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The Influence of Depression and Anxiety on Working Memory in Children with ADHD

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Abstract

Attention Deficit-Hyperactivity Disorder (ADHD) is one of the most common disorders diagnosed in children (Feldman & Reiff, 2014). ADHD is known to impact a child's working memory, with deficits ranging from mild to severe (Bedard et al., 2014). Research has explored the performance of working memory in children with ADHD and individual co-occurring disorders, finding that internalizing disorders such as depression and anxiety, both independently negatively impact working memory performance (Kofler et al., 2011; Saarinen et al., 2015; Skogan et al., 2013). However, there is limited research on how multiple co-occurring diagnoses in children with ADHD impact working memory. More specifically, research is limited on depression and anxiety, which are also common in children with ADHD. Depression itself has a significant impact on a child's executive functioning skills. When depression is present, parts of the prefrontal cortex regions are hypoactive and therefore lead to impairment in executive functioning abilities (Snyder, 2013). In regard to anxiety, previous literature (Moran, 2016) has found that anxious arousal competes with processes located in the prefrontal cortex leaving

limited neural resources for executive functioning skills (Moran, 2016). Since working memory plays a significant role in holding short term information, concentration, and following through with instructions, deficits in working memory often impact reading and mathematical abilities in children at school. The current study will evaluate the influences of depression and anxiety on working memory in children with ADHD.

Keywords: ADHD, attention deficit-hyperactivity disorder, working memory, depression, anxiety, children

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Chapter 1

Introduction

Neurocognitive deficits are widely known and recognized in Attention-Deficit Hyperactivity Disorder (ADHD) among children, significantly impacting a child's well-being, academic success, overall quality of life, and activities of daily living (Feldman & Reiff, 2014). In turn, difficulty with daily life activities such as remembering to complete important tasks, ability to follow multi-step instructions, social skills, and academic struggles, have been associated with increases in anxiety and depression (Feldman & Reiff, 2014). Furthermore, anxious thoughts and low mood have been found to impact neurocognitive deficits in children with ADHD (Roy et al., 2017). Existing research on co-occurring disorders in children with ADHD has been largely focused on externalizing disorders (Kofler et al., 2011; Saarinen et al., 2015; Skogan et al., 2013). Research on anxiety and depression has independently demonstrated that "adolescents with ADHD plus an onset of depression showed poorer working memory maintenance" (Roy et al., 2017, p. 71), and those with anxiety and ADHD demonstrated "slower self-generated motor speed, lower externally cues response speed, and enhanced inhibition" (Bloemsma et al. 2012, p. 231). Research is now beginning to explore the joint interactive impacts of multiple co-occurring internalizing disorders, such as major depressive disorder and anxiety, however, most have focused on late adolescents or adults (Jensen et al., 2000).

ADHD

Attention-deficit hyperactivity disorder (ADHD) is one of the most common neurodevelopmental disorders with an estimated prevalence rate of 8.4% in children in the United States (American Psychological Association, 2017). The prevalence of this condition increased by 33% between 1997-1999 and 2006-2008 (Feldman & Reiff, 2014). "Cognitive mechanisms involved in ADHD have mostly been linked to either two major brain networks: cortical-thalamic-cerebellar pathways involved in regulation and cognitive control and ascending arousal circuitry involved in alertness and motivation" (Nigg, 2010, p. 25). These two pathways consist of a range of executive functioning abilities (e.g., working memory, set shifting, temporal information processing) and functions such as, alertness, effort, and motivation (Nigg et al., 2010). According to Nigg (2010), the key brain structures relevant to ADHD are:

> The dorsolateral prefrontal cortex (often associated with working memory or the ability to keep plans in mind), orbital prefrontal cortex (often associated with the ability to inhibit inappropriate actions), and anterior cingulate cortex (related both to emotional control and to cognitive control). (p. 55)

Clinical features of ADHD in children are hyperactivity, inattentiveness, impulsivity, or a combination of these symptoms. In addition, affected children also show cognitive functioning deficits, particularly with executive functioning skills.

"Executive functioning abilities in children and adults have been associated with activity in specific, and somewhat distinct, areas of the prefrontal cortex" (Roberts et al., 2017, p. 285). For example, "set-shifting appears to be in the left inferior prefrontal cortex, whereas response inhibition taps more medial and left inferior prefrontal structures" (Roberts et al., 2017, p. 285). These executive functioning deficits include problems in planning, organization, inhibition,

mental flexibility, sustained attention, and in working memory particularly (Roy et al., 2017). Children who display these symptoms are often referred for a clinical evaluation, however, children who do not explicitly display these symptoms (e.g., disruptive or hyperactive behavior) most likely remain unidentified or untreated. These cognitive and executive functioning deficits often negatively impact academic success for children with ADHD. A diagnosable learning disorder is present in about 20% to 30% of children with ADHD (Roberts et al., 2017). Additionally, ADHD is associated with low rates of high-school graduation, completion of postsecondary education, and poor peer relationships (Feldman & Reiff, 2014).

ADHD and Working Memory

Working memory impairment is a primary neurocognitive deficit for children with ADHD (Bedard et al., 2014). Working memory is a limited capacity system for temporarily storing and processing internally held information. It consists of three primary components, which includes two subsidiary systems responsible that are responsible for temporary storage of verbal/visual information, and a domain-general central executive (Kofler et al., 2011).

Working memory deficits have wide impacts on academic performance, social functioning, and quality of life for children with ADHD, making it difficult for children with ADHD to perform well in academic settings where they are required to temporarily hold and decode information on a daily basis. In terms of scope, visuospatial working memory impairments occur in about 29-47% of children with ADHD (Dovis et al., 2015). This may make it difficult for children with ADHD to learn from a multi-modal learning method that includes visual or visual spatial information. For 20% to 30% of children with ADHD, a diagnosable learning disorder is exhibited (Roberts et al., 2017). Additionally, working memory deficits negatively impact long-term quality of life and peer relationships (Kofler et al., 2011).

Specifically, social interactions can be impacted related to the involvement of working memory in the child's ability to store, recall, and decode information as well as process social cues effectively (Kofler et al., 2011). In this way, working memory has been found to predict functional impairment in social relationships (Kofler et al., 2011). With a deficit in working memory, developmental tasks such as following through with instructions, the ability to concentrate on sustained mental tasks, and the ability to hold information until needed are more challenging for a child, especially for a child with ADHD.

Co-Occurrence of ADHD and Major Depressive Disorder (MDD)

It is estimated that 60-100% of individuals with ADHD also meet criteria for one or more co-occurring disorders (Menghini et al., 2018). In specific, depression commonly co-occurs with ADHD, perhaps related to structural and neurochemical commonalities. Depression develops in about 30% to 70% of individuals between ages 4 to 18 years old with ADHD, regardless of gender. In general, Major Depressive Disorder (MDD) is one of the most commonly diagnosed mental illnesses in the United States, with significant impacts on social, occupational, and educational functioning (Snyder, 2013). Individuals who are diagnosed with MDD are also found to have increased difficulty with cognitive functions such as executive skills, memory, attention, problem solving, flexibility, speed, and inhibition, cognitive processes that heavily rely on executive functioning and prefrontal functions (Snyder, 2013). These same cognitive functioning domains are similar to working memory deficits we see in those affected by ADHD. Those with ADHD and depression have been shown to have poorer cognitive functioning than those with either depression or ADHD separately (Roy et al., 2017). Similarly, depression has been linked to functional activity differences in the prefrontal cortex including the dorsolateral prefrontal cortex, medial prefrontal cortex/anterior cingulate, and oribitofrontal cortex (Bremner et al.,

2002, p. 273). Depression has also been associated with decreased brain serotonin levels, associated with decreased function in the dorsolateral prefrontal and orbitolateral cortex (Bremner et al., 2002).

Co-Occurrence of ADHD and Anxiety

Anxiety is a commonly co-occurring diagnosis in children with ADHD (Schatz & Rostain, 2006). The prevalence of anxiety disorders co-occurring with ADHD is as high as 50% (Schatz & Rostain, 2006). Between 15-51% of children with ADHD will also endorse significant anxiety (Melegari et al., 2018; Schatz & Rostain, 2006). When compared to children who did not have ADHD, 27% of children with ADHD endorsed more than one anxiety disorder, whereas only 5% of those without ADHD endorsed more than one anxiety disorder (Schatz & Rostain, 2006).

Furthermore, children diagnosed with ADHD and anxiety may experience a more severe form of ADHD in terms of working memory and executive functioning impairments (Menghini et al., 2017). Children with both anxiety disorders and ADHD show deficits in executive functioning abilities, specifically working memory and processing speed (Roberts et al., 2017; Skirbekk et al., 2011). This is due to how symptoms of ADHD and anxiety overlap (e.g., inattention, planning, organization, and inability to hold information for a short period of time; (Melegari, 2018; Menghini et al., 2018). In addition, anxiety has been known to take place in the anterior insular cortex, which works in conjunction with the anterior cingulate cortex in regard to emotions to cognitive processes (Paulus & Stein, 2006). The orbitofrontal cortex is also involved regarding behavioral processes and responses in terms of anxious actions (Paulus & Stein, 2006).

In one study on working memory in ADHD, those who were diagnosed with ADHD and anxiety made more errors on working memory tasks compared to children with only ADHD

(Schatz & Rostain, 2006). This demonstrates that anxiety may be a significant factor rather than strictly poor working memory or decreased semantic organization alone (Schatz & Rostain, 2006). Due to the additional errors on working memory tasks, children with co-occurring anxiety and ADHD may also differ in academic performance. It was also found that children with ADHD and co-occurring anxiety disorders have a much slower reaction time on memory tasks that measure working memory and reaction times compared to children without a co-occurring anxiety disorder (Bloemsma et al., 2012).

Co-Occurrence of ADHD, MDD, and Anxiety

While depression and anxiety both co-occur with ADHD, they also often co-occur with each other, and jointly co-occur with ADHD, likely increasing complications with executive functions and working memory, though more research is needed in this area (Robin et al., 2018). Both highly prevalent, approximately 50-60% of those diagnosed with MDD report at least one anxiety disorder (Hranov, 2007; Kaufman & Charney, 2000). Few studies have examined whether co-occurring anxiety and depression together influence working memory profiles in children affected by ADHD. Anxiety alone has been found to be associated with increased inhibition control, whereas ADHD is associated with reduced inhibition control, suggesting that anxiety may be a factor in reducing ADHD symptoms (Menghini et al., 2017). Past researchers have also proposed that anxious arousal competes with other processes located in the same area as working memory, the prefrontal cortex, leaving access to limited neural resources (Moran, 2016). Similarly, in those affected with depression, depression has been associated with decreased left prefrontal cortex activity (Nusslock, et al., 2016). Additionally, children with higher levels of internalizing symptoms have been found to perform better on a working memory task (spatial span component) (Ferrin & Vance, 2014).

ADHD and Gender

The impact of ADHD on a child's cognitive functioning varies on the severity of the diagnosis, however, it has also been found that the impact on a child's cognitive functioning may be different based on the child's gender. Gender differences regarding performance on specific tasks have been found in previous studies among children with ADHD (Canovas et al., 2008; Lejbak et al., 2011). It has been found that males performed better than females on tasks that involved spatial working memory (Canovas et al., 2008). Additionally, it was also found that specifically boys with ADHD and co-occurring internalizing disorders had significantly lower verbal IQ scores, arithmetic skills, and concentration skills compared to boys with ADHD without internalizing disorders (Crawford, Kaplan & Dewey, 2006).

ADHD and Age

Similar to the child's gender, the age of a child when diagnosed with ADHD is also impactful on a child's cognitive functioning. Previous studies have found that cognitive development had age-related developments between the ages of 5 and 10 years old, whereas children 10 years and older were to be more similar with adults (Sheridan et al., 2014). The development of cognitive control for a child develops at specific age ranges and depending on when the child begins to struggle with symptoms of ADHD, it may impact the development of their working memory or response conflict (Rubia et al., 2007).

In sum, neurocognitive deficits from ADHD alone significantly influence a child's cognitive functioning. Additionally, children with co-occurring anxiety and depression likely demonstrate further complicated cognitive abilities, but more research is needed in this area. Specifically, anxiety may enhance auxiliary strategies to compensate for deficits in working memory storage and processing. This may be facilitated by the prefrontal cortex and anterior

attentional system redirecting attention toward the stimulus driven condition. Depression has also been associated with functional differences in prefrontal regions. Similarly, neurocognitive deficits such as executive functions associated with ADHD have been localized to the prefrontal cortex (Ferrin & Vance, 2014). In combination, these mixed findings are worthy of ongoing exploration, exploring cognitive differences for children with co-occurring ADHD, anxiety, and depression, which is the focus of this study.

Purpose of the Study

There have been several studies that have explored cognitive domains in children with ADHD with co-occurring externalizing disorders whereas only few with internalizing disorders (Menghini et al., 2017). Prior research studies that have examined the relationship between depression and ADHD, and between anxiety and ADHD, have found that it is beneficial to consider co-occurring disorders as meaningful subtypes or even separate disorders (Jensen et al., 2000). It has been stated this could be potentially beneficial due to the fact that ADHD, depression, and anxiety show abnormalities in the prefrontal cortex. Prior research studies investigating the relationship between MDD and ADHD and anxiety and ADHD, most have focused on late adolescents or adults. The overlap between two internalizing disorders (depression and anxiety) and working memory in children with ADHD is worth considering as it may be unique to its own clinical etiology, treatment course, and treatment outcome.

Hypotheses

Hypothesis 1. In the group with ADHD, Depression (as measured by the CDI-2) and Anxiety (as measured by the MASC) will be inversely correlated with working memory (as measured by Digit Span total and Spatial Span backwards and forwards).

Hypothesis 2. The control group will have significantly higher scores on Spatial Span and Digit Span, forwards and backwards, compared to the group with ADHD, regardless of co-occurring diagnoses.

Hypothesis 3. Children who identify as male will perform significantly different than children who identify as female on Digit Span, forwards and backwards, and Spatial Span, forwards and backwards, in the group with ADHD, regardless of co-occurring diagnoses.

Hypothesis 4. Children between the ages of 7-10 years old will perform significantly different than children between the ages of 10-14 years old in the group with ADHD.

Hypothesis 5. In the group with ADHD, Digit span will have a linear relationship with Depression and Anxiety.

Chapter 2

Methods

Participants

Participants were from an archived data set at a university health care system in the Pacific Northwest, which included 849 individual children ages 7-15 years old and their biological parents, recruited between 2009 and 2015. The 849 children included 76 sibling pairs. Families were part of an ongoing longitudinal study. Families were recruited via community outreach using commercial mailing lists and public advertisements to minimize referral bias.

Table 1

Demographics Characteristics of the Sample

Variable	Category	*n*	%
Ethnicity	White	484	83.3
	Not White	97	16.7
Gender	Male	373	64.2
	Female	208	35.8
Age Group	7-10 years old	416	71.6
	11-14 years old	165	28.4
ADHD Status	Control	178	30.6
	ADHD	403	69.4

Exclusionary Criteria

Children were excluded if they: were prescribed long-acting psychotropic medications; had neurological impairment, seizure history, head injury with loss of consciousness, other major medical conditions, or substance abuse; had prior diagnosis of intellectual disability, or psychosis; were currently experiencing a major depressive episode; or had estimated IQ < 80.

Stimulant Medication

Children with ADHD taking stimulant medications were included in the study but were required to be off their medication for 24 hours (short-acting preparations) to 48 hours (long acting preparations) prior to testing.

Materials

Measures of Working Memory

The children completed a computerized version of a spatial working memory task identical to the spatial span task from CANTAB (De Luca et al., 2003). Forward and backwards conditions were both administered. In both versions of the task, a screen containing 10 squares was arranged in a fixed position. Individual squares changed color in a fixed sequence. In the forward span task, children were instructed to click on the squares in the order in which they changed color. In the backward span task, children were instructed to click on the squares in the reverse order in which they changed color. For both tasks, number of squares in the sequence began at three and increased to nine, with two trials for each sequence length. The task discontinued when a child got two sequences of the same length incorrect. The primary outcome variables used were the total number items attempted during the forward and backward trials, which is directly related to span length.

In regard to verbal working memory, children completed Digit Span from the WISC-IV, including both forward and backward conditions. Raw accuracy scores were used as primary outcome variables.

Measures of Depression

The children completed the Children's Depression Inventory, 2nd edition (Kovac, 2004, during the visit. The Children's Depression Inventory (CDI) is a brief self-report assessment that helps assess cognitive, affective, and behavioral signs of depression and adolescents between the ages of 7 and 17 years old. The CDI contains 28 items, each consisting of three statements. For each statement, the child is asked to select the statement that best describes his or her feelings. The reliability of the test was calculated using test-retest, split-half, and Kuder-Richardson. For the test-retest, the reliability coefficient was .87 ($p < .001$). For the split-half, the reliability for the even/odd split was .61 and .73 ($p < .0001$) for the first half/second half split. The alpha coefficient for Kuder-Richardson was calculated to be .94. All of these scores indicate good internal consistency for the CDI. In regard to validity, criterion and concurrent validity was determined to be excellent (Saylor et al., 1984). The raw score was used as a primary outcome variable in this study.

Measures of Anxiety

Anxiety was measured by having the children complete the Multidimensional Anxiety Scale for Children, 2nd edition (MASC-2) (March, 2012). The MASC is a self-report assessment that helps assess the presence of symptoms related to anxiety disorders in children between the ages of 7 to 19. The MASC includes the following anxiety scales: separation anxiety/phobias, social anxiety, obsessions and compulsions, physical symptoms, and harm avoidance. In addition, it also includes the following subscales: humiliation/rejection, performance fears, panic,

and tense/restlessness. The internal reliability coefficient for the various scales and subscales is .90. Test-retest reliability was completed and was satisfactory to excellent. In regard to validity, convergent and divergent validity were considered adequate since shared variance with scales among anxiety were high, intermediate for depression, and lowest for externalizing symptoms (March et al., 1996). The overall general anxiety disorder (GAD) score was used as a primary outcome variable in this study. The Cronbach's alpha for this study was .870.

Measures of ADHD

ADHD was measured having the parents and teachers complete two questionnaires: the ADHD rating scale (ADHD-RS; DuPaul et al. 1998) and the Connor's Rating Scale, 3rd edition (CRS-R, Connors 2003) and an in person semi-structured diagnostic interview (Kiddie Schedule for Affective Disorders and Schizophrenia – KSADS, Kaufman et al. 1997).

The ADHD Rating Scale (DuPaul et al., 1998). This questionnaire is a parent and teacher report. It includes 18 items that correspond to the criteria of the DSM-IV for ADHD. Each item is scored on a Likert scale, ranging from 0 (*not at all*) to 3 (*very often*). "Raw scores are derived for two subscales (Inattention and Hyperactivity-Impulsivity), and these scores for both parents and teachers' ratings were used as dependent measures" (DuPaul et al., p. 60, 2013). The reliability coefficient for this scale was determined to be .95 validity and sensitivity of the measure is well established (DuPaul et al., 1998). Internal consistency was also well established (parent = .85; teacher = .99) for inattention and hyperactivity (parent = .82, teacher = .99) (DuPaul et al., p. 60, 2013).

Connor's Rating Scale 3rd Edition (Connors, 2003). Both parent and teacher versions of the CRS-R consists of 80 and 59 items. Each item receives a score between 0 (*never*) and 3 (*very often*). This scale is designed for the assessment of children and adolescents between the

ages of 3 to 17 years of age. This scale was determined to be valid with coefficients ranging from .77 to .92 for the parent version and from .83 to .95 for the teacher version and have shown to "demonstrate satisfactory test-retest reliability and have stable pattern of intercorrelation across gender and age" (Connors et al., p. 494, 1997).

Kiddie Schedule for Affective Disorders and Schizophrenia (KSADS; Kaufman et al. 1997). The KSADS is a semi-structured interview assessing present and lifetime symptoms of affective disorders and schizophrenia. This interview is served to diagnose children between the ages of 6 and 18 years of age. Interrater reliability ranged from 93% to 100%, test re-test reliability as good to excellent range for most present and lifetime diagnoses (MDD, any Bipolar Disorder, Generalized Anxiety, Conduct, and Oppositional Defiant Disorder = .77 to 1.00). In regard to diagnoses of Post-Traumatic Stress Disorder and ADHD, reliability was in the good range (.63-.67) (Kaufman et al., 1997).

Procedure

All procedures were approved by the Oregon Health & Science University's Institutional Review Board. Study data were collected and managed using RED Cap electronic data capture tools hosted at OHSU. A parent/legal guardian provided written informed consent in addition to the children providing written assent for the study. Participants were screened by a screener via phone to ensure they were eligible for the study based on exclusionary points. Once the families were deemed eligible, the families were scheduled for their first visit.

At the initial visit, the parents and teachers of the children were invited to complete the ADHD Rating Scale (ADHD-RS, DuPaul et al. 1998), Connor's Rating Scale, 3rd edition (CRS-R; Connors, 2003), and an in person semi structured diagnostic interview (Kiddie Schedule for Affective Disorders and Schizophrenia – KSADS, Kaufman et al. 1997) while the child

completed brief IQ screening based on a reliable and valid three subtest short form of the WISC-IV (Vocabulary, Block Design and Information; Wechsler 2003) and brief academic achievement testing (WIAT). In addition, the child also completed the MASC and CDI.

After the initial visit was completed, a best estimate *DSM-IV ADHD* (American Psychiatric Association [APA], 1994) diagnosis was established by a multidisciplinary diagnostic team. Together, they formed a diagnostic opinion based on all the available information. Their agreement rate was excellent (ADHD diagnosis kappa = .88). Disagreements were conferenced and consensus reached. On cases where consensus was not achieved, they were excluded from the participant pool and this became the clinical referred control group for the study.

Specific symptom counts and diagnosis criteria were followed by the *ADHD DSM-IV* (1994) cutoffs. Once a *DSM-IV ADHD* diagnosis was determined, families were invited to the second visit. At the second visit, the parents were asked to complete a brief IQ screening (Wechsler Adult Intelligence, 4th Edition) and academic achievement testing (Wide Range Achievement Test, 4th Edition) in addition to completing any online questionnaires they were unable to complete during the first visit. The children were required to complete additional table tasks and computerized testing, including the working memory measure, Spatial Span and Digit Span. The families were sent a feedback report by the lead clinician in the clinic regarding the performance of their child and the results of the questionnaires.

Chapter 3

Results

Hypothesis 1

It was hypothesized that the working memory of children with ADHD would significantly negatively relate to depression and anxiety. A Pearson correlation was run to compare the Depression scale measured by the CDI and the Anxiety scale measured by the MASC with verbal and visual working memory scales, Digit Span forwards and backwards, and Spatial Span forwards and backwards. The results of the Pearson correlation did not completely support the hypothesis as verbal working memory of children with ADHD was the only scale weakly negatively related, and only by depression.

Table 2

Correlation Between Working Memory Scales with Depression and Anxiety

Scale		SSpan Backwards	SSpan Forwards	Digit Span Total	Digit Span Backwards	Digit Span Forwards
Depression	*r*	-.049	-.082	-.187**	-.130*	-.163*
	p	.342	.111	.000	.011	.001
	n	378	378	377	377	378
Anxiety	*r*	-.064	.041	.030	.044	-.001
	p	.209	.424	.555	.388	.981
	n	382	382	381	381	382

Note. * indicates significance level of $p < .05$; ** indicates significance level of $p < .01$.

Hypothesis 2

It was hypothesized that children with ADHD would perform significantly lower on Spatial Span and Digit Span, forwards and backwards, compared to children without ADHD. An ANOVA was run to compare the working memory scales, Spatial Span and Digit Span, between children with ADHD and children without ADHD. The results of the ANOVA supported the hypothesis as children with ADHD performed significantly lower than children without ADHD. In regard to visual working memory, Spatial Span backwards (M = 3.99, SD = 2.152) was significantly lower compared to the norm population (M = 4.76, SD = 2.017) and was statistically significant, $F(1, 574) = 15.864$, $p = < .001$. In children with ADHD, Spatial Span forwards (M = 4.67, SD = 2.040) was significantly lower compared to the norm population (M = 5.48, SD = 1.901) and was statistically significant, $F(1, 575) = 19.845$, $p = < .001$. With verbal working memory, Digit Span backwards (M = 9.65, SD = 2.928) was significantly lower compared to the norm population (M = 10.99, SD = 2.844), and was also statistically significant $F(1, 578) = 26.180$, $p = < .001$. In addition, Digit Span forwards (M = 9.34, SD = 2.814) in children with ADHD were significantly lower compared to the norm population (M = 10.93, SD = 2.798) and was statistically significant, ($F(1, 579) = 39.520$, $p = < .001$).

Table 3

Descriptives of ADHD and Control Groups with Working Memory Scales

Group		SSpan Backwards	SSpan Forwards	Digit Span Backwards	Digit Span Forwards
Control	*M*	4.76	5.48	10.99	10.93
	SD	2.01	1.90	2.84	2.79
	n	173	174	178	178
ADHD	*M*	3.99	4.67	9.65	9.34
	SD	2.15	2.04	2.92	2.81
	n	403	403	402	403

Hypothesis 3

In order to evaluate if gender and age impacted working memory in children with ADHD, a MANOVA was conducted comparing males and females separated into two age groups (ages 7-10 and 11-14) on Spatial Span Forward and Backward, and Digit Span Forward and Backward. Unfortunately, the MANOVA was not significant, (Wilks' Lambda, $F(4, 395) = .598$, $p = .664$, $\eta^2 = .006$).

Furthermore, it is hypothesized that children with ADHD who identify as male will perform significantly different than children who identify as female on Digit Span, forwards and backwards, and Spatial Span, forwards and backwards. An ANOVA was run to compare the working memory scales, Digit Span and Spatial Span, between male ($n = 286$) and female children ($n = 117$). The results of the ANOVA did not support the hypothesis as children who identified as male did not perform significantly different than children who identified as female.

In regard to visual working memory, the ANOVA comparing male identified children ($M = 4.04$, $SD = 2.170$) and female identified children ($M = 3.88$, $SD = 2.110$) on Spatial Span backwards was not statistically significant $F(1, 401) = .448$, $p = .504$. On the task of Spatial Span forwards, the ANOVA comparing male identified children ($M = 4.79$, $SD = 2.028$) and female identified children ($M = 4.40$, $SD = 2.051$) was also not statistically significant, $F(1, 401) = 2.973$, $p = .085$.

With verbal working memory, the ANOVA comparing male identified children ($M = 9.72$, $SD = 2.881$) and female identified children ($M = 9.50$, $SD = 3.045$) on Digit Span backwards was not statistically significant, $F(1, 400) = .468$, $p = .494$. On Digit Span forwards, the ANOVA comparing male identified children ($M = 9.43$, $SD = 2.839$) and female identified children ($M = 9.32$, $SD = 2.766$) was not statistically significant, $F(1, 401) = .003$, $p = .954$.

Table 4

Descriptives of Male and Female Children with ADHD and Working Memory Scales

	Male		Female	
	N	*M(SD)*	*N*	*M(SD)*
SSpan Backwards	286	4.04(2.17)	117	3.88(2.11)
SSpan Forwards	286	4.79(2.02)	117	4.40(2.05)
Digit Span Backwards	285	9.72(2.88)	117	9.50(3.04)
Digit Span Forwards	286	9.34(2.83)	117	9.32(2.76)

Hypothesis 4

It is hypothesized that children between the ages of 7-10 years old will perform significantly different than children between the ages of 10-14 years old. An ANOVA was run to compare the working memory scales, Spatial Span and Digit Span, forwards and backwards, between two age groups, 7-10 years old (n = 281) and 10-14 years old (n = 122) with ADHD. The results of the ANOVA partially supported the hypothesis. Children within the age group of 7-10 years old (M = 3.71, SD = 1.98) performed poorer on Spatial Span backwards when compared to children between the ages of 11-14 years old (M = 4.64, SD = 2.38), $F(1, 574)$ = 22.967, p = .00. In regard to Spatial Span forwards, a similar pattern was found. Children between the ages of 7-10 years old (M = 4.20, SD = 1.75) performed poorer than children 11-14 years old (M = 5.78, SD = 2.22), $F(1, 575) = 56.15$, p = .000. With verbal working memory, the opposite was found. Children between the ages of 11-14 years old (M = 9.22, SD = 3.00) performed poorer than children between 7-10 years old (M = 9.84, SD = 2.88) on Digit Span backwards, $F(1, 578) = 3.997$, p = .046. However, the ANOVA comparing children between the ages of 11-14 years old (M = 9.28, SD = 2.93) and children between the ages of 7-10 years old

(M = 9.36, SD = 2.76) on Digit Span forwards was not statistically significant, $F(1, 579) = .037$, $p = .85$. Levene's test for equality of variances was not significant, therefore the assumption of homogeneity of variance was met for these samples.

Table 5

Descriptives of Children Ages 7-10 and 11-14 with ADHD and Working Memory Scales

	Ages 7-10 Years Old		Ages 11-14 Years Old	
	N	*M*(*SD*)	*N*	*M*(*SD*)
SSpan Backwards	281	3.71(1.98)	122	4.64(2.37)
SSpan Forwards	281	4.20(1.75)	122	5.78(2.22)
Digit Span Backwards	280	9.84(2.88)	122	9.22(3.00)
Digit Span Forwards	281	9.36(2.76)	122	9.28(2.93)

Hypothesis 5

It was hypothesized that there would be a linear relationship between Depression and Anxiety and Digit Span in those who have ADHD. A multiple regression analysis was conducted to evaluate how well the depression and anxiety measures predicted working memory. The predictors were the t-scores of the MASC and the CDI, while the criterion variable was the Digit Span Total. The linear combination of depression and anxiety measures was significantly related to working memory $R^2 = .040$, Adjusted $R^2 = .03$, $F(2, 373) = 7.69$, $p = .001$. Depression (CDI) was a significant predictor of working memory (Digit Span Total) ($B = -.20$, $p = .00$). Anxiety (MASC) was not a significant predictor of working memory (Digit Span Total) ($B = .08$, $p = .13$).

Chapter 4

Discussion

Sample Characteristics

The majority of the sample identified as White. This is not unusual as most of the children participating in the study are from the Pacific Northwest. Similar studies that have reviewed working memory deficits in children with ADHD have a more diverse sample as they are located in different areas of the country (Bedard et al., 2014). A little over half of the sample identified as male and the rest identified as female. Similarly, in previous studies, the sample consisted of twice as many males as females (Hesapcioglu et al., 2016; Melegari et al., 2018). The participants in the sample were between the ages of 7 and 14 years old, with the majority of the sample between the ages of 7 and 10 years old. In addition, more than half the sample were diagnosed with ADHD, which was also similar to previous literature.

Working Memory

The children who were not diagnosed with ADHD performed with an average score of 11.16 on Verbal Working Memory (Digit Span Total). This was similar to previous studies that have examined working memory in children with ADHD, which demonstrated average scores of 10.28 on Verbal Working Memory (Ferrin & Vance 2014; Hesapcioglu et al., 2016). Additionally, the performance of verbal working memory in children diagnosed with ADHD in our sample (M = 9.37) was also similar to the previous studies (M = 8.32, 8.60) (Ferrin & Vance, 2014; Hesapcioglu et al., 2016). In regard to visual working memory, the children in our sample that were diagnosed with ADHD performed within one standard deviation of a previous study's

sample (Vance et al., 2013). However, with our control group, their performance on the visual working memory task backwards were lower when compared to the mean of previous studies (Ferrin & Vance, 2014; Vance et al., 2013). The control group of our sample performed similarly on the visual working memory task forward when compared to a previous study (Vance et al., 2013). Overall, the results of this study supported the hypothesis that children with ADHD will perform significantly lower working memory tasks.

When compared to the comparison samples, children with ADHD were more likely to experience difficulties with visual and verbal working memory skills. This is consistent with previous literature showing that working memory impairments is a primary neurocognitive deficit for children with ADHD (Bedard et al., 2014; Kofler et al., 2011). One of the key brain structures of ADHD is the dorsolateral prefrontal cortex (Nigg, 2010). The dorsolateral prefrontal cortex has been associated with working memory and the ability to keep plans in mind (Nigg, 2010, p. 55). As a result, when a child has ADHD, this specific brain structure is impacted, which directly impacts their working memory abilities. Due to this, the working memory performance differences in specific subgroups within the ADHD population were also assessed.

ADHD and Gender

The findings regarding the performance of male and female children with ADHD did not support the hypothesis. It was originally hypothesized that there would be significant working memory differences between children who identify as female and male. The findings of this study were consistent with a previous work (Leon et al., 2014), which found that there were no gender differences in working memory tasks that were administered in their study, regardless of the level of complexity (e.g., one or two rewards). However, in multiple previous studies

(Canovas et al., 2008; Lejbak et al., 2011) found that there were gender differences in regard to spatial working memory performance. These studies found that those who identified as male performed better than those identified as females. More specifically, "no differences were found under low or very high task demands in the same spatial memory task, but when the level of difficulty was medium, males outperformed females" (Canovas et al., 2008). These previous findings (Filova et al., 2013; McEwen, 1980; Wartman et al., 2012) were suggestive that there could potentially be an underlying difference in development of brain structures between male and females in terms of hormonal changes that could be impacting the performance differences between genders. However, based on the results of this study, there does not seem to be a gender difference in working memory tasks, both visually and verbally.

ADHD and Age Groups

The differences between two specific age groups were also assessed in this study. Based on the findings, the hypothesis that there would be a significant difference in working memory performance between children with ADHD ages of 7 to 10 years old and 11 to 14 years old was partially supported. The results suggest that children between the ages of 7 and 10 years old performed slightly better than children with ADHD between 10 and 14 years old on verbal working memory tasks, however, it was only partially significant. However, there was a significant difference in the performance of visual working memory tasks between children with ADHD ages 7 to 10 years old and children 10 to 14 years old. These findings are an addition to a previous study regarding cognitive development in children between the ages of 5 to 10 years old and those older than 10 years old. Previous literature (Rubia et al., 2007; Sheridan et. al, 2014) discussed the development of cognitive control, such as, working memory or response conflict, as having different developmental trajectories. The development of cognitive control

among children were well developed after the age of 10 and sustained throughout adulthood (Rubia et al., 2007). However, cognitive control for children between the ages of 5 and 10 years old were found to also have age-related changes in the ACC, and children ages 10 years and older were found to be similar to adults (Sheridan et al., 2014). These previous findings help explain the potential difference in cognitive development, more specifically, working memory as children grow older; however, it does not explain the differences between the visual and verbal working memory abilities. The results suggest that visual working memory improves as the child grows older, whereas, verbal working memory abilities decrease as the child grows older. A potential explanation for this could be as these children grow older, it is harder for them to sustain their attention due to the decrease in stimuli. When children are younger, they are able to encounter more visual information, which could be interpreted as more stimulating. However, as they grow older, they begin to encounter more complex verbal information, which could be interpreted as more difficult and less stimulating for them. It is also important to note that to our knowledge, there has not been any previous literature addressing this finding.

ADHD, Depression and Anxiety

The results of this study support the hypothesis in that the verbal working memory in children with ADHD is negatively related to depression and anxiety comorbidly. However, the findings of this study suggest that depression has a greater impact on working memory in children with ADHD than anxiety does. This is consistent with previous literature examining the impact of depression and anxiety on working memory in children with ADHD. For example, children with ADHD and comorbid anxiety disorders tend to have a slower processing speed and reaction time on memory tasks than a significant impact on working memory tasks (Bloemsma et al., 2012). Whereas children with depression and ADHD comorbidly tend to have poorer

cognitive functioning, more specifically, working memory rather than just processing speed (Roy et al., 2017; Snyder, 2013). When depression, anxiety, and verbal working memory were examined, it resulted in a poor relationship between anxiety and verbal working memory. Due to this, the relationship between depression and verbal working memory were considered independently. The results of this relationship suggest that there is a significant relationship between depression and verbal working memory.

Limitations

There are three noted limitations in this study. The first limitation is that this study used a small measure of working memory, which was only one subtest for visual and verbal working memory. By having multiple measures or subtests to examine working memory in children with ADHD will help the study be more reliable and ensure accuracy. Second, the visual working memory measure was also limited. Due to the sample being archival secondary data, the total score of the visual working memory measure was not available. The study was only able to use the individual backwards and forwards scores of the visual working memory measure. By having the total score of the visual working memory task may yield more accurate results. Third, there was not a high endorsement of depression and anxiety in this sample. Due to the utilization of the CDI and MASC to measure depression and anxiety, it is important to note that this may not be accurately capturing the levels of depression and anxiety since the children were expected to complete this self-report measure. Some children may not have understood and/or interpreted the items on the CDI and/or MASC correctly, therefore, yielding an inaccurate representation of depression and anxiety. This is a limitation because it does not accurately reflect the true impact of depression and anxiety in children with ADHD.

Implications

The findings of this study provide important information into how working memory in children with ADHD is impacted. It continues to show how important it is to address depression symptoms in children with ADHD as this has a significant impact on their working memory abilities. Additionally, children with ADHD often struggle in school settings, and the difference between visual and verbal working memory abilities during different stages of cognitive development may help provide teachers and parents a better understanding of their child with ADHD. The findings in this study (e.g., impact of depression comorbidly with ADHD on working memory, differences between visual and verbal working memory abilities in the different age groups) may also help inform treatment goals for clinicians working with this population.

Future Directions

This study has shown that children with ADHD who have a co-occurrence of a depression diagnosis struggle more with working memory abilities when compared to those who have no co-occurring diagnoses. Future studies may look at how anxiety impactful may be on working memory abilities in children with ADHD in addition to a co-occurring diagnosis of depression. This study also has found that the working memory of children with ADHD differ in regard to visual working memory and verbal working memory during different stages of development. Other studies can try to measure working memory with a larger battery to explore this gap in the literature between visual and verbal working memory in children with ADHD. Additionally, the impact of depression and anxiety on visual and verbal working memory individually could also be further researched.

Conclusions

The current study found that children with ADHD that have a co-occurring diagnosis of depression experience more difficulties with working memory abilities than those who do not have a co-occurring diagnosis of depression. This is consistent with previous research (Roy et al., 2017). This finding supports the need to address and treat depressive symptoms in children with ADHD prior to treating symptoms of ADHD. Furthermore, we also know that children with ADHD struggle in academic settings for various reasons, behavioral issues, impulsivity, attention difficulties, and working memory deficits (Crawford et al., 2006). This study found that the working memory abilities in children with ADHD differ between different cognitive developmental stages. This study indicated a significant difference between visual and verbal working memory in children at different stages. Younger children tend to have better verbal working memory than visual working memory; whereas, older children may need extra support for verbal working memory. "As children mature, they improve in their ability to self-regulate" and changes in their cognitive development also change, such as their working memory skills (Sheridan et al., 2014). Due to this, it is important for teachers, caretakers, and parents to understand the impact of co-occurring diagnoses as well as how working memory abilities are affected during certain stages of development. With a holistic understanding of working memory deficits in children with ADHD, it will help caretakers and providers integrate more effective intervention plans to help mitigate significant working memory deficits.

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Appendix A

Curriculum Vitae

Angel Linh Nguyen David

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EDUCATION

2016 – Present **Doctorate of Clinical Psychology – Assessment Emphasis**
George Fox University, Newberg, Oregon (APA Accredited)
Anticipated: May 2021

2014 – 2016 **Master of Arts – Community Psychology**
Concordia University, Portland, Oregon

2010 – 2014 **Bachelor of Science – Psychology**
Portland State University, Portland, Oregon

CLINICAL EXPERIENCE

July 2020 - Present **Predoctoral Intern, Child Neuropsychology and Educational Testing Track**
California Pacific Medical Center (APA-Accredited)
San Francisco, CA
Director of Training: Jeremy Bornstein, Ph.D.
Primary Supervisor: Brianna Coffino, Ph.D.
Neuropsychology Track Supervisor: Joe Gumina, Ph.D.

- Conduct comprehensive neurodevelopmental and neuropsychological evaluations with children and adolescents as part of a multidisciplinary team to assist with diagnostic clarification, educational recommendations, and behavioral interventions at the Kalmanovitz Child Development Center (CDC)
    - Measures utilized includes: WISC, WAIS, WASI, NEPSY, IVA-2, DKEFS, CHAMP, CVLT-C, CVLT, WRAML-2, PPVT, EVT, Berry VMI, Rey-O, WIAT-III, WRAT-IV, FAR, FAM, BASC-3, Connors, BRIEF, CBCL, CDI, BDI, MASC, Vineland, ADOS
    - Referrals include: ASD, ADHD, developmental delays, and behavioral, learning and intellectual disabilities

- Conduct parent consultations for behavioral and educational concerns
- Provide long-term psychotherapy to predominately children and adolescents, and two adult patients to promote generalized training
- Collaborate with outpatient psychiatry, primary-care physicians, developmental pediatricians, and teachers to provide on-going interdisciplinary care as well as interdisciplinary collaboration through the CDC and CPMC's Outpatient Mental Health Clinic
- Provide peer supervision within the area of child neuropsychology and assessment to psychology interns
- Provide peer supervision to Dartmouth-Hitchcock medical students as they rotate through psychiatry
- Participate in didactic/coursework during the week including psychodynamic theory, weekly child case conference, weekly child seminars, psychopharmacology, and substance abuse
- Attend weekly neuropsychology training didactics and neuroscience grand rounds
- Participate in ADOS-2 training, including a two-day workshop offered by UCSF and on-site training at the CDC

Additional Supervisors: Jonathan Shedler, Ph.D., Meryl Botkin, Ph.D., Robert Riddell, Psy.D., Hugh Molesworth, Ph.D., Whitney Clarke, Psy.D.

August 2019 - May 2020 **Assessment Specialist**
Assessment Clinic at the Behavioral Health Center, Newberg OR
Supervisors: Glena Andrews, Ph.D., Kenneth Logan, Ph.D.
Number of Integrated Reports: 12

- Conduct behavioral, psychological, and neuropsychological evaluations in order to provide helpful feedback on cognition, memory, personality, achievement, executive functioning, sensory, communication, and motor abilities to children, adolescents, and adults.
- Assessments utilized include WAIS-IV, WISC-V, WNV, WIAT-III, WRAT, MMPI-A, MMPI-II, Roberts-2, CVLT-II, REY-O, NEPSY-2, D-KEFS, TOMM, BRIEF-2, ABAS, BASC-3, ABCL, CARS-2.
- Additional duties include: Managing the waitlist, charting, providing feedback, and report writing.

July 2019 - May 2020 **Neuropsychology Practicum Student**
Oregon Science and Health University, Portland OR
Doernbecher Children's Hospital

Child Development & Rehabilitation Center (CDRC)
Pediatric Epilepsy Clinic
Supervisor: Emily Olsen, Ph.D.
Number of Integrated Reports: 14

- Conduct diagnostic neuropsychological and pre- and post-surgical evaluations (WISC-V, WASI, Mullen, DAS, D-KEFS, NEPSY, PPVT, EVT, CVLT-C, , Grooved Pegboard, Beery VMI, WRAT, WIAT-III, BASC-3, ABAS-2, BRIEF, CBCL) to children between 20 months and 10 years old diagnosed with Epilepsy or with developmental delays to assist with treatment planning and interventions.
- Additional duties include: Assembling a neuropsychological battery based on each individual child's needs, scoring, chart review, interviewing the child and the family, report writing, and providing feedback.

May 2019 - May 2020 **Psychometrician**
Private Practice, Lake Oswego, OR
Supervisor: Gary Monkarsh, Ph.D.

- Administer psychological assessments to both adults and children ages 7 to 18 years old.
- Test administration included: MMSE, TOMM, WAIS-IV, WISC-V, WIAT-III, CVLT, WMS-IV, IVA-2, PAI, BASC, BRIEF.
- Additional duties include assessment scoring and report writing.

July 2018 - July 2019 **Neuropsychology Practicum Student**
Oregon Science and Health University, Portland OR
Doernbecher Children's Hospital
Child Development & Rehabilitation Center (CDRC)
Pediatric Hematology/Oncology Unit
Supervisor: Justin Lee, Ph.D.
Number of Integrated Reports: 27

- Conduct comprehensive neuropsychological evaluations (WISC-V, WAIS, WASI, D-KEFS, NEPSY, PPVT, EVT, WRAML, CVLT-C, CVLT, Rey-O, Grooved Pegboard, Beery VMI, WRAT, BASC, ABAS, BRIEF) to children between ages 6 and 18 in the hematology/oncology unit to assist with treatment planning, particularly with the late effects of cancer treatment.
- Additional duties include: Assembling a neuropsychological battery based on each individual child's needs, scoring, chart review, interviewing the child and the family, report writing, and providing feedback.

March 2018 - July 2019 **Clinical Practicum Student**
Behavioral Health Clinic, Newberg OR
Supervisor: Winston Seegobin, Psy.D.

- Provide outpatient, individual, psychotherapy from a cognitive behavioral and relational framework.
- Sessions include initial assessment to termination with children, adolescents, and adults with various mental health needs in a community mental health setting.

November 2017 - January 2020 **Behavioral Health Consultant**
Providence Newberg Medical Center, Newberg, OR
Willamette Valley Medical Center, McMinnville, OR
Supervisors: Mary Peterson, PhD, ABPP, Joel Gregor, PsyD, William Buhrow, PsyD, Luann Foster, PsyD

- Provide on-call behavioral health consultation services for Providence Newberg Medical Center and Willamette Valley Medical Center emergency department.
- Assess mental health needs in various hospital departments including suicidal ideation and intent, self-injurious behaviors, cognitive decline, and psychosis.
- Use diagnostic tools to determine level of risk to coordinate discharge planning, providing resources for follow-up care.
- Collaborate with supervisors, medical staff and Yamhill County Mental Health to provide ongoing integrative care.

July 2017 - January 2018 **Clinical Practicum Student**
Providence Children's Developmental Institute, Portland, OR
Supervisor: Darryn Sikora, Ph.D.
Number of Integrated Reports: 23

- Conduct diagnostic evaluations and administered neuropsychological and behavioral assessments (WISC-V, WPPSI-IV, BASC-2, ABAS) to children between ages 2 and 18 years old.
- Specific emphasis on Autism using the ADOS-2.
- Additional duties included: assessment scoring, writing integrated assessment reports, and feedback sessions regarding assessment results and diagnosis.

January 2017 - April 2017 **Student Therapist**
George Fox University, Newberg, Oregon
Supervisor: Glena Andrews Ph.D.

- Provide outpatient, individual, client-centered psychotherapy from initial assessment to termination to undergraduate students in a university setting.
- Sessions were videotaped, reviewed, and discussed in individual and group supervision.

March 2015 - July 2016 **Crisis Worker Intern**
Lines for Life, National Suicide Prevention Hotline, Portland, OR
Supervisor: Rotating department staff

- Administer risk assessments and provided brief counseling over the phone.
- Assess the level of crisis and contact emergency dispatch, if necessary.
- Participated and received certification in Applied Suicide Intervention Skills Training.

RESEARCH EXPERIENCE

March 2017 – July 2018 **Clinical Interviewer**
Oregon Health and Science University (Neurophysiological Attention Test (NAT) Adult ADHD Research Study), Portland, OR
Supervisors: Dr. Leeza Maron, Ph.D. & Dr. Sarah Karalunas, Ph.D.

- Administer drug screens, the Stanford Sleepiness Scale, a brief medical history interview, MINI, and ACD.
- Administer a battery of neuropsychological assessments, WAIS, D-KEFS Trails, Colorword, Word Reading, Digit Span, Math, and the Nelson-Denny Reading Comprehension assessment to adults between the ages of 18-40 years old.

December 2016 – April 2020 **Clinical Interviewer**
Oregon Health and Science University (ADHD Research Study), Portland, OR
Supervisors: Dr. Leeza Maron, Ph.D. & Dr. Joel Nigg, Ph.D.

- Administer semi-structured clinical interviews; administer K-SAD, Q-Sort, FMSS, and SCID.
- Conduct child interviews, including risk assessments.
- Administer a battery of neuropsychological assessments, collect DNA samples, obtain parent and child consent, and assist the Diagnostic Team in the decision process.
- The population for this clinic are children ages 6-18 years old and their parents/guardians.

March 2016 – Present
Research Vertical Team Member
George Fox University Graduate Department of Clinical Psychology
Supervisor: Christine-Marie Goodworth, Ph.D.

- Collaborate and design various research projects with team members, formal presentations of research projects and results via posters and publications

October 2016 – October 2017
Data Collection – Fairy Tale Test
George Fox University, Newberg, OR
Supervisor: Dr. Glena Andrews, Ph.D.

- Collect data utilizing the Fairy Tale Test with children ages 6-12 years old for an international research project.

October 2015 – July 2016
Student Research Assistant
Oregon Health and Science University (Neuroimaging Lab) Portland, OR
Supervisor: Dr. Jeff Erikson, Ph.D. & Dr. Damien Fair, Ph.D.

- Utilizing high-density EEG in combination with MRI to explore the human brain.
- Process and analyze EEG data using Matlab, Brainstorm, Netstation, and EEGLab.

June 2015 – July 2016
Student Research Assistant
Oregon Health and Science University (ADHD Research Lab), Portland, OR
Supervisor: Dr. Joel Nigg, Ph.D. & Dr. Jessica Tipsord, Ph.D.

- Administer neuropsychological assessments (WISC-WIAT, D-KEFS, Color-word, Digit Span, Block Design, Vocabulary, Math, CPT), interviewing families, collecting DNA and RNA samples, and participating in bi-weekly group case consultations to better understand the development of ADHD in children ages 6-18 years old.

PROFESSIONAL TRAINING AND WORKSHOPS

September 2020
Introduction to the Neurosequential Model of Therapeutics
Cognitive Behavior Institute
Presenter: Bruce D. Perry, M.D., Ph.D.

August 2016 – May 2020
Clinical Team
George Fox University Graduate Department of Clinical Psychology

Supervisor: Joel Gregor, Psy.D., Winston Seegobin, Psy.D., Brooke Kuhnhausen, Psy.D.

Meetings are conducted weekly and include case conceptualizations and consultation from the team from various clinical perspectives and theoretical orientations.

March 2019 **Foundations of Relationships Therapy – The Gottman Model**
George Fox University Graduate Department of Clinical Psychology
Facilitator: Douglas Marlow, Ph.D.

October 2018 **Old Pain in New Brains**
George Fox University Graduate Department of Clinical Psychology
Facilitator: Scott Pengelly, Ph.D.

February 2018 **History and Application of Interpersonal Psychotherapy**
George Fox University Graduate Department of Clinical Psychology
Facilitator: Carlos Taloyo, Ph.D.

January 2018 **Dramatic Dialogues with Harold Searles: Relationship Psychoanalysis**
George Fox University Graduate Department of Clinical Psychology
Facilitator: Lewis Aron, Ph.D., ABPP, FABP, co-founder of Relational Psychoanalysis movement

October 2017 **Telehealth**
George Fox University Graduate Department of Clinical Psychology
Facilitator: Jeff Sordahl, Psy.D.

October 2017 **Using Community Based Participatory Research to Promote Mental Health in American Indian/Alaska Native Children, Youth and Families**
George Fox University Graduate Department of Clinical Psychology
Facilitator: Eleanor Gil-Kashiwabara, Psy.D.

September 2017 **Leadership Development Workshop**
George Fox University Graduate Department of Clinical Psychology
Facilitator: Deborah Dunn, Ph.D., Professor of Communication at Westmont in Santa Barbara, Co-Director of Westmont Initiative for Public Dialogue

March 2017 **Difficult Dialogue**
George Fox University Graduate Department of Clinical Psychology
Facilitator: Winston Seegobin, Psy.D., Mary Peterson, Ph.D. ABPP, Mark McMinn, Ph.D., ABPP, Glena Andrews, Ph.D.

March 2017 **Collaborative Assessment and Management of Suicidality (CAMS) Training**
George Fox University Graduate Department of Clinical Psychology
Facilitator: Luann Foster, Psy.D.

March 2017 **Domestic Violence: A Coordinated Community Response**
George Fox University Graduate Department of Clinical Psychology
Facilitator: Patricia Warford, Psy.D.

November 2016 **When Divorce Hits the Family: Helping Parents and Children Navigate**
George Fox University Graduate Department of Clinical Psychology
Facilitator: Wendy Bourg, Ph.D.

September 2016 – May 2016 **Clinical Foundations**
George Fox University Graduate Department of Clinical Psychology
Peer Supervisor: Erika Eisele

Evaluate, implement, and process clinical case conceptualizations, simulate psychotherapy with peers and undergraduate clients, and practice record keeping, legal and ethical guidelines, and case management

TEACHING EXPERIENCE

October 2015 – April 2016 **Teacher Assistantship**
Concordia University, Portland, OR
PSY 288/488 – Intervention and Prevention
Reed Mueller, Ph.D.

Leading 80-minute graduate classes, creating class assignments, grading, and being a resource for students

August 2015 – April 2016 **Teacher Assistantship**
Concordia University, Portland OR
PSY 519 – Social Research Methods
Reed Mueller, Ph.D.

Grading class assignments, holding office hours, and being a resource for students

PUBLICATIONS AND PRESENTATIONS

David, A., Lee, J. (2019) The neurocognitive profile of a 12-year-old with DOCK8 deficiency. Poster session presentation at The American Academy of Pediatric Neuropsychology, Las Vegas, NV.

David, A., Hughes, I., Goodworth, M., & Mueller, R. (2018). The influence of race on the severity of ADHD symptoms. Poster session presentation at the American Psychological Association Conference, Austin, TX.

Marston, A., Johnson, A., Wenger, A., **David, A**., & Goodworth, M. (2018). Body shame differences between clergy and non-clergy in women in the Nazarene. Poster session presentation at the American Psychological Association conference, San Francisco, CA.

Nguyen, A., Shim, P., Wade, L., & Colunga, A. (2017). Minority psychology graduate students in predominately white institutions: Narrative perspectives. Interactive session presented at the Asian American Psychological Association conference, Las Vegas, NV.

Nguyen, A. (2016). The influence of race, economics, neighborhood, and school category on the severity of ADHD symptoms. MA Community Psychology Theses. 3. http://commons.cu-portland.edu/commpsychtheses/3

PROFESSIONAL AND ACADEMIC AFFILIATIONS

Student Affiliate, American Psychological Association, Division 45
Student Affiliate, American Psychological Association, Division 27
Student Affiliate, Asian American Psychological Association
Member, National Alliance of Mental Illness (NAMI), Clackamas County, OR
Student Affiliate, Society for Community Research and Action – Division 27
Student Member, Neuropsychology Student Interest Group

LANGUAGES

Vietnamese – speak fluently, read and write with high proficiency