics of New Practice Frontiers
Dr. Mike R. Schoenberg PhD, ABPP, Doug Johnson-Greene, PhD, ABPP, & Corwin Boake, PhD, ABPP

Fundamentals of Concussions: Assessment and Management of Persistent Symptoms
NAN Online
May 26, 2022
Presentations Attended:
Blood-based Biomarkers for Traumatic Brain Injury
Dr. Leighton Chan, MD, MPH

Promoting Athlete Brain Health: Enhancing performance and recovery, and mitigating injury risk
Dr. Marla Shapiro, PhD, NCSP, DBSM

Accelerating Recovery from Child Concussion: A symptom-targeted, multi-disciplinary model
Dr. Vicki Anderson, DPsych

Relevant Colloquium and Grand Rounds, George Fox University Graduate School of Clinical Psychology, Newberg, OR.
Intractable Conflict in Families and Society: What Do We Know About Healing the Rifts?
Dr. Wendy Bourg, PhD
February 2, 2022

May it be Well with Your Soul: Anti-Racism, Spiritual Freedom, and Wellness
Dr. Brandy Liebscher & Pastor Liz Vaiz
November 3, 2021

Gender Diverse Care
Chloe Ackerman, Psy.D.
March 10, 2021

Complex PTSD: Advanced Case Conceptualization, Assessment, and Treatment Approaches in Trauma Populations
Jason Steward, PhD
November 4, 2020

Examining the Role of Neuropsychology within the Pediatric Cancer Setting
Justin B. Lee, PhD
October 14, 2020

Effective Therapy with Underserved and Marginalized People

Daniel Gatzembidi, PsyD
March 18, 2020

Intercultural prerequisites for effective diversity work.
Cheryl Forster, PsyD.
October 15, 2019.

References

Freeman M. Chakara, PsyD; ABPP-CN; ABN-FACPN
Dissertation Chair
Providence Behavioral Health | George Fox University
Email: fchakara@georgefox.edu
Phone: (503) 554-2386

Emily A. Blegen, PsyD, ABN
Psychology Internship Training Director
Clinical Neuropsychology Supervisor
Sioux Falls VA Health Care System
Email: emily.blegen@va.gov
Phone: (605) 336-3230

Kristi C. Wall, PsyD
Clinical Neuropsychology Supervisor
Sioux Falls VA Health Care System
Email: emily.blegen@va.gov
Phone: (605) 336-3230

Corey D. Anderson, PsyD
Randall Children's Hospital at Legacy Emanuel
Inpatient Rehabilitation Program
Practicum Supervisor
Email: codander@lhs.org
Phone: (503) 413-2941