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Factors Related to Psychopharmacological Treatment Adherence for College Students with
ADHD: Individual Characteristics, Medication Tolerability, and Attitudes

by
Melanie Franklin

A Dissertation
Presented to the Graduate and Research Committee
of Lehigh University
in Candidacy for the Degree of
Doctor of Philosophy
in
School Psychology

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Approved and recommended for acceptance as a dissertation in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

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Abstract

Both pharmacological and behavioral interventions are widely accepted as methods to manage ADHD. For emerging adults with ADHD, low rates of treatment adherence preclude individuals from the long-term health benefits of evidence-based treatments, and instead leave them vulnerable to negative outcomes associated with the disorder. Despite these concerns, little is known about factors impacting treatment adherence in the adult ADHD population. The present study aimed to address limitations to the extant literature through examination of alterable and inalterable factors related to treatment adherence to psychopharmacological treatments in college students with ADHD. Data collected through self-report ratings and direct testing was analyzed for 94 college students with a diagnosis of ADHD who received medication treatments. Results indicated that none of the identified factors were predictive of treatment adherence in this population. Relationships between the latent variables (i.e., medication tolerability, attitudes towards treatment), and treatment adherence were also not statistically significant. Findings suggest that factors related to treatment adherence for the college population likely differ from those for the rest of the ADHD population. Additionally, findings demonstrate the necessity for additional research on treatment adherence to psychopharmacological treatments in emerging adults with ADHD to better understand and improve trends in adherence across the lifespan.

CHAPTER 1

Introduction

The worldwide point prevalence of attention-deficit/hyperactivity disorder (ADHD) is estimated at 5.3-7.1% (Polanczyk, de Lima, Horta, Biederman, & Rohde, 2007; Willcutt, 2012). In the United States, the rate of childhood ADHD is estimated at 5-11% (Centers for Disease Control, 2013) and adult ADHD at 4.4% (Kessler et al., 2006). Although ADHD emerges during early childhood, research has documented the persistence of ADHD into adolescence and adulthood (Bramham et al., 2012; Fischer, Barkley, Smallish, & Fletcher, 2005; Goodman, 2007; Hechtman, 2017; Hechtman et al., 2016). The *Diagnostic and Statistical Manual of Mental Disorders* (5th ed.; *DSM-5*; American Psychiatric Association, 2013) characterizes adult ADHD by five or more symptoms of hyperactivity/impulsivity or inattention associated with significant impairments in life functioning.

The core symptoms of ADHD can be highly impairing for individuals with the disorder as symptomatic behaviors interfere with multiple aspects of an individual's functioning (e.g., social, cognitive, occupational). More specifically, ADHD is associated with academic impairments (DuPaul, Weyandt, O'Dell, & Varejao, 2009), social skills difficulties (Cordier, Bundy, Hocking, & Einfeld, 2010; DuPaul, McGoey, Eckert, & VanBrakle, 2001; Normand et al., 2011), and increased risk-taking behaviors that can lead to extremely detrimental health and educational outcomes (e.g., school dropout, car accidents, alcohol and drug use, psychiatric disorders, criminal activity; Barkley, Cook, Dulcan, Campbell, & Prior, 2002; Barkley, Fischer, Smallish, & Fletcher, 2006; Biederman et al., 2007; Biederman et al., 2008; Hechtman, 2017; Hechtman et al., 2016; Roy et al., 2016). Although symptoms of adult ADHD may look slightly different from the manifestation of the disorder in childhood (e.g., shift towards inattentive

clinical presentation vs. hyperactivity-impulsivity clinical presentation, decreased severity of behavioral symptoms; Bramham et al., 2012; Fischer, Barkley, Smallish, & Fletcher, 2005), ADHD in adults leads to many similar negative outcomes and significant impairments in school, work, social, and home environments (Brown, 2000).

College Students with ADHD

Although there has been a significant amount of research on children and adults with ADHD, relatively less is known about the college population. Due to significant impairments in functioning, only a small percentage of individuals with ADHD attend college, and from that group, only about 5% actually graduate (Barkley, 2002; Hechtman, 2017; Hechtman et al., 2016). Because such a small portion of students with this disorder pursue and complete a degree in higher education, it is likely that this group of individuals has a set of characteristics that differ from the rest of the population with ADHD. It is important to understand this subset of the population in order to target interventions and treatments to best promote positive post-secondary school outcomes.

Despite deficits in multiple functional domains, rates of college students with ADHD continue to rise (Gaddy, 2008). It is estimated that between 2-8% of college students have a diagnosis of ADHD (DuPaul, Weyandt, O'Dell, & Varejao, 2009), with more recent reports indicating that approximately 5.9% of first-year college students self-report a diagnosis of ADHD (Eagan et al., 2014). Among the population of college students with disabilities, about 25% are diagnosed with ADHD (DuPaul, Weyandt, O'Dell, & Varejao, 2009). Because symptoms of ADHD may cause impairments in behaviors essential for successful functioning in adulthood (e.g., self-regulation, attention), emerging adulthood (i.e., college age) is a particularly consequential time for intervention and symptom management (Fleming & McMahon, 2012).

The college environment poses unique challenges (e.g., loss of structure and parental support, increased emphasis on executive functioning) for students with ADHD that may interfere with treatment and positive outcomes. These challenges represent a less than ideal environment for individuals with ADHD because they emphasize skills (e.g., self-regulation, executive functioning) that are specifically impaired by the disorder (American Psychiatric Association, 2013). Further, because the neurological systems of college students are still maturing, the self-regulation skills of college students may be underdeveloped and insufficient to respond appropriately to these heightened demands (Fleming & McMahon, 2012).

Based on these challenges, college students with ADHD are at risk for experiencing academic difficulty and failure (for review, see DuPaul et al., 2009). Specifically, college students with ADHD are at risk for lower academic performance (Heiligenstein, Guenther, Levy, Savino, & Fulwiler, 1999; Weyandt & DuPaul, 2006) and have more academic problems and lower GPAs than their healthy peers (Gormley et al., 2015; Gormley et al., 2016; Hellingstein et al., 1999). College students with ADHD are also at an increased risk for engaging in risk-taking behaviors (e.g., risky sexual behaviors, substance abuse; Charach, Yeung, Climans, & Lillie, 2010; Flory, Molina, Pelham, Gnagy, & Smith, 2006; Molina et al., 2013). Additional social, occupational, emotional, and other functional impairments may also have profound impacts on both short- and long-term outcomes (Arnold, Hodgkins, Caci, Kahle, & Young, 2015; Fleming & McMahon, 2012; Weyandt et al., 2013).

Treatments for ADHD

To protect against these negative outcomes, ADHD can be effectively managed with pharmacological and/or behavioral treatments (American Academy of Pediatrics [AAP], 2011). Individuals who are treated for their ADHD tend to have better outcomes (e.g., social,

educational, occupational, risk taking) than those who are not treated (Arnold et al., 2015; Shaw et al., 2012). Both pharmacological and behavioral interventions are widely accepted as methods to manage ADHD, and can help to promote positive functioning in a variety of areas (AAP, 2011; He & Antshel, 2017; Wilens et al., 1998; Wilens et al., 2001). Despite the benefits of each form of treatment, however, each treatment modality is associated with various risks and barriers. Best practice treatment should maximize benefits and minimize harm for each individual. Therefore, in order to optimize outcomes, it is important to carefully evaluate the costs and benefits of each treatment modality.

Psychopharmacological Treatment. The most frequently recommended treatment for children (Greenhill, Pliszka, & Dulcan, 2002; Pliszka, 2007; Subcommittee on Attention Deficit/Hyperactivity Disorder, 2011) and adults (for reviews, see Prince, Wilens, Spencer, & Biederman, 2015; Wilens, Morrison, & Prince, 2011) with ADHD is psychopharmacological therapy. In 2007, over 2.7 million children between the ages of 4 to 17 were receiving pharmacological treatment for ADHD (Visser et al., 2014). Medication treatment for ADHD includes stimulant medications, specifically central nervous system (CNS) stimulant medications such as methylphenidate, dextroamphetamine, and mixed amphetamines (Levine, 2005; Stolzer, 2009). For the pharmacological treatment of adults with ADHD, the approved medication classes include atomoxetine (ATMX), amphetamine (AMPH), and methylphenidate (MPH). These medications decrease symptoms of inattention, impulsivity, and hyperactivity (Connor, 2006; DuPaul et al., 2012; Heiligenstein, Johnston, & Nielsen, 1996; Northup, Gulley, Edwards, & Fountain, 2001; Peterson et al., 2009; Southammakosane & Schmitz, 2015, Prince et al., 2015), and individuals who are treated with medication have improvements in disruptive behavior, academic achievement, and peer relations (Connor, 2006; DuPaul et al., 2012; Jensen

et al., 2007; Molina et al., 2009; MTA Cooperative Group, 1999; MTA Cooperative Group, 2004). Further, the use of stimulant medications helps to protect individuals with ADHD from problems with drug abuse, learning difficulties, social dysfunction, and comorbid psychopathology in adulthood (Biederman et al., 2005; Goksoyr & Nottestad, 2008).

Despite the many benefits of pharmacological treatment, there are also risks associated with this type of intervention for ADHD. Of particular prominence are adverse side-effects associated with psychostimulant medication including reduction in appetite, emotional lability, difficulty sleeping, and other deleterious symptoms (Fleming & McMahon, 2012). These side-effects can be extremely harmful and unpleasant, creating their own challenges for functioning. In addition to negative physical reactions, there are also social consequences associated with psychopharmacological treatment. Due to stigma surrounding the disorder, many individuals (e.g., parents, teachers, healthcare professionals, public) have incorrect knowledge about ADHD treatment and falsely believe that ADHD medication is used for unsuitable reasons (Moldavsky & Saval, 2013). Regardless of the well-established research supporting the use of these medications, these fallacious beliefs may increase stigma towards those being treated with medication for the disorder. Additionally, particularly in the college population, there is a risk of stimulant misuse or diversion, which could also influence the health of individuals without ADHD (Fleming & McMahon, 2012).

Behavioral Treatment. Due to barriers associated with ADHD medications (e.g., adverse side-effects, stigma), behavioral treatments are also used to manage ADHD symptoms and have been suggested to be highly effective (AAP, 2011; Fabiano et al., 2009; Kaiser & Pfiffner, 2001). Given the unique and complimentary strengths of each treatment type, it is recommended that psychosocial treatments and psychopharmacological treatments are used in

combination (Arnold, Hodgkins, Caci, Kahle, & Young, 2015; Jensen et al., 2001); however, if families opt for a single method treatment modality, there are a variety of evidence-based behavioral interventions used for treatment for ADHD. For children, psychosocial treatment includes parent and teacher training (Evans, Owens, Wymbs, & Ray, 2018 Pelham & Fabiano, 2008), classroom management, peer intervention, organizational training, combined behavioral management interventions, (Evans et al., 2018), cognitive behavioral therapy (Prevatt & Yelland, 2013), and neurocognitive training (Chacko et al., 2013; Fabiano, Schatz, Aloe, Chacko, & Chronis-Tuscano, 2015; Rapport et al., 2013). Interventions for adults with ADHD include group (e.g., dialectical behavioral therapy, metacognitive therapy, cognitive-behavioral therapy [CBT], mindfulness meditation training) and individually based (e.g., CBT, coaching) treatments (He & Antshel, 2017; Prevatt & Yelland, 2013; Safren et al., 2010; Solanto et al., 2010). Psychosocial interventions for adults with ADHD are still in the early stages of development; however, there is a growing body of evidence supporting the efficacy of these treatments for adult ADHD (for review, see He & Antshel, 2017). By using behavioral interventions rather than medication, the risks of adverse physical side-effects are eliminated and individuals are also taught behavioral skills that may generalize across settings in ways that medication effects do not. Additionally, although the research has not fully evaluated long-term consequences for adults, for children, psychosocial treatments may have less social consequences and may be perceived as more acceptable than psychopharmacological treatments (Krain, Kendall, & Power, 2005).

Although behavioral treatments may offset some of the negative consequences of pharmacological treatment, significant challenges are also associated with the implementation of psychosocial treatment. For example, behavior therapies require a great deal of resources and

time commitment (AAP, 2011; Van Cleave & Leslie, 2008). Additionally, because adolescents and emerging adults have a tendency to resist treatment and deny impairment, as individuals begin to make independent treatment decisions, they may be less willing to engage in behavioral interventions (Barkley, Edwards, Laneri, Fletcher, & Metevia, 2001; Biddle, Donovan, Sharp, & Gunnell, 2007; Fischer, Barkley, Fletcher, & Smallish, 1993). Other factors such as therapeutic alliance, affordability, scheduling, cultural barriers, and stigma may also influence appropriate psychosocial treatment usage (Gearing et al., 2014). Perhaps most importantly, although evidence supports the use of psychosocial treatments with certain childhood populations, there are still challenges associated with effectively implementing these techniques in practical settings, particularly due to limitations in the understanding of the utility of these interventions across all populations (e.g., varying demographic characteristics; Evans et al., 2018). For adolescents and adults, due to methodological limitations in the literature and the large variability in types and intensities of psychosocial interventions it is difficult to make firm conclusions about the overall effectiveness of psychosocial treatments in older populations (Evans et al., 2018; Fabiano et al., 2015; He & Antshel, 2017).

Combined Treatments. Best practice treatment for children with ADHD is a combination of pharmacological and behavioral therapy (Arnold et al., 2015; Jensen et al., 2001). For adults, combined CBT and medication interventions have shown promise in reducing ADHD symptoms; however, due to a dearth of studies in this area, it is unclear to what extent combined treatments were superior to individual treatments in this population (Rostain & Ramsay, 2006; Safren et al., 2005). Because many adults do not respond to or experience full symptom relief from medication, it is recommended that pharmacological treatment is supplemented with psychosocial interventions (Dulcan & Benson, 1997; Wender, 1998; Wilens, Biederman, &

Spencer, 1998; Wilens et al., 2001). Despite this recommendation, however, limited empirical research has evaluated the benefits of combined treatments for adults. Due to the complex and individualized components of combined treatments, the exact dosage or methods of therapy can be difficult to measure.

Regardless of these limitations, in addition to possible positive treatment effects, evidence suggests that the use of combined therapy can lead to greater treatment acceptability (Pelham & Gnagy, 1999). Increased acceptability is potentially associated with treatment effectiveness and/or required dosage (e.g., each individual treatment component typically administered in lower doses), thus reducing the risk of adverse side-effects associated with isolated pharmacological or psychosocial therapies, as side-effects typically correlate with treatment dosage or intensity. Combined treatments may more comprehensively treat symptoms of ADHD by minimizing many of the shortcomings of each individualized treatment (e.g., psychopharmacology, psychosocial). Unfortunately, combined therapies may not fully eliminate many of the negative aspects of treatment associated with each treatment type (e.g., medication side-effects, resources, stigma). Finally, there can be a great degree of variability in the topography of combined treatments, which can lead to differences in treatment effectiveness.

Treatment Adherence

Regardless of the potential harm associated with the treatments for ADHD, in general, the benefits of evidence-based treatments outweigh the risks and can assuage or eliminate many of the deleterious outcomes associated with ADHD (AAP, 2011; He & Antshel, 2017; Kaiser & Pfiffner, 2011; Vaughan, March, & Kratochvil, 2012; Wilens et al., 2001). Despite the efficacy of these treatments, many individuals do not receive proper or any treatment for their ADHD (Corkum et al., 2013). Families are more willing to pursue recommendations for medication-

based treatment than psychosocially based treatment, but treatment initiation rates are still only estimated to be around 65% (MacNaughton & Rodrigue, 2001). Among those who do initiate treatment, adherence over a long period of time is extremely limited (Corkum et al., 2013). Treatment adherence is conceptualized as the extent to which a person's behavior follows the agreed upon recommendations from the health care provider (e.g., dose, frequency, duration; Sabate, 2003; Treuer, Mendez, Montgomery, & Wu, 2016). For children and adults with ADHD, the prevalence of medication nonadherence or discontinuation has been estimated between 13.2% to 64% (for review, see Adler, Nierenberg, & Andrew, 2010). According to some reports, adherence to medication is estimated to decrease to rates of 61% adherence over a 5-year period (Corkum, Rimer, & Schachar, 1999; Faraone, Biederman, & Zimmerman, 2007; Gau et al., 2008; Thiruchelvam, Charach, & Schachar, 2001). Other estimates of adherence report persistence rates are as low as 15% following one year of treatment (Marcus, Wan, Kemner, & Olfson, 2005). Due to the variability in treatment type and measurement, even less is known about adherence to psychosocial treatments and the resultant outcomes, but it is likely that the efficacy of psychosocial treatments is greatly reduced when treatment guidelines are not appropriately implemented or adhered to (Gearing, Townsend, Elkins, El-Bassel, & Ostreberg, 2014). Research has demonstrated that regardless of treatment type (e.g. pharmacological, behavioral, stimulant), individuals with ADHD, in particular, have especially poor treatment adherence (Hong et al., 2013).

Proper treatment adherence is associated with many benefits including improvements in psychological functioning, overall quality of health, and quality of life (Drotar et al., 2007; Ekberg et al., 2007; Fredericks et al., 2008; Hommel, Davis, & Baladasso, 2008). Additionally, from a broader public health perspective, treatment adherence can reduce medical expenditure

and disease burden (Krueger, Berger, & Felkey, 2005). In contrast, any deviation from the health care provider's recommendations (e.g., altered dosage, termination of treatment) is defined as non-adherence. Low medication adherence impacts multiple aspects of treatment including symptom severity and relapse as well as a clinician's ability to determine treatment efficacy and appropriate dosage adjustments (Adler, & Nierenberg, 2010; Safren, Duran, Yovel, Perlman, & Sprich, 2007). Non-adherence to pharmacological and behavioral treatments is associated with increased health care needs and occupational and academic impairments, placing a burden on the individual as well as society as a whole (Gearing et al., 2014; Lehane, & Mccarthy, 2009; National Council on Patient Information and Education, 2004; Pai & Drotar, 2010). Without proper adherence, clinical decision-making is compromised, and individuals do not receive the benefits of evidence-based treatments. Because ADHD is a chronic disorder, individuals must demonstrate treatment adherence for long periods of time in order to fully benefit from positive treatment effects and continuously prevent negative outcomes (Ahmed & Aslani, 2013).

Despite these serious health concerns, factors related to treatment adherence for children with ADHD remains an under-researched topic. Research on adults with the disorder is even more limited, with only one expert opinion article providing reasoning for treatment discontinuation (i.e., adverse-side effects, suboptimal response rates, social stigma, and dosing inconvenience; Ahmed & Aslani, 2013; Gajria et al., 2014). Throughout the research literature, there is a lack of standardization of the definitions and measurements of treatment adherence making it difficult to conceptualize the scope of the problem and to target intervention strategies to promote adherence (Emilsson, Gustafsson, Ohnstrom, & Marteinsdott, 2017; Osterberg & Blaschke, 2005). Though it is clear that rates of medication adherence decline significantly over

time, partially due to these limitations, there is currently no clear estimation of adherence rates in the emerging adult and adult populations with ADHD. The identified factors (e.g., social stigma, treatment ineffectiveness) in the adult adherence literature, however, are consistent with a developmental model for treatment adherence and may explain the trends in adherence rates over time (Ahmed & Aslani, 2013; Gajria et al., 2014). Based on the limited research on children and adults with ADHD, it is hypothesized that a variety of factors contribute to low rates of treatment adherence (Corkum et al., 2013). Contributing factors that have been identified in the literature are comprised of some unchangeable variables (i.e., individual demographic factors), but also others that are malleable (e.g., attitudes towards treatment) and can be targeted by clinicians to improve adherence. The extent to which each of these factors individually contributes to treatment adherence is currently unstudied; however, it is clear that a combination of variables may influence treatment adherence.

Individual characteristics.

Demographic risk factors. Certain patient demographic factors (i.e., family history of ADHD, ethnicity, gender) were implicated in contributing to poor treatment adherence (Charach & Fernandez, 2013). These factors are largely inalterable, but may indirectly contribute to treatment outcomes based on adherence. For example, family history of ADHD is one factor related to decreased adherence, presumably due to the caregiver's lack of organization and poor management skills associated with ADHD (Gau et al., 2008). Racial or ethnic minority status (i.e., Hispanic, African-American) has also been cited as a factor related to treatment adherence (Berger-Jenkins et al., 2012). Lower rates of treatment adherence for minority populations have been associated with cultural beliefs and skepticism about mental illness and treatment, and less knowledge about ADHD and treatment (Arcia, Fernandez, & Jaquez, 2004; Bussing, Gary,

Mills, & Garvan, 2007). Additionally, past studies have documented gender as relating to treatment adherence, with females exhibiting higher rates of adherence than males (Atzori et al., 2009; Chacko et al., 2010; Miller, Lalonde, & McGrail, 2004).

Symptomatology.

ADHD symptom severity. Symptoms of ADHD and other psychiatric disorders have also been associated with treatment adherence (Ahmed & Aslani, 2013; Atzori et al., 2009).

Individuals with higher levels of baseline ADHD symptoms tend to have lower rates of treatment adherence (Charach & Gajaria, 2008; Charach, Ickowicz, & Abel, 2004). Considerations that may contribute to this phenomenon include increased adverse side-effects associated with higher doses of medication (Atzori et al., 2009) as well as increased ADHD symptom severity possibly impeding self-regulatory responsibilities necessary for adherence.

Comorbid symptoms. There have been mixed findings on the relationship of comorbid diagnoses to treatment adherence with some studies indicating worsened adherence with the presence of comorbidities (Charach et al., 2004; Corkum et al., 2015; Thiruchevlam et al., 2001), and others indicating improved adherence (Atzori et al., 2009; Palli, Kamble, Chen, & Aparasu, 2012). Contributing factors of comorbidities to adherence may be related to the use of multiple medications to manage symptoms or higher symptom severity that would lead to an increased perceived benefit or difficulty managing treatment. For these reasons, differences in findings may be related to comorbid diagnosis type (e.g., oppositional defiant disorder, anxiety disorder, conduct disorder, learning disability) and prior medication habits (Corkum et al., 2015). When individuals are generally noncompliant with medication regimens, as often is the case for individuals with severe ADHD, it is probable that the higher symptom severity of individuals with comorbid ADHD is associated with lower levels of treatment adherence. However, the

presence of multiple comorbidities may increase the need for and benefits of medication, potentially contributing to higher rates of treatment adherence. Because individuals with ADHD are at increased risk for displaying comorbid disorders, this is a particularly importance facet of treatment adherence to examine for this population (Anastopoulos et al., 2106).

Medication tolerability. Corkum and colleagues (2013) identified a variety of medication-specific factors related to adherence. A main consideration of medication usage related to adherence is tolerability (Gajaria et al., 2014). Tolerability of medication (i.e., acceptableness of use) can be related to multiple factors including ease of use, adverse side-effects, fear around long-term effects of medication, and stigma about ADHD treatment (Gau et al., 2008; Johnston, Hommersen, & Seipp, 2008; Wong et al., 2009). In general, children and adults exhibit greater adherence to long-acting medications than short-acting medications (Christensen et al., 2010; Gau et al., 2008; Wong et al., 2009). This difference is attributed to the convenience of taking medication once a day rather than multiple times. The reduced administration efforts associated with long-acting medications minimize the chance of forgetfulness and maximize the ease of treatment.

The type of medication and dosing is also related to treatment adherence. Specifically, stimulant medications are associated with better treatment adherence than non-stimulant medications (Christensen, Sasane, Hodgkins, Harley, & Tetali, 2010) and both children and adults demonstrate higher rates of adherence to amphetamines than methylphenidates (Christensen et al., 2010; Gajria et al., 2014). These differences are potentially attributable to augmentation and medication switching rates, which may compromise the stability of treatment, thereby negatively influencing adherence rates (Christensen et al., 2010). For example, when medications are constantly changed and adjusted, it may become more difficult for individuals to

follow their treatment regimen with fidelity. Individuals receiving higher doses of medication also tend to have lower adherence (Ahmed & Aslani, 2013). This difference can be attributed to presumably more severe symptomatology warranting the need for higher dosing of medication (Atzori et al., 2009) or to the increased adverse side-effects resultant of higher medication dosages (Wong et al., 2009).

For adolescents in particular, increased adverse side-effects have been identified as a common contributor to treatment nonadherence (Bussing et al., 2012; Charach & Fernandez, 2013; Kendall, Hatton, Beckett, & Leo, 2003). Adverse side-effects common to psychostimulant medications (e.g., appetite reduction, emotional lability, difficulty sleeping) may lead to decreased tolerability, and therefore, decreased medication usage (Charach & Fernandez, 2013; Fleming & McMahon, 2012). Despite the benefits of these treatments, certain individuals may experience limited tolerability for medication that may preclude optimal usage. The tolerability of these treatments may be highly influential in individuals' attitudes towards treatment. Various characteristics of prescribed treatment regimens can lead to more or less intense costs and benefits to treatment, an important component of treatment use (Horne & Weinman, 1999).

Attitude towards treatment.

Because the aforementioned individual characteristics are largely unchangeable, it is necessary to target malleable factors related to treatment adherence. Currently, the relative influence of individual characteristics to attitudes towards treatment and/or treatment adherence for the college population is unknown. Attitudes towards treatment present a possible point of intervention to promote treatment adherence. However, it is necessary to examine the extent to which attitudes towards treatment influence the relationship between individual characteristics and treatment adherence in order to empirically evaluate whether attitudes constitute a fruitful

point of intervention for promoting adherence.

Adherence is related to the extent that an individual's perceived benefits of treatment outweigh the treatment costs (Emilsson et al., 2017; Horne & Weinman, 1999). This relationship likely explains the reasoning that tolerability of treatment has been cited as an important factor influencing treatment adherence (Gajria et al., 2014). The positive differential belief in the necessity of the medication versus the concerns of medication and levels of adverse side-effects is strongly associated with treatment adherence (Emilsson et al., 2017). Although some components related to tolerability are more difficult to change (e.g., side-effects, ease of administration), other components that tolerability of medication may predict (e.g., attitudes) can be targeted to increase the perceived benefits of treatment.

Currently, there is no best practice method for promoting treatment adherence; however, recommendations for promoting adherence typically focus on strategies to increase the perceived treatment benefits relative to the costs. The cognitive-behavioral model of psychology emphasizes altering cognitions in order to change behavior (Dobson, 2010). Based on the application of this theoretical orientation, in order to promote behavior change (i.e., treatment adherence), it is necessary to alter cognitions (i.e., thoughts about impairment, knowledge) about treatment for ADHD. Based on this model, strategies that emphasize the promotion of perceived benefits of treatment may be an effective way to influence behavioral change in the form of treatment adherence. For this reason, it is necessary to examine attitudes towards treatment (i.e., malleable factors such as knowledge, perceived impairment from ADHD, and satisfaction with treatment) in order to inform possible interventions to promote treatment adherence.

Knowledge. Health literacy is an important aspect of treatment; individuals should be well informed about the need for and benefits of treatment for ADHD (Charach & Fernandez,

2013). Despite compelling research, there are still many misconceptions and heightened stigma about individuals with ADHD (Moldavsky & Sayal, 2013). Some of the main areas that reinforce stigma concern the etiology and treatment of ADHD (e.g., inadequate parenting skills), due to inaccuracies of knowledge about these domains. This stigma, resulting from inaccurate knowledge, may impact help-seeking behaviors, and therefore interventions should target reversing these misconceptions by improving the knowledge base surrounding ADHD and treatment. Currently, there is no clear direction identified in the research for the knowledge base that is most likely to improve treatment adherence, but by providing individuals with a comprehensive, accurate, and realistic expectation of the benefits and risks associated with treatment and non-adherence, individuals will be able to make better informed, evidence-based decisions and adjust their attitudes related to treatment (Charach & Fernandez, 2013).

Psychoeducation is commonly targeted as a behavioral treatment strategy to promote adherence in adult populations with other mental illnesses (Kemp, Hayward, Applewhaite, Everitt, & David, 1996; Montoya, Colom, & Ferrin, 2011; Unutzer, et al., 2001). Although many interventions to promote adherence to ADHD medication suggest an educational component, there is limited research to confirm that this is an effective strategy (Montoya et al., 2011). Corkum, Rimer, and Schachar (1999) demonstrated that knowledge about ADHD may increase willingness to initiate pharmacological treatment, but did not document significant changes to treatment adherence. Similarly to adherence, treatment willingness is influenced by perceptions and attitudes (e.g., feeling knowledgeable about treatment; Bussing et al., 2012). Theoretically, knowledge about the benefits of treatment should help to alter attitudes and promote treatment adherence. However, due to methodological flaws in the scant examination of this phenomenon, the current research on the influence of knowledge on treatment adherence

is inconclusive (Emilsson et al., 2017; Osterberg & Blaschke, 2005). Despite the ambiguous nature of available research, knowledge and psychoeducation is still targeted as a common strategy to promote adherence. To support the efficacy of this type of intervention, it is critical to examine the influence of knowledge about ADHD and its treatment on treatment adherence.

Perceived Impairment from ADHD. Thoughts about impairment from and treatment for ADHD can be critical factors in treatment use and adherence (Bussing et al., 2012; Emilsson et al., 2017). As discussed previously, ADHD can cause significant short and long-term impairments for individuals that can influence multiple aspects of their lives (Arnold, Hodgkins, Caci, Kahle, & Young, 2015; Fleming & McMahon, 2012; Weyandt et al., 2013). Although there is strong evidence to support the efficacy of ADHD medication in improving outcomes and symptom expression, there are also significant adverse effects associated with treatment (e.g., side effects, stigma; Fleming & McMahon, 2012; Moldavsky & Saval, 2013). If, however, perceived impairment from ADHD does not exceed the adverse effects from alternatives (i.e., no treatment, treatment) individuals will have little reason to sustain treatment efforts.

Willingness to engage in treatment, a necessary prerequisite to treatment adherence, is related to an individual's expectations of treatment effectiveness (Bussing et al., 2012). Individuals who expect positive outcomes from treatment for ADHD will be more likely to engage in treatment efforts than those who do not. Perceptions of impairment from ADHD can also be highly influential in an individual's decision to initiate and adhere to treatment. Emilsson and colleagues (2017) found that, for adolescents with ADHD, adherence is related to the degree to which an individual's belief in the necessity of treatment overrides the individual's concern about treatment risks. A positive differential of belief in the necessity of medication can have profound impacts on the treatment adherence habits of this population. For this reason, it is

important to understand the ways in which an individual's perceptions of their impairment relate to treatment adherence. Although it might not be feasible to eliminate the adverse effects of medication, it is possible to alter individuals' understanding of their impairment from and need for treatment for ADHD.

Satisfaction. Once treatment is initiated, the perceived effectiveness and utility (i.e., satisfaction) of treatment is highly correlated with willingness to adhere to treatment (Charach & Fernandez, 2013; Wong et al., 2009). Beliefs about the need for, safety of, and effectiveness of medications are highly influential factors in promoting adherence (Bussing et al., 2012; DosReis et al., 2009; Gearing et al., 2011). Individuals are unlikely to adhere to treatments that are too burdensome or are perceived as unsafe, inappropriate, or unnecessary (Charach & Fernandez, 2013). Additionally, treatment efficacy is an important factor related to adherence, as individuals are less likely to adhere to treatment recommendations when they do not perceive any symptomatic improvement (Wong et al., 2009).

Individuals who are satisfied with improvements from their treatments are more likely to exhibit treatment adherence (Chacko et al., 2010). For example, Hebert, Polotskaia, Joober, and Grizenko (2013) found that children with parents who perceived significant psychosocial benefits of treatment for ADHD had greater adherence with their treatments than those whose parents did not. Both attitudes towards treatment effectiveness (Hebert et al., 2013) and actual treatment effectiveness (Ahmed & Aslani, 2013; Wong et al., 2009) are critical factors in treatment adherence. Therefore, it is necessary to understand individuals' satisfaction with their treatment in order to promote treatment adherence.

Developmental Model for Treatment Adherence

ADHD is a chronic condition that persists throughout adulthood, and therefore

individuals commonly must adhere to treatment regimens over long periods of time (Ahmed & Aslani, 2013; Chacko et al., 2010). Patterns of treatment adherence, however, shift across the lifespan. Age has been identified as a particularly important contributor to treatment adherence with rates declining from childhood to adulthood (Ahmed & Aslani, 2013; Corkum et al., 2013). To optimize success, the AAP recommends considering treatment for ADHD within a developmental context in order to reflect differences across age groups (Sibley, Kuriyan, Evans, Waxmonsky, & Smith, 2014).

The current literature on treatment adherence for ADHD is limited and focuses mainly on childhood populations. However, due to differences in barriers to treatment across the lifespan, the child research base may not be completely applicable to older populations (e.g., adolescents, young adults, adults; Sibley et al., 2014), and best practice treatment might vary to most effectively accommodate individuals in different developmental stages. Specific barriers to treatment adherence for each age group should be considered in order to understand where to target intervention efforts to promote treatment adherence for ADHD.

Across all age groups of individuals with ADHD, treatment adherence rates are low (Hong et al., 2013). The reasons for these low rates, however, differ across populations as adolescents and adults face different obstacles to treatment adherence for ADHD than children (Ahmed & Aslani, 2013). In the childhood population, for example, children often have limited clinical power over their treatment, and have to defer to the decisions of their parents and healthcare providers (Matsui, 2007). Presumably due to higher levels of parent involvement (Atzori et al., 2009), typically, younger children are more likely to comply with psychopharmacological treatments (Atzori et al., 2009; Barner, Khoza, & Oladapo, 2011; Berger-Jenkins, McKay, Newcorn, Bannon, & Laraque, 2012; Gau et al., 2008; Miller et al.,

2004; Thiruchelvam et al., 2001) with adults demonstrating the lowest medication adherence rates (Ahmed & Aslani, 2013).

As children get older, they gain independence, autonomy, and control over their medical treatment, putting the responsibility of medication adherence on the individual rather than their caregivers (Chacko et al., 2010). This greater independence in combination with symptomatic changes, a common occurrence in the progression of ADHD, can lead to decreased medication usage (Atzori et al., 2009). Although this is a critical stage for treating ADHD in terms of future health outcomes (e.g., driving, risk taking, education; Fleming & McMahon, 2012; Sibley et al., 2014), adolescents in the process of parental detachment and increasing responsibility over their health care may be especially prone to nonadherence (Brinkman et al., 2012). Despite persistent symptomatic impairment (Sibley et al., 2014), adolescents tend to prefer self-reliance over formal treatment for mental health help-seeking and may exhibit acts of rebellion (e.g., terminating treatment) in order to establish their independence (Gulliver, Griffiths, & Christensen, 2010). Adolescents with ADHD tend to underestimate or deny impairment (Fischer et al., 1993). Further, stigma associated with ADHD treatment (Moldavsky & Sayal, 2013) and lack of motivation to take medication (Kent et al., 2011) are particularly pertinent treatment barriers for individuals at this developmental stage. For a variety of reasons, adolescents are less willing to use medication than adults (Bussing et al., 2012; Charach & Fernandez, 2013) and may resist treatments for their ADHD (Barkley et al., 2001). Unlike in childhood, however, where caregivers are largely responsible for treatment decisions, adolescents typically make decisions about treatment termination (McCarthy, 2014). By the end of high school, up to 90% of individuals with ADHD refuse and cease pharmacological treatment for ADHD (Biswas, Gnagy, Molina, & Pelham, 2009). These changes in patterns of adherence support the

importance of alterable factors (e.g., attitudes towards treatment) that may best predict treatment adherence across different periods of the lifespan. Additionally, the relationship of the unchangeable factors to treatment adherence may differ over the lifespan (e.g., family history of ADHD may impact adherence more when the parent is in charge of child's treatment), making attitudes an even more pertinent influence to treatment adherence during emerging adulthood.

The research base on college students with ADHD is even more limited (DuPaul, Weyandt, O'Dell, & Varejao 2009; Fleming & McMahon; Green & Rabiner, 2012). In general, emerging adulthood has been identified as a critical period for establishing patterns of treatment adherence (Pai & Ostendorf, 2011). Across a variety of chronic illness conditions, treatment adherence rates tend to decline significantly as children transition from pediatric to adult-based medical care (i.e., emerging adulthood; Annunziato et al., 2007; Kipps et al., 2002; Watson, 2000). In the college setting, parental involvement becomes even more limited than in adolescence and individuals gain greater control over their treatment decisions (Fleming & McMahon, 2012). For individuals with ADHD in particular, the loss of structure and parental support in addition to increased demands on executive functioning may create significant and unique barriers to treatment. In an analysis of adherence patterns to psychopharmacological treatment among college students with ADHD, college students adhered only to about half of their prescribed doses (Gray et al., 2018). Gray and colleagues identified the transition to college as a highly risky time for poor self-management of ADHD, citing the lowest adherence rates during the beginning of college, with rates of adherence during the college years improving over time. As with adolescents, it is clear that individuals with ADHD in the college setting continue to face significant impairment from the disorder. College students may experience specific challenges related to tolerability and attitudes towards treatment. The perceived cost and lack of

satisfaction with treatment in this population may override the motivation for treatment adherence (Meaux, Hester, Smith, & Shoptaw, 2006; Rabiner, Anastopoulos, Costello, Hoye, & Swartwelder, 2008). The idiosyncratic characteristics of college students with ADHD necessitate individualized intervention strategies that specifically target treatment barriers relevant to this population. Despite this understanding, there is a dearth of research that specifically assesses factors related to treatment adherence in the emerging adult population with ADHD or with chronic illnesses in general (Pai & Ostendorf, 2011). It is critical to understand factors that may influence treatment adherence for college students with ADHD in order to target intervention efforts that maximize short and long-term outcomes.

Proposed Study

Treatment adherence for chronic health conditions is an important mental and public health issue (Truer et al., 2016). For emerging adults with ADHD, low rates of treatment adherence preclude individuals from the long-term health benefits of evidence-based treatments for ADHD, and instead leave them vulnerable to the negative outcomes associated with the disorder. Because, however, patterns of adherence change across development, it is likely that certain aspects related to treatment adherence are alterable and may serve as a point of intervention. Despite serious health concerns, we know little about factors impacting treatment adherence in the adult ADHD population. Further, the scant research that does exist mainly focuses on the pediatric population and, due to developmental differences, may not be applicable to adults with ADHD.

The present study aims to address limitations to the extant literature by examining factors related to treatment adherence to pharmacological treatments in college students with ADHD. Due to methodological limitations in the ability to specifically quantify and measure

psychosocial treatments as well as the limited information on factors related to adherence for these types of treatments, to increase the validity of study results, the scope of this study is limited to examining adherence to psychopharmacological treatments rather than psychosocial treatments. Similarly consistent with past adherence studies and particularly because this was an observational rather than an interventional study, concentrating on more standardized psychopharmacological treatments will provide a more accurate and informative understanding of the ways that various identified factors relate to treatment adherence in this population.

In the childhood literature, a variety of factors related to treatment adherence have been identified (Charach & Fernandez, 2013). Although the strengths of these relationships are unknown, individual characteristics (i.e., gender, ethnicity, family history of ADHD, ADHD symptom severity, and comorbidities) as well as attitudes have been previously established as relating to treatment adherence (Arcia, Fernandez, & Jaquez, 2004; Atzori et al., 2009; Bussing, Gary, Mills, & Garvan, 2007; Chacko et al., 2010; Miller, Lalonde, & McGrail, 2004; Gau et al., 2008). Medication tolerability has also been consistently cited as one of the most common reasons for decreased rates of treatment adherence in this population (Gau et al., 2008; Johnston, Hommersen, & Seipp, 2008; Wong et al., 2009). Although the relationship between medication tolerability and attitudes has not been empirically explored, presumably the tolerability of medications is greatly influential in individual appraisal of the costs and benefits of treatment use (i.e., attitudes towards treatment). For this reason, it is expected that medication tolerability and attitudes towards treatment are also highly related constructs (e.g., more tolerable medication may lead to greater perceived benefit; more negative attitudes towards treatment may lead to lower tolerability of medication side-effects). Based on this theoretical understanding of the relationship between these two constructs, it is likely that the relationship between medication

tolerability and treatment adherence is better explained by individual's attitudes towards treatment than the tolerability of the medication itself.

To address the gap between what is known and what is needed in relation to treatment adherence, the first purpose of this study was to examine the specific individual relationships of a variety of identified factors (i.e., risk factors, ADHD symptom severity, comorbidities, medication tolerability, and attitudes towards medication) to treatment adherence in college students with ADHD. Additionally, as previously explained, existing literature cites medication tolerability as an important factor in treatment adherence (Gau et al., 2008; Johnston, Hommersen, & Seipp, 2008; Wong et al., 2009). Unchangeable tolerability factors (e.g., medication type, side-effects), however, may have a strong influence on individuals' attitudes towards treatment, which in the emerging adult population in particular, has been hypothesized to have a strong influence on treatment adherence. Based on this theoretical relationship and because individual characteristics are largely unchangeable, while factors related to attitudes towards ADHD may be alterable through intervention efforts, the second purpose of this study was to examine if the relationship between the latent construct of medication tolerability is mediated by the latent construct of attitudes towards treatment when controlling for other individual characteristics (i.e., demographic risk factors [family history of ADHD, ethnicity, gender], ADHD symptom severity, and number of comorbid diagnoses). This study aimed to answer the following research questions;

1. What are the unique relationships of demographic risk factors, ADHD symptom severity, comorbidities, medication tolerability, and attitudes towards treatment with treatment adherence in college students with ADHD?
2. Does the latent construct of attitudes towards treatment mediate the relationship between

the latent construct of medication tolerability and treatment adherence when controlling for demographic risk factors, ADHD symptom severity, and comorbidities? More specifically, (A) is there a significant relationship between medication tolerability and treatment adherence? (B) Does attitudes towards treatment mediate that relationship? (i.e., [a] is there a significant relationship between medication tolerability and attitudes towards treatment?, [b] is there a significant relationship between attitudes towards medication and treatment adherence?, and [c] is the relationship between medication tolerability and treatment adherence significantly reduced or eliminated when controlling for attitudes towards treatment?)

It was hypothesized that all identified variables (i.e., demographic risk factors, ADHD symptom severity, comorbidities, medication tolerability, and attitude towards treatment) would be significantly related to treatment adherence. More specifically, given the evidence to support the importance of attitudes towards treatment for the adolescent and emerging adult populations, attitudes would have the strongest correlation with treatment adherence. Additionally, it was hypothesized that attitude towards treatment would mediate the relationship between medication tolerability and treatment adherence (For primary proposed model, see Figure 1).

In order to utilize a model that would provide the most accurate representation of the data and to prevent confirmation bias, an alternative model was also proposed (see Figure 2). In the secondary model, demographic risk factors were further separated into individual predictors (i.e., gender, ethnicity, and family history of ADHD) to assess if those risk factors are more accurately analyzed individually, rather than as a total score. Because there is no information from the literature on the extent to which each variable will be related to treatment adherence (e.g., whether gender is more influential than ethnicity), to find the best representation of the data,

demographic risk factors were analyzed both individually and together. All other aspects of the model are identical to the primary proposed model.

CHAPTER 2

Method

Participant Recruitment

Data for this study were taken from a larger, longitudinal study examining the long-term outcomes of college students with ADHD (Anastopoulos et al., 2016). The purpose of the original study was to collect data on educational outcomes; cognitive, social, and vocational functioning; and use of treatment services to better understand the long-term impact of ADHD on college students. At the time of the proposed study, the original study was ongoing.

Participants in the original study were college students recruited from 12 colleges and universities in North Carolina, Pennsylvania, and Rhode Island. Two cohorts of first-year college students were recruited over a span of two consecutive years. Two groups of students, individuals with ADHD ($n=204$) and comparisons without ADHD ($n=215$), were recruited for the original study. Students volunteered in response to various campus recruitment efforts (e.g., campus fairs, Facebook, office of disability referrals, fliers). In exchange for their participation, individuals received up to \$100 for each year of participation in the study as well as a report to provide them with information about their functioning. All students were screened prior to their inclusion in the study to determine their eligibility for participation. Approval for the study was obtained from the Institutional Review Boards (IRB) from each university, and all participants consented to participation in the study.

Screening Procedures and Group Designation

Group designation was based on multiple diagnostic measures. Participants completed two versions (childhood and past 6-months) of an ADHD Rating Scale and a semi-structured ADHD interview to determine their eligibility for the study. The ADHD Rating Scale was

developed for this study and was based on the *Diagnostic and Statistical Manual of Mental Disorders* 4th edition-text revision criteria for adult ADHD (*DSM-IV-TR*; American Psychiatric Association, 2000). Parents of participants also completed the ADHD Rating Scale-IV: Parent Version (DuPaul et al., 1998). Criteria for inclusion in the ADHD group required that either students or their parents indicated that students exhibited four or more symptoms of hyperactivity/impulsivity or inattention on the ADHD Rating Scales both in childhood (prior to the age of 12) and in the past six months. Additionally, on a semi-structured ADHD interview, individuals needed to indicate that five or more symptoms of hyperactivity/impulsivity or inattention were present prior to the age of 12 to be included in the ADHD group. The ADHD semi-structured interview was also developed for this study and was based on DSM-5 adult ADHD criteria (American Psychological Association, 2013). The interview addressed symptom presentation as well as impairment.

Finally, each participant was screened using the Structured Clinical Interview for DSM Disorders (SCID-I; First, Gibbon, Spitzer, & Williams, 2002) and evaluated by a panel of four licensed psychologists (the principal investigators of the original study and a clinical psychologist consultant) to ensure that hyperactive/impulsive and/or inattentive symptoms were due to ADHD rather than another disorder or condition. The panel of psychologists used a combination of information to determine comorbid diagnoses. Panel members independently reviewed specific diagnosis and interview information generated from the SCID-I (First et al., 2002) as well as scores from the Beck Anxiety Inventory (Beck & Steer, 1993), the Beck Depression Inventory-Second Edition (Beck, Steer, & Brown, 1996), and the Externalizing Behavior Rating Scale, and assigned diagnoses based on those data. The panel discussed any diagnostic disagreements until a consensus was achieved.

Individuals in the comparison group needed to report fewer than four symptoms of hyperactivity/impulsivity and inattention on the ADHD Rating Scales as well as fewer than four symptoms on the semi-structured ADHD interview. Those who did not meet all criteria for either the ADHD or comparison group were excluded from the study. For the proposed study, only individuals with a diagnosis of ADHD, with complete data, who reported past use of medication for behavior management purposes were included in the analysis.

Participant Description

For the purposes of the current study, year one data from students who met research criteria for ADHD and indicated that they had used ADHD-related medication at any point since the beginning of the Fall semester of their first year of college were examined (i.e., answered “yes” to “at any time during the fall semester, did you take medication for ADHD-related difficulties”; [$n=99$ out of 204 total participants with ADHD]). An additional five participants were excluded from analysis due to incomplete data (see Figure 1). Participants for the current study were college first-year students with ADHD who endorsed the use of ADHD medication within the past year ($N = 94$, 43 = men, 51 = women) ranging from the ages of 18-22 ($M = 18.22$; $SD = 0.55$). The sample was 81.9% Caucasian/non-Hispanic and 18.1% non-Caucasian or Hispanic. Year 1 data from cohorts 1 and 2 were collected for this study over two consecutive years (51 = cohort one, 43 = cohort two). An independent samples t -test between groups on age and a series of chi-square analyses on relevant variables (i.e., gender, race, ethnicity) confirmed that there were no statistically significant differences in the demographic characteristics of the two cohorts. Additionally, a series of comparative tests on individual characteristics (i.e., independent samples t -tests on a number of comorbidities, ADHD severity, and total risk factors; chi-squared analyses on gender, ethnicity, and family history of ADHD) revealed that aside from

number of comorbid diagnoses, there were no significant differences between the demographic factors of individuals with ADHD who were or were not included in the present analysis.

Individuals with ADHD who were excluded from the analysis, had higher numbers of comorbid diagnoses ($M=.94$, $SD=.98$) than those who were included in the analysis ($M=.66$, $SD=.71$); $t(227)=2.39$, $p=.018$.

Although it is typically recommended that a minimum of 200 participants are included for analysis in a structural equation model, Schumacker and Lomax (2010) indicate that, in certain cases, it is possible to conduct a structural equation model with 100 participants (i.e., simple model with a plan for replication). Based on this recommendation, although the sample for this analysis was smaller than the recommended sample size and did not meet all of the recommended criteria, because college students with ADHD who are taking medication are a difficult sample to access, it was decided that the sample size for the present study was acceptable to perform the analysis.

Materials

Screening measures.

ADHD Rating Scale, Self-Report Version.

Childhood Version. The ADHD Rating Scale-Childhood Version was created for use in the larger TRAC study. The 18 items on the rating scale are based on the DSM-IV-TR criteria for ADHD and tap symptoms of inattention and hyperactivity-impulsivity (American Psychiatric Association, 2000). Participants were instructed to rate their behavior as a child prior to 12 years of age on a 4-point Likert scale (0 = *never or rarely*, 3 = *very often*) with higher scores indicative of more severe ADHD symptomatology. Total inattention and hyperactivity-impulsivity subscores are calculated by summing the number of items ($n=9$) with scores of 2 or higher.

Before completing the measure, participants were asked if they were receiving medication for behavior management purposes before they were 12-years-old. If they answered yes, they completed the questions thinking about their behavior when they were not taking this medication (i.e., never on medication). If they answered no, they completed the questions thinking about their typical behavior (i.e., behavior when not taking medication). To qualify for the ADHD group based on research criteria, participants needed to rate themselves with a score of two or higher on four or more symptoms of either hyperactivity/impulsivity or inattention.

Past 6 Months Version. The ADHD Rating Scale-Past 6 Months is identical to the ADHD Rating Scale-Childhood Version except participants completed it based on their behavior in the past 6 months rather than before the age of 12. Before completing the measure, participants were asked if they had been receiving medication for behavior management purposes during the past 6 months. If participants indicated that they had not been receiving medication, they responded to scale items accordingly. If participants indicated that they had been receiving medication, they responded to each item in two ways: when they were taking medication and when they were not taking medication during this time period.

In the full sample ($N=443$), both the Childhood and Past 6 Months versions of the ADHD Rating Scale demonstrated adequate levels of internal consistency ($\alpha=.74-.94$; Anastopoulos et al., 2016). Additionally, these measures demonstrated adequate levels of concurrent validity with statistically significant correlations between corresponding subscales on the Conners' Adult ADHD Rating Scale- Self Report: Long Version (CAARS; Conners, Erhardt, & Sparrow, 1999) ranging from .27 to .92 (Anastopoulos et al., 2016).

ADHD Rating Scale-IV: Parent Version. The ADHD Rating Scale-IV: Parent Version is an existing measure that was sent to parents so that diagnostic information about participants

could be collected from multiple sources (DuPaul et al., 1998). The scale has the same items as the ADHD Rating Scale-Childhood Version and the Past 6 Months Version; however, the wording on each item reflects that the questions are asking about the individual's child, rather than the individual completing the questionnaire. Parents were instructed to respond to each item thinking about their child's behavior when children were not taking medication. Parents gave two behavior ratings for each item. The first rating addressed their child's behavior from the ages of 5-12 and the second rating addressed their child's behavior in the past 6-months. The ADHD Rating Scale-IV: Parent Version has adequate internal consistency ($\alpha = .92$) and discriminant validity (DuPaul, Power, Anastopoulos, & Reid, 1998).

Semi-Structured ADHD Interview. The Semi-Structured ADHD Interview was created for the larger TRAC study to address symptom presentation and impairment. The interview is based on DSM-5 adult ADHD criteria and includes nine questions about symptoms of inattention and nine questions about symptoms of hyperactivity/impulsivity (American Psychological Association, 2013). Additionally, if participants endorsed the presence an ADHD symptom either taking or not taking medication, they were asked if the presentation of the symptom had caused problems for them in a variety of settings. If participants indicated four or more symptoms, they were also asked about age of symptom onset and concerns about symptoms.

In the full sample ($N=456$), the internal consistency for symptom responses on the semi-structured interview was 0.90 for attention and 0.85 for hyperactivity-impulsivity. Correlations between responses on the interview and CAARS scores were 0.78 for inattention and 0.84 for hyperactivity-impulsivity (Anastopoulos et al., 2016).

Individual characteristics.

Demographics. Participants completed a demographic questionnaire to indicate their

age, gender, ethnicity, race, and marital status.

Family history of ADHD. During an orally administered background interview, participants were asked to report if anyone in their family (i.e., yourself, siblings, mother, father, extended relatives) had a history of ADHD. Participants also indicated if the history of ADHD was suspected or diagnosed. For the purposes of this study, individuals were considered to have a family history of ADHD if they reported that any member of their family (i.e., immediate or extended) had diagnosed (i.e., not suspected) ADHD.

The variable representing demographic risk factors was calculated by summing the total number of risk factors each participant endorsed ranging from 0-3 (i.e., male, non-White, family history of ADHD) with higher values indicating greater risk.

ADHD Symptoms. ADHD symptoms were calculated as the total number of symptoms of hyperactivity-impulsivity and inattention, when not taking medication that participants reported on the ADHD Rating Scale-Past 6 Months version (measure described previously).

Comorbid Symptomatology. Decisions on comorbid diagnoses were determined through the expert panel review (described previously) based on information collected through the *Structured Clinical Interview for DSM Disorders (SCID-I*; First et al., 2002), *Beck Anxiety Inventory (BAI*; Beck & Steer, 1993), *Beck Depression Inventory-Second Edition (BDI-II*; Beck, Steer, & Brown, 1996), and *Externalizing Behavior Rating Scale*.

Structured Clinical Interview for DSM Disorders (SCID-I). The *SCID-I* is a computer-based semi-structured interview based on the DSM-IV-TR criteria (American Psychiatric Association, 2000) that is used to assess clinically significant presentations of psychiatric disorders (First et al., 2002). For the purposes of this study, only the modules for mood episodes, mood disorders, and anxiety disorders were used. Trained graduate assistants in Ph.D. or

Masters level clinical and school psychology programs conducted the *SCID-I* interviews. During the interview, individuals were asked specifically about symptoms of mood and anxiety disorders, but were given the opportunity to respond and elaborate in an unstructured format. Interviewers either endorsed or did not endorse the structured question presented on the *SCID-I*. The *SCID-I* has adequate inter-rater reliability with kappa levels between .70 and 1.00 (First et al., 2002).

Beck Anxiety Inventory (BAI). The BAI is a self-report measure of anxiety symptom severity in adults (Beck & Steer, 1993). The scale includes 21 items that measure symptom severity over the past week. Each item is rated on a 4-point Likert scale (0 = *not at all*, 3 = *severely*) with higher scores indicating greater severity of anxiety symptoms. Total scores are calculated by creating a sum of all of the items; individuals who score higher on the BAI are more likely to be experiencing more severe symptoms of an anxiety disorder. The BAI has adequate levels of internal consistency ($\alpha = .92$) and concurrent validity (Beck, Epstein, Brown, & Steer, 1988).

Beck Depression Inventory- Second Edition (BDI-II). The BDI-II measures depression symptom severity among adults, where adults self-report symptom severity over the past 2 weeks (Beck, Steer, & Brown, 1996). The scale includes 21 items, and each item provides response options rated on a 4-point scale (0 = *not at all*, 3 = *severely*). Higher ratings on each question indicate greater severity of depression symptoms. The BDI has been shown to include high levels of reliability and validity in adults as well as in college students (Sprinkle et al., 2002).

Externalizing Behavior Rating Scale. The Externalizing Behavior Rating Scale is a self-report measure of externalizing behavior in adults that was created for use in this study. Participants were instructed to complete items to best describe their behavior over the past 6

months. The 20-item scale rated on a 4-point scale (0 = *not at all*, 3 = *very much*) includes 8 items based on the DSM-IV-TR criteria for Oppositional Defiant Disorder (e.g., “losing your temper,” “arguing with others”) and 12 items based on criteria for Conduct Disorder (e.g., “starting physical fights,” “deliberate fire setting”; American Psychiatric Association, 2000). Total scores measure symptom count (sum of items with scores of 2 or above) and severity (sum of items) of Oppositional Defiant Disorder and Conduct Disorder, with higher scores indicating higher symptom severity. The Externalizing Behavior Rating Scale has demonstrated adequate internal consistency for all items ($\alpha=.85$) as well as for oppositional defiant disorder ($\alpha=.85$) and conduct disorder ($\alpha=.66$) subscales (Anastopoulos et al., 2016). Significant correlations between the subscales and the CAARS ADHD Index also support the validity of this measure.

Medication tolerability. An oral interview about services for college students (i.e., help or assistance students received) included questions about participant’s medication usage. Participants indicated whether or not they had received medication for ADHD-related difficulties at any point since the start of the Fall semester. Medications were coded as methylphenidate, amphetamine, non-stimulant ADHD, or other. Participants endorsed or denied the presence of medication side-effects (i.e., loss of appetite, sleep disruption, irritability, other). Affirmed side-effects were summed to create a total side-effect score (0 to 4), with higher scores indicating greater numbers of side-effects. Items on this measure also addressed the length of time that participants had been taking their medication (less than 1 month, 1-2 months, 3+ months), the prescribed frequency of administration (times per day [1 = once, 2 = twice, 3 = three or more times]; days per week [1 = daily, 2 = weekdays only, 3 = as needed]) of their medication, with higher scores indicating greater medication usage. Participants could report up to three different medications utilized for ADHD-related difficulties since the start of the Fall semester. Data for

this study were based on scores for medication with the highest reported usage. The composite latent construct, medication tolerability, included the observed variables: total side-effects, time on medication, and frequency of medication usage.

Attitude towards medication. The composite latent construct attitude towards medication was comprised of scores from measures addressing knowledge about ADHD, perceived impairment from ADHD, and satisfaction with treatment (described below).

Test of ADHD Knowledge (TOAK). The TOAK was created for use in this study to measure knowledge about ADHD. Each of the 39 items on the scale included a statement about ADHD that was either true or false (e.g., “most adults with ADHD who take stimulant medication benefit from its use,” “taking stimulant medication for ADHD increases the risk that a person will use illegal drugs”). Participants were asked to indicate whether they “agreed,” “disagreed,” or were “not sure” about the statement. The total score was calculated by summing the total number of correct item responses to medication-related questions with higher scores indicating higher levels of correct knowledge. The TOAK demonstrated adequate levels of internal consistency in the current sample ($n=94$; $\alpha=.77$).

Perceived Impairment from ADHD.

The ADHD Impact Module for Adults (AIM-A; Landgraf, 2007). The AIM-A is a self-report measure designed to evaluate six domains related to the quality of life for adults with ADHD. Aside from the “Living with ADHD” subscale ($\alpha = .68$), all domains on the AIM-A demonstrated adequate levels of internal consistency ($\alpha = 0.83$ to 0.91). The entire measure has also demonstrated adequate discriminant validity. For the purposes of this study, Item 9B was utilized to collect information on the impact of ADHD symptoms on daily life. Participants rated how frequently nine common symptoms of ADHD (e.g., “being distracted and jumping

from one activity to another,” “forgetfulness/losing things”) interfered with their daily life on a 5-point Likert scale (1 = *not at all*, 5 = *a lot*), with higher scores indicating greater interference.

ADHD Cognitions Test (ACT). The ACT is a 12-item self-report scale designed to measure maladaptive thoughts associated with ADHD (Anastopoulos et al., manuscript in progress- ADHD Cognitions Scale for Adults). Participants rate how often they experience various thoughts (e.g., “I’ll just do this one thing first,” “I do better waiting until the last minute”) on a 5-point Likert scale (1 = *not at all*, 5 = *all the time*), with higher total scores indicating higher rates of maladaptive thoughts associated with ADHD. The ACT demonstrated adequate levels of internal consistency for the current sample ($n=94$, $\alpha=.77$).

Satisfaction with medication. Participants who indicated that they had received medication for ADHD-related difficulties at any point since the start of the Fall semester, were asked to indicate “in [their] opinion, how helpful was taking [name of medication]?” Responses were coded on a three-point scale (1 = *not very helpful*, 2 = *moderately helpful*, 3 = *very helpful*).

Treatment Adherence. Participants reported how closely they followed their medication regimen. Answers were provided on a 3-point scale (1 = *not well*, 2 = *moderately well*, 3 = *very well*) with higher numbers indicating higher levels of treatment adherence.

No standard method for measuring treatment adherence has been identified in the previous literature, contributing to the lack of understanding and methodological limitations of this phenomenon (e.g., differences in time scales, changing treatments, multiple respondents; Emilsson et al., 2017; Osterberg & Blaschke, 2005; Quittner, Modi, Lemanek, Ievers-Landis, & Rapoff, 2008). Consistent with measurement issues noted in prior studies, the limited precision of the identified measure of treatment adherence for the current study may provide a restricted understanding of this construct. However, for the purposes of the present analysis, treatment

adherence was operationalized as the self-reported answer to the treatment adherence question described previously. Results should therefore be interpreted according to this conceptualization of treatment adherence, which may be less comprehensive or discrepant from definitions used in other studies.

Procedure

As part of the original study, each participant first underwent a screening process to determine group designation and eligibility for the study. Once eligible for the study and after providing informed written consent, participants completed a variety of measures in a standardized order over a series of two or three meetings conducted by graduate students trained on all assessment procedures. Data on medication tolerability, treatment satisfaction, and treatment adherence was collected in the final meeting (held between September-June) with all participants; all other data were collected in separate meetings that occurred earlier in the academic year. Information on participants was derived through a combination of self-report ratings and interviews. Individuals in the study were followed for four years. Participants were provided with monetary incentives at the completion of each meeting and a report of their overall functioning for each year they participated in the study. Only data from Year 1 will be used in the proposed study.

Statistical Analysis

Year 1 data from cohorts 1 and 2 were used to conduct analyses for the present study. To better understand the relationships between latent (i.e., medication tolerability, attitudes toward treatment) and observed (i.e., demographic characteristics) variables and treatment adherence, two proposed models based on factors related to treatment adherence that were identified in the literature were created and tested using structural equation modeling.

The primary proposed model examines whether attitude towards medication mediates the relationship between medication tolerability and treatment adherence when controlling for demographic risk factors, ADHD symptom severity, and number of comorbidities (see Figure 2). To account for potential non-equivalent contributions of each specific demographic risk factor (i.e., gender, ethnicity, family history of ADHD), the second, alternative model was identical to the primary model; however, the composite observed variable of demographic risk factors was separated to individually control for gender, ethnicity, and family history of ADHD as separate observed variables (see Figure 3). The model with the best fit was used to evaluate relationships between variables.

Parameters of each model were estimated using the maximum likelihood procedure implemented in the Amos software (version 25). In addition to the chi-square test (χ^2), the fit indices used to evaluate the models were the Root Mean Square Error of Approximation (*RMSEA*), Comparative Fit Index (*CFI*), and Tucker Lewis Index (*TLI*). A value of .05 or less was used to indicate good fit for the *RMSEA*; values of .95 or greater indicated good fit on the *CFI*, and *TLI* (Schumacker & Lomax, 2009).

In order to understand whether attitudes towards medication mediates the relationship between medication tolerability and treatment adherence, the direct, total, and indirect effects between variables were examined. According to Brown's (1997) model, a mediational relationship was indicated if the following conditions were met; (a) there is a significant relationship between medication tolerability and treatment adherence, (b) the path between medication tolerability and attitudes towards medication is significant, (c) the path between attitudes towards medication and medication tolerability is significant, and (d) the relationship between medication tolerability and treatment adherence is reduced or eliminated (i.e., smaller

than or non-significant compared to the total-effect) when controlling for attitudes toward medication. Initially, the full model was estimated to yield indirect and total effects. Bootstrapping was then attempted to generate the standard errors and significance tests for the indirect effects. Finally, because the proposed models did not adequately fit the data, three separate multiple regression analyses were conducted to examine relationships between factors related to medication tolerability and each component of attitudes towards medication.

CHAPTER 3

Results

Prior to analyzing the specified models, the univariate normality of each observed variable was checked. The skewness of all variables fell within the recommended range of -3 to +3 (Weston & Gore, 2006; see Table 1). Although the kurtosis value of one variable (i.e., medication frequency) fell slightly outside of the recommended range of -10 to +10, given the acceptable skewness of all items, to improve the interpretability of the results, none of the variables were transformed. Additionally, means and standard deviations of each variable were examined for the sample (see Table 1). Overall, this sample of college students with ADHD was relatively adherent to their medication; an overwhelming majority (88.3%) of individuals reported that they followed their medication regimen either moderately well (37.2%) or very well (51.1%).

The fit of the primary model ($\chi^2[36, N=94]=57.010, p=.014, RMSEA=.079, CFI=.725, TLI=.580$) was not acceptable according to the criteria established *a priori* (see Table 2 for individual factor loadings). The alternative model did not converge, thus parameter estimates could not be obtained. Modifications were made to the models to improve model fit (Schumacker & Lomax, 2010).

Both the TOAK (knowledge) and the AIM-A (impairment) include multiple items about real or commonly misconceived symptoms or impacts resultant from ADHD. For example, the TOAK includes items such as “many college students with ADHD display poor organizational skills and time management difficulties” and “college students with ADHD often have difficulty planning ahead and remembering things.” The AIM-A includes items such as “forgetfulness and losing things” and “being distracted and jumping from one activity to another.” To answer

questions on both of these scales, individuals would be required to attribute these symptoms or impacts to a diagnosis of ADHD. Therefore, it is likely that those with incorrect knowledge about symptoms related to ADHD may also not have attributed the symptoms addressed on the impairment measure to their ADHD. Because an individual's body of knowledge about the disorder very likely systematically influenced the way in which they responded to both of these measures, the error terms for both of these measures were correlated in the modified model. No further modifications were theoretically justified or significantly improved model fit.

Although this modified primary model (see Figure 4) represented an improvement in fit over the proposed primary model ($p=0.009$), the modified model still did not show an acceptable level of fit to the data according to criteria established *a priori* ($\chi^2[35, N=94]=50.227$, $p=.046$, $RMSEA=.068$, $CFI=.801$, $TLI=.687$). No further modifications were theoretically justifiable or improved model fit. Despite this lack of fit to established *a priori* criteria, given the small sample size, the model represented acceptable global fit according to less stringent standards for *RMSEA* values (Browne & Cudek, 1993). The same modification was made to the alternative model (see Figure 5). With the modification, the model converged and the fit of the alternative model was significantly improved ($p=.011$). The modified alternative model also did not show an acceptable level of fit according to criteria established *a priori* ($\chi^2[47, N=94]=71.057$, $p=.013$, $RMSEA=.074$, $CFI=.748$, $TLI=.581$). In models with sample sizes less than 100, *RMSEA* tends to worsen as the number of variables increase (Kenny & McCoach, 2003). Although the modified primary model and the modified alternative model showed similar levels of overall fit, due to the smaller number of variables included in the model, the modified primary model was selected for further analysis.

When examining the fit of the model according to individual parameters, only the

indicators of side effects ($p=.037$) and thoughts about ADHD ($p=.036$) had statistically significant loadings on the latent factor to which they were assigned (see Table 3). Values for the indicators of medication frequency ($p=.062$) and time on medication ($p=.064$) approached statistical significance, but along with of the other factor loadings in this model, did not reach statistical significance. Based on an assessment of both global and parameter fit, despite modifications to the primary model, the fit of the model was considered unacceptable.

Although the model did not demonstrate adequate fit, to evaluate the study hypotheses, additional examinations were conducted on the model. To evaluate the first hypothesis that examined the unique relationships of demographic risk factors, ADHD symptom severity, comorbidities, medication tolerability, and attitudes towards treatment with treatment adherence in college students with ADHD, regression weights of each variable were examined. Contrary to findings in the childhood ADHD literature (Corkum et al., 2013), none of the variables were significantly predictive of treatment adherence in college students with ADHD.

To examine the second hypothesis evaluating whether the latent construct of attitudes towards treatment mediates the relationship between the latent construct medication tolerability and treatment adherence when controlling for demographic risk factors, ADHD symptom severity, and comorbidities various relationships between the latent variables and treatment adherence were examined. Contrary to the second hypothesis, however, none of the paths that would indicate a mediated relationship between variables were statistically significant; medication tolerability did not significantly predict treatment adherence ($\beta=-.628$, $SE=1.436$, $p=.662$), medication tolerability did not significantly predict attitudes towards medication ($\beta=1.433$, $SE=.897$, $p=.110$), and attitudes towards medication did not significantly predict treatment adherence ($\beta=.063$, $SE=.290$, $p=.827$). Bootstrapping analyses were not possible for

the current sample, likely due to the small sample size and insufficient model fit.

Due to the insufficient model fit, and given the theoretical nature of this model and the paucity of research on the predictors of treatment adherence in the college age population of students with ADHD, additional regression analyses were conducted to further examine the relationship between observed variables. Specifically, a simultaneous regression was conducted to determine the specific and combined relationships between each measured variable and treatment adherence. None of the variables significantly predicted treatment adherence either individually or in combination ($F[10,83]=.632, p=.782$; see Table 4 for *beta* weights).

Next, to further examine relationships between medication tolerability and attitudes towards medication, additional regression analyses were conducted. When controlling for demographic risk factors, ADHD symptoms, and comorbidities, together medication side-effects, time on medication, and medication frequency accounted for 25.4% of the variance in perceived impairment from ADHD ($F[6,87]=4.93, p<.001$), 17.2% of the variance in satisfaction with treatment ($F[6,87]=3.01, p=.01$), and 24.7% of the variance in thoughts about ADHD ($F[6,87]=4.76, p<.001$). These same variables did not significantly predict knowledge about ADHD ($F[6,87]=1.95, p=.082$). Higher levels of ADHD symptoms ($p<.001$), less time on medication ($p=.01$), and greater medication frequency ($p=.026$) were significant predictors of higher levels of maladaptive thoughts about ADHD (see Table 5 for *beta* weights). Greater time on medication significantly predicted greater satisfaction with medication ($p<.001$; Table 5). Lower levels of ADHD symptoms ($p<.001$) and fewer comorbidities ($p=.05$) significantly predicted higher perceived impairment from ADHD (see Table 5).

CHAPTER 4

Discussion

This study aimed to examine factors related to the treatment adherence of college students with ADHD to their prescribed pharmacological treatment. Specifically, the present analysis focused on the exploration of the specific individual relationships of a variety of identified factors (i.e., risk factors, ADHD symptom severity, comorbidities, medication tolerability, and attitudes towards medication) to treatment adherence in college students with ADHD. Further, this study aimed to examine whether the relationship between the latent construct of medication tolerability and adherence was mediated by the latent construct of attitudes towards treatment when controlling for other individual characteristics.

A proposed primary model and an alternative model were tested to determine which model was best supported in the current sample. The results of structural equation modeling maximum likelihood estimation indicated that neither model met the specified criteria to indicate that it was adequately supported by the data. Because the primary model exhibited better fit than the alternative model, the primary model was modified and utilized for further analysis. Even after theoretically justifiable modifications were made to the model; however, the model still did not exhibit an acceptable level of fit according to *a priori* criteria. Additionally, aside from side-effects and thoughts about ADHD, none of the indicators had statistically significant loadings on the latent factor to which they were assigned, indicating that the observed variables (i.e., time on medication, frequency of medication usage) did not accurately represent the latent variable of medication tolerability and that the observed variables (i.e., knowledge about ADHD, perceived impairment from ADHD, satisfaction with treatment) did not adequately represent the latent variable of attitude toward treatment. Because of the insufficient model fit, the specific

hypothesized relationships could not be thoroughly explored.

There are multiple explanations for the insufficient model fit in this sample. The psychometric properties of the observed variables selected for use in this study have not been examined with respect to their ability to adequately measure the constructs of interest identified in this study (i.e., factors related to treatment adherence). For this reason, despite the psychometric adequacy of the measure for other purposes, the utilization of these instruments in the current study may have led to insufficient measurement of the identified constructs. Certain measures (e.g., TOAK, ACT) were created for use in this study, and demonstrated sufficient, but moderate reliability in the current sample. Additionally, many of the observed variables were measured through a single item (e.g., time on medication, and frequency of medication usage) or a portion of a full measure (e.g., perceived impairment items). These alterations to the intended and validated use of these measurement tools may have limited the reliability and validity of the measurement of the variables of interest. Based on the trend towards statistical significance of all variables assigned to the latent factor medication tolerability, it is likely that more extensive measurements were necessary to adequately capture this latent construct.

It is also possible that the groupings of observed variables were not conceptually similar enough to accurately create the defined latent variables. Although, based on the literature, the grouped observed variables appear to measure similar constructs, it is possible that variables such as knowledge about ADHD and perceived impairment from ADHD, for example, may measure dissimilar constructs that would be more appropriately captured through a different conceptualization of latent variables.

It is also critical to consider the influence of the study's small sample size on the overall model fit. Although Schumacker and Lomax (2010) indicate the possibility of conducting a

structural equation model with 100 participants, typical recommendations require the inclusion of a minimum of 200 participants for this type of analysis. Because college students with ADHD who are taking medication are a difficult population to access, it was decided that the sample size for the present study was acceptable to perform the analysis; however, guidelines for model fit in samples with fewer than 100 participants are extremely limited and may not conform to the typical expectations for model fit with larger samples (MacCallum & Austin, 2000). Given the sensitivity of measures of fit to sample size, smaller sample sizes can impair the ability to accurately generate and interpret results of structural equation modeling procedures. For these reasons, additional analyses with larger samples are necessary to more sufficiently determine the representativeness of these findings for the larger population of college students with ADHD.

The global fit of the modified proposed model may be considered acceptable according to less stringent criteria than had been determined *a priori*. For example, Browne and Cudeck (1993) cite *RMSEA* values between 0.06 and 0.08 as acceptable. Given the small sample size, together with the non-significant χ^2 value, it may be plausible to designate the global fit of the model as an adequate representation of the current sample. Although there is limited guidance available on the appropriateness of the use of various fit indices for non-continuous data, Garrido, Abad, and Ponsoda (2016) suggest that *RMSEA*, *CFI*, and *TLI* perform similarly for use with unskewed categorical variables. In comparison with the other fit indices, however, *RMSEA* can provide more accurate and descriptive information in small sample sizes (Smith & McMillan, 2001). Therefore, based on the small sample size and use of categorical variables in the analysis, judgment of fit was weighted more strongly on *RMSEA* than the other fit indices. Despite this allowance, however, the results generated from the model did not support the hypotheses. Specifically, no statistically significant relationships between identified factors (i.e.,

risk factors, ADHD symptom severity, comorbidities, medication tolerability, and attitudes towards medication) and treatment adherence in college students with ADHD were identified. Additionally, there were no statistically significant relationships between medication tolerability and treatment adherence, medication tolerability and attitudes towards treatment, or attitudes towards treatment and treatment adherence. These non-significant relationships contradict the hypothesis that attitudes towards treatment mediated the relationship between medication tolerability and treatment adherence. Further, regardless of the acceptability of model fit, additional findings from a multiple regression analysis corroborate the non-significant findings of the relationships between individual identified factors and treatment adherence. None of the observed variables predicted treatment adherence, either in isolation or in combination.

Because of the small sample size and lack of model fit, additional regression analyses were conducted to more thoroughly examine relationships between factors related to medication tolerability and attitudes towards treatment. When controlling for individual characteristics, factors related to medication tolerability were significantly predictive of various components of attitudes towards treatment (i.e., perceived impairment from ADHD, treatment satisfaction, thoughts about ADHD). These results suggest that the measures used within the present study for measuring attitudes towards treatment may not have been sufficiently detailed or psychometrically strong enough to demonstrate adequate measurement of the latent variable in the current sample. Based on the results of these specific predictive relationships, it is likely that utilizing measures that more accurately, consistently, and reliably measure this construct may provide a stronger conceptualization of attitudes towards treatment. For example, instruments that measure multiple aspects of the perceived risks and benefits of ADHD medication use in greater detail would likely provide a more valid operationalization of this construct. Further,

particularly because the TOAK only included 3 items that were specifically focused on medication, an alternative measure of ADHD knowledge with a greater focus on potential risks and benefits of psychopharmacological treatment may be more appropriate for indicating attitudes towards treatment.

These specific relationships between factors related to medication tolerability and individual aspects of attitudes towards treatment (i.e., perceived impairment from ADHD, treatment satisfaction, thoughts about ADHD), however, are supported by previous research that indicates the influence of medication tolerability on the perceived risks and benefits of treatment use, an important component of attitudes towards treatment (Horne & Weinman, 1999). Higher levels of ADHD symptoms, less time on medication, and greater medication frequency were significant predictors of higher levels of maladaptive thoughts about ADHD. These relationships are consistent with past literature that has identified higher symptom severity (Ahmed & Aslani, 2013; Atzori et al., 2009) and difficulty of taking medication (Christensen et al., 2010) as related to adherence. Presumably, individuals with greater symptom severity who also have more challenging and novel medication regimens may experience more negative thoughts about their condition and condition management. Additionally, individuals who perceive treatment benefits and believe in the effectiveness of their treatment are likely to maintain their treatment over time (Charach & Fernandez, 2013; Wong et al., 2009). Therefore, it is also not surprising that greater time on medication predicted greater satisfaction with treatment. Although not explicitly examined, for similar reasons, the significant correlation between these two variables likely supports a bidirectional relationship.

Unexpectedly, lower levels of symptom severity and fewer comorbidities significantly predicted higher levels of perceived impairment from ADHD. It is possible that those with less

severe symptoms have less intense treatment regimens than those with greater overall symptom severity. As a result, despite their less severe symptomatology, these individuals may not be as well managed on treatment; and therefore, perceive greater impairment from their symptoms. For comorbid diagnoses in particular, there are mixed findings on how these symptoms impact the attitudes and treatment adherence of individuals with ADHD (Atzori et al., 2009; Charach et al., 2004; Corkum et al., 2015; Palli et al., 2012; Thiruchevlam et al., 2001). These relationships warrant further exploration in future research to more clearly understand the impacts of symptom severity and comorbidities on attitudes towards treatment.

Another surprising finding was the lack of statistically significant relationships between factors related to medication tolerability and knowledge about ADHD. Theoretically, those with greater knowledge about the uses and benefits of psychopharmacological interventions would perceive their own medication as more beneficial (Charach & Fernandez, 2013). However, to date, there is no research that indicates the specific body of knowledge necessary to improve attitudes related to medication use. Particularly because only 2 out of 39 questions on the knowledge measure used in this study focused on the potential benefits of medication use for ADHD, it is possible that the knowledge assessed in this study did not include information necessary for promoting more positive attitudes towards treatment.

Because of the deficit of prior research on treatment adherence in the college population, the analyses in the present study were largely exploratory in nature. Overall, the individuals in this study had relatively high rates of treatment adherence to their ADHD medication, limiting the variability of adherence rates reported in the study and, therefore, possibly obscuring the predicted relationships within the sample. However, because college students represent such a unique facet of the population of individuals with ADHD, the treatment adherence patterns of

college students may be different than those of the rest of the population. Therefore, factors identified for the childhood population may not influence treatment adherence in this population or for adults in general. Due to the significant, well documented, decline in adherence rates during emerging adulthood, it is possible that those who are taking ADHD medication during their first year of college are either not strongly experiencing factors that negatively impact treatment adherence or have experienced higher rates of benefits than risks from taking their ADHD medication, a critical factor in treatment adherence (Adler et al., 2010; Corkum et al., 1999; Faraone et al., 2007; Gau et al., 2008; Marcus et al., 2005; Thiruchelvam et al., 2001). These non-significant relationships in combination with moderate to high rates of treatment adherence in this sample, lend support for the existence of differences between the general population of individuals with ADHD and college students with ADHD in terms of medication tolerability and attitudes towards treatment. These differences, if identified, may provide important strategies that can inform interventions to support treatment adherence in the general population of individuals with ADHD.

The transition to the college environment includes unique challenges that can impact treatment adherence. In addition to the increased emphasis on self-regulation (Fleming & McMahon, 2012), the class schedules of college students are typically different from the traditional high school schedule. The irregularity of class days and times throughout the week might necessitate alterations in medical regimens. For example, a student with a full day of classes on Monday, might only have a single class on Tuesday afternoon. Day-to-day variability in medication regimens may be necessary to promote optimal functioning within the context of these irregular schedules (e.g., short vs. long acting medications; administration at different points during the day). These potential inconsistencies with and alterations to medication

routines may make treatment adherence more difficult for college students. Additionally, measurement of treatment adherence under these conditions may be confounded, which may have impacted the results of this study. Measurement of treatment adherence in the college environment presents particular challenges that may necessitate specific methodological considerations in future studies (e.g., assessment of variable medication routines).

Although it appears that for this population, medication tolerability and individual characteristics are, at least in part, related to various components of attitudes towards medication, the links between attitudes towards treatment and treatment adherence are less clear. Particularly given the results of follow-up regression analyses, it is possible that the latent variables conceptualized in this model and measure of treatment adherence utilized in this study were insufficient for use in accurately exploring these relationships. The lack of information on factors related to treatment adherence in adults makes it difficult to contextualize and understand the accuracy or generalizability of these results to other portions of this population (e.g., there is no current information on whether or not these identified factors influence the general adult population with ADHD). Further, there is no clear estimate of treatment adherence rates across different facets of the adult population. The limited information available suggests that factors influencing treatment adherence, medication tolerability, and attitudes towards treatment in college students are likely different from those of the rest of the population of individuals with ADHD (e.g., children, other adults). To thoroughly understand differences between the college population and other subsets of the population with ADHD, more research with greater methodological control is necessary.

Limitations

Findings from the current study should be interpreted in light of its limitations. One of

the main methodological difficulties cited in the adherence literature in general is the lack of standardization in the definitions and measurements of treatment adherence (Emilsson et al., 2017; Osterberg & Blaschke, 2005). In the present study, treatment adherence was operationalized according to a response to a single item (i.e., “how closely did you follow [your] medication regimen”). As mentioned previously, treatment adherence is generally conceptualized as the extent to which a person’s behavior follows the agreed upon recommendations from the health care provider (e.g., dose, frequency, duration; Sabate, 2003; Treuer et al., 2016). The measurement utilized in the present analysis may have provided an oversimplified definition of treatment adherence that is inconsistent with alternative definitions. Additionally, the 3-point scale limited the variability of responses, providing a restricted range for the measurement of treatment adherence. The use of a single categorical outcome variable, versus the use of more items with continuous data, may have also limited the value of SEM for use in this study (Garrido et al., 2016). A more extensive measure of treatment adherence may have allowed for a more accurate and thorough representation of the construct.

Treatment adherence is a complicated construct that should be viewed on a spectrum rather than categorically (i.e., non adherent vs. adherent). For example, individuals who use their medication as prescribed 50% of the time may have different characteristics than individuals who use their medication as prescribed 75% of the time, or than individuals who incorrectly use their medication 100% of the time (e.g., incorrect dosage or administration). A measure with multiple subscales that provides a more descriptive range of components of treatment adherence (e.g., understanding of treatment, perceived frequency of use, intensity of treatment) could be useful in detecting these idiosyncratic differences. More descriptive measurements would be useful in providing more accurate information that would promote a better understanding about

the various components of treatment adherence that could be differentially impacted based on attitudes towards treatment, medication tolerability, and individual characteristics. This information would also be helpful in understanding current rates of treatment adherence and creating a definition of treatment adherence that is most useful and informative both in research and clinical practice.

To qualify for inclusion in the present study, participants needed to have indicated that they had *used* medication for ADHD-related difficulties at any point since the beginning of the Fall semester. As a result, the sample did not capture data on individuals who had been prescribed medication that either terminated or did not utilize their prescribed treatments at all. For this reason, at baseline, participants in this sample may have displayed higher rates of adherence than the rest of the population. Because the individuals in this sample had continued, to some degree, to utilize their pharmacological treatments in college, their attitudes towards treatment and other factors related to treatment adherence may have differed (i.e., more positive) from those of the individuals who did not utilize their treatment who were not included in this analysis. Obtaining a sample without this inherent bias would provide a fuller picture of treatment adherence patterns and factors related to treatment adherence in this population.

The small sample size and insufficiency of the model fit according to *a priori* specifications also limited the ability to analyze the study hypotheses. Additionally, the psychometric properties of many of the measurement tools interfered with the interpretation and accuracy of the results. Despite these limitations, however, the proposed model may still be considered acceptable according to less stringent criteria that may be more appropriate with a smaller sample size. Similar methodology should be replicated in a larger sample to lead to more firm conclusions about treatment adherence in this population.

Access to and the quality of services may have been impacted by the socioeconomic status (SES) of participants. The SES of individuals in the current sample was not reported or controlled for in the analysis, possibly further limiting the generalizability of results. Additionally, because this study was non-interventional, there was no control over variations in treatment type and intensity across participants. Factors related to treatment adherence can differ based on treatment type, and therefore, this variability diminished control within the study (Christensen et al., 2010; Gajria et al., 2014). However, given the lack of standardization in treatment across the population, the applied nature of this research is more generalizable to help inform interventions for a larger portion of individuals with ADHD. Another limitation to this study concerns the time frame of data collection. Data were collected throughout the academic year. The time of year that the assessment took place may have impacted adherence patterns (e.g., students who reported on their treatment adherence early on in the semester may have higher or lower reports of adherence than those assessed later in the school year). Further, data for this study only examined treatment adherence during the first year of college. Rates of treatment adherence tend to increase after the first year of college (Gray et al., 2018). The lack of standardization in the time of year that the data were collected as well as the limited time frame (i.e., year 1 of college) may have confounded the results and limited the generalizability of obtained findings to other college students.

Additionally, because many measures relied on self-report data, there is a lack of objective understanding of many of the constructs. For a topic such as treatment adherence, for example, people may unintentionally overestimate or misrepresent their actual rates of adherence (e.g., due to social desirability or memory bias; Wilson, Carter, & Berg, 2009). Both objective and subjective methods of reporting on treatment adherence represent unique challenges and

advantages for obtaining data (Chesney, 2006; Garfield, Clifford, Eliasson, Barber, & Willson, 2011; Quittner et al., 2008; Williams, Amico, Boya, & Womack, 2013) and may vary in accuracy and utility across different chronic conditions (Stirratt et al., 2015). To obtain the most accurate estimation, extensive data collected through multiple methods (e.g., objective data, daily pill counts, treatment diary, multiple informants should be included to corroborate self-report.

Future Directions

Inconclusive findings from this study highlight the problematic nature of the dearth of information on treatment adherence for individuals with ADHD. Results from this study contradict findings from past studies and suggest that the factors most strongly related to treatment adherence in childhood are likely different from those in adulthood. Continuing to examine factors related to treatment adherence for emerging adults with ADHD may help to improve treatment adherence within this population as well as with other populations of individuals with various chronic illnesses. Exploring factors related to treatment adherence in larger samples across different subsets (e.g., varying ages, socioeconomic status, education levels) of the population with ADHD is critical to maximize outcomes for these individuals. Consistent with the developmental model, a greater understanding of barriers and benefits to treatment across the lifespan and individual circumstances will provide important information to design and implement appropriate interventions that promote medication use (Sibley et al., 2014). Utilizing measures with strong psychometric properties that thoroughly and accurately capture the constructs of medication tolerability, attitudes towards treatment, and treatment adherence will provide important information on both the alterable and inalterable factors related to treatment adherence for individuals with ADHD. For example, a measure that specifically assesses knowledge of ADHD medication would be particularly important to better understand

the relationship between knowledge and treatment adherence.

As research on treatment adherence continues to expand, it is also critical to obtain a more accurate estimate of adherence rates across various subsets of the population of individuals with ADHD (e.g., children, college students, adults) to help illuminate differences across the lifespan that can aid in targeting effective and appropriate interventions. Additionally, if college students do, in fact, have higher adherence rates than the rest of the population, characteristics of this population can be carefully examined to further inform interventional techniques that will promote adherence for other individuals.

Future studies should also examine differences between college students with ADHD who are prescribed medication and those who are not. Because treatment adherence declines over the lifespan, particularly during emerging adulthood, there are likely differences between individuals who continue to take their medication in college and those who do not (Ahmed & Aslani, 2013; Barkley et al., 2001; Bussing et al., 2012; Charach & Fernandez, 2013). Further, it would be interesting to examine changes in treatment adherence before, during, and after college to identify environmental contributions to treatment adherence.

This study concentrated on treatment adherence to psychopharmacological interventions for ADHD. To continue to address gaps in the current literature, future research should also examine factors related to treatment adherence to psychosocial interventions. For example, examining the ways that various aspects (e.g., type, dosage, sustainable effects) of psychosocial treatments or combined treatments impact adherence throughout the lifespan will further illuminate differences in adherence patterns to better inform treatment for ADHD. Based on the unique risks and benefits of each treatment type, it is likely that factors related to adherence may vary significantly across treatments. It is also possible that unmeasured effects of psychosocial

interventions contribute to adherence rates of psychopharmacological interventions (e.g., development of self-regulation strategies decreasing need for medication overtime). More information on adherence to psychosocial treatments may help inform healthcare providers in their recommendations to provide best practice, sustainable treatment options. Additionally, to rectify methodological limitations in the adherence research, it is necessary to identify a standardized definition and measure of treatment adherence that can be used throughout the literature.

Conclusions

In general, there is limited information on factors related to treatment adherence, particularly in the emerging adult population (Ahmed & Aslani, 2013; Gajria et al., 2014). Although there is support for the contribution of a combination of a variety of factors (e.g., individual characteristics, medication tolerability) to rates of treatment adherence to psychopharmacological treatments in the pediatric population, the individual contributions of each unique factor had previously remained unstudied (Corkum et al., 2013). Contrary to past literature, according to the results of this study, none of the previously identified factors were significantly predictive of treatment adherence in college students with ADHD either individually or in combination. Although these results may be partially due to statistical limitations, these contradictions with the extant literature further necessitate the critical need for additional research in this area to best identify areas of intervention that can maximize outcomes for these individuals. Adherence is largely related to the degree to which an individual's belief in the necessity of treatment overrides the individual's concern about treatment risks (Emilsson et al., 2017). Based on the results of this study, it is possible that these perceived risks and benefits are different for the college population, and are impacting treatment use. A greater

understanding of factors that influence these perceptions is necessary to promote adherence to psychopharmacological treatments in this population as well as to provide important information that may help to improve outcomes for all individuals with ADHD.

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Table 1. *Correlations, Means, SDs, Skewness, and Kurtosis Values for Full Group*

Variable	Risk Factors	ADHD Sx	Comorbidities	Side Effects	Time on Meds.	Med. Frequency	Knowledge	Impairment	Satisfaction	Thoughts	Tx. Adherence
Risk Factors	1										
ADHD Sx	-.086	1									
Comorbidities	-.237*	.289**	1								
Side Effects	-.083	.196	.215*	1							
Time on Meds.	-.026	.220**	-.002	.115	1						
Med. Frequency	.044	.175	-.051	.089	.139	1					
Knowledge	-.059	.310**	.112	-.058	.120	.067	1				
Impairment	.092	-.455**	-.317**	-.170	-.103	-.142	.006	1			
Satisfaction	.102	-.028	.046	.129	.349**	-.038	.045	.053	1		
Thoughts	-.029	.367**	-.012	.028	-.131	.259*	.150	-.337**	-.131	1	
Tx Adherence	-.078	.061	-.069	-.025	.050	-.101	.082	.040	.069	-.127	1
<i>M</i>	1.18	10.74	0.94	1.56	2.82	6.55	21.06	56.60	2.63	35.79	2.39
<i>SD</i>	0.73	3.68	1.05	1.17	0.53	2.54	5.46	20.10	0.62	7.72	0.07
Skewness	0.04	0.19	1.05	0.50	-2.87	2.71	0.34	-0.43	-1.73	0.07	-0.71
Kurtosis	-0.47	-0.90	0.66	-0.42	6.94	11.79	0.01	-0.11	3.09	-0.07	-0.65

Note. * Correlation is significant at the $p \leq .05$ level

**Correlation is significant at the $p \leq .01$ level

Table 2. *Regression Weights for the Primary Model*

	Medication Tolerability			Attitudes Towards Medication		
	β	B	SE B	β	B	SE B
Side Effects	.231*	.268*	.133	--	--	--
Time on Medication	.208	.109	.060	--	--	--
Medication Frequency	.222	.562	.289	--	--	--
Knowledge	--	--	--	.294	.571	.904
Impairment	--	--	--	-.555	-3.974	6.214
Satisfaction	--	--	--	-.052	-.012	.031
Thoughts	--	--	--	.463	1.274	1.990

Note. *Regression values significant at $p \leq .05$ level

Table 3. *Regression Weights for the Modified Primary Model*

	Medication Tolerability			Attitudes Towards Medication		
	β	B	SE B	β	B	SE B
Side Effects	.238*	.277*	.133	--	--	--
Time on Medication	.211	.111	.060	--	--	--
Medication Frequency	.212	.537	.288	--	--	--
Knowledge	--	--	--	.383	1.192	.693
Impairment	--	--	--	-.670	-7.663	3.883
Satisfaction	--	--	--	-.048	-.017	.043
Thoughts	--	--	--	.478*	2.101*	1.001

Note. *Regression values significant at $p \leq .05$ level

Table 4. *Regression Analysis of Predictors of Treatment Adherence*

	β	<i>B</i>	SE <i>B</i>
Risk Factors	-.109	-.103	.104
ADHD Symptoms	.166	.031	.026
Comorbidities	-.160	-.105	.081
Side Effects	-.023	-.014	.066
Time on Medication	-.036	-.048	.161
Medication Frequency	-.083	-.023	.031
Knowledge	.074	.009	.015
Impairment	-.010	.000	.004
Satisfaction	.079	.088	.130
Thoughts	-.180	-.016	.011

Note. All regression values are non-significant at $p \leq .05$ level

Table 5. Regression Analysis of Predictors of Variables Related to Attitudes Towards Treatment

	Knowledge			Impairment			Satisfaction			Thoughts		
	β	<i>B</i>	SE <i>B</i>	β	<i>B</i>	SE <i>B</i>	β	<i>B</i>	SE <i>B</i>	b	<i>B</i>	SE <i>B</i>
Risk Factors	-.033	-.244	.773	.012	.336	2.621	.134	.114	.085	-.041	-.434	1.012
ADHD Symptoms	.302	.449	.164	-.371	-2.026	.555	-.134	-.023	.018	.423	.888	.214
Comorbidities	.048	.249	.576	-.202	-3.880	1.950	.089	.053	.064	-.129	-.955	.753
Side Effects	-.140	-.652	.490	-.044	-.765	1.659	.111	.059	.054	-.021	-.142	.640
Time on Medication	.066	.678	1.079	-.005	-.183	3.655	.381	.448	.119	-.253	-3.699	1.411
Medication Frequency	.021	.046	.223	-.084	-.660	.754	-.079	-.019	.025	.217	.660	.291

Note. Standard Error reported in parentheses

*Beta weight significant at $p \leq .05$ level

**Beta weight significant at $p \leq .001$ level

Figure 1. Sampling Information

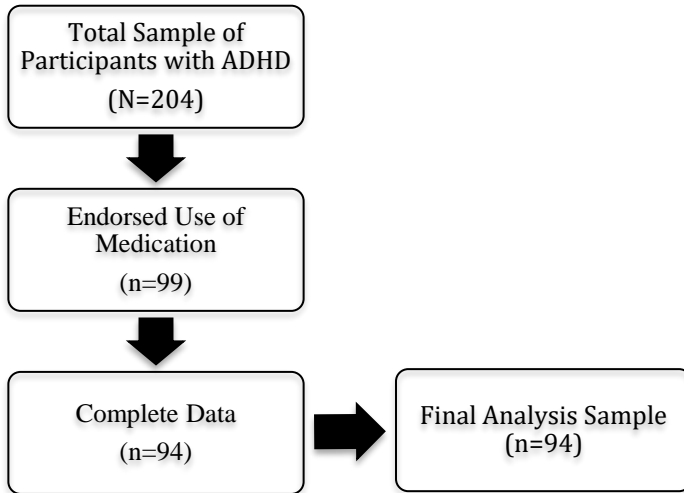


Figure 2. Primary proposed mediation model.

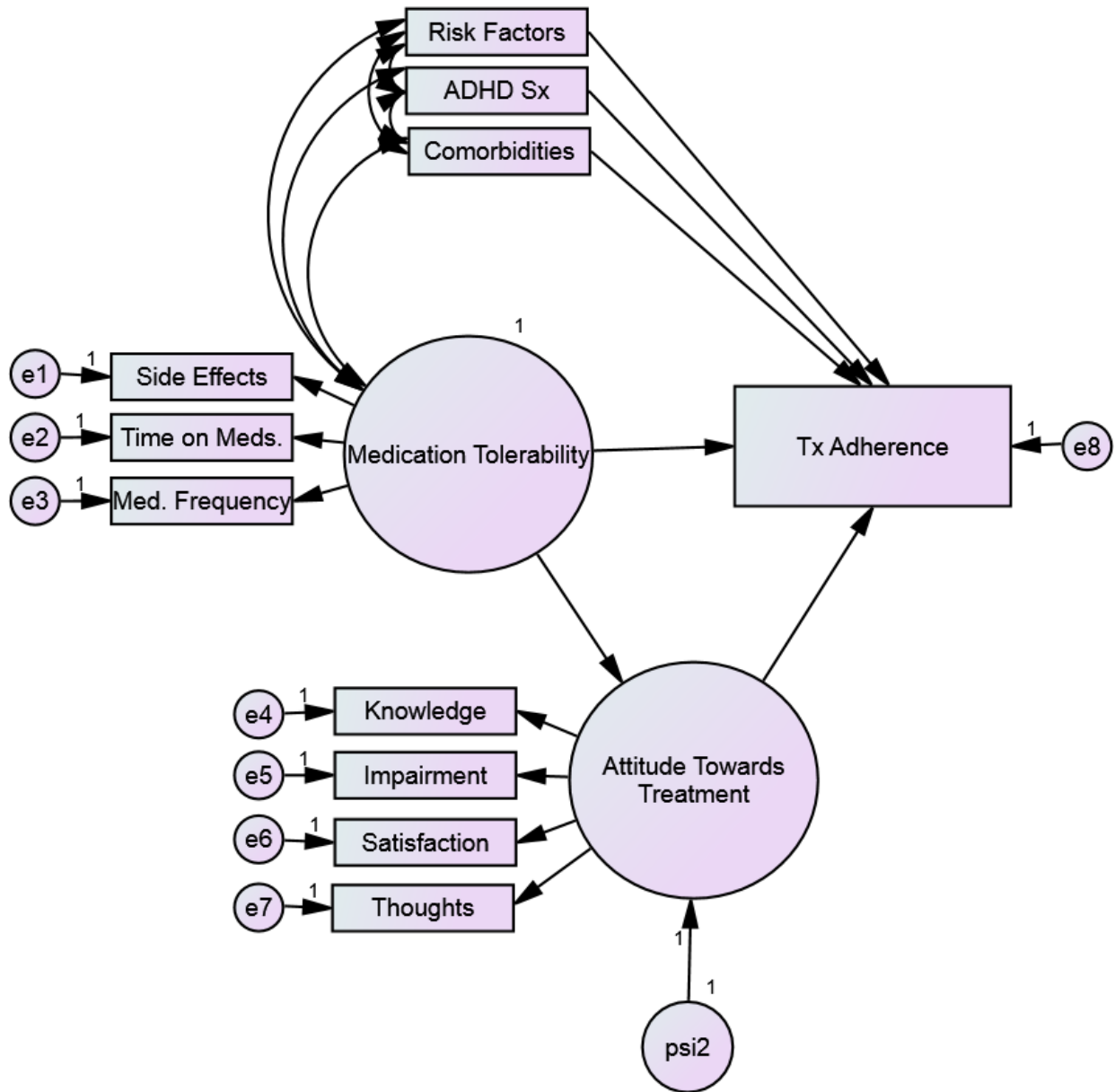


Figure 3. Alternative proposed mediation model.

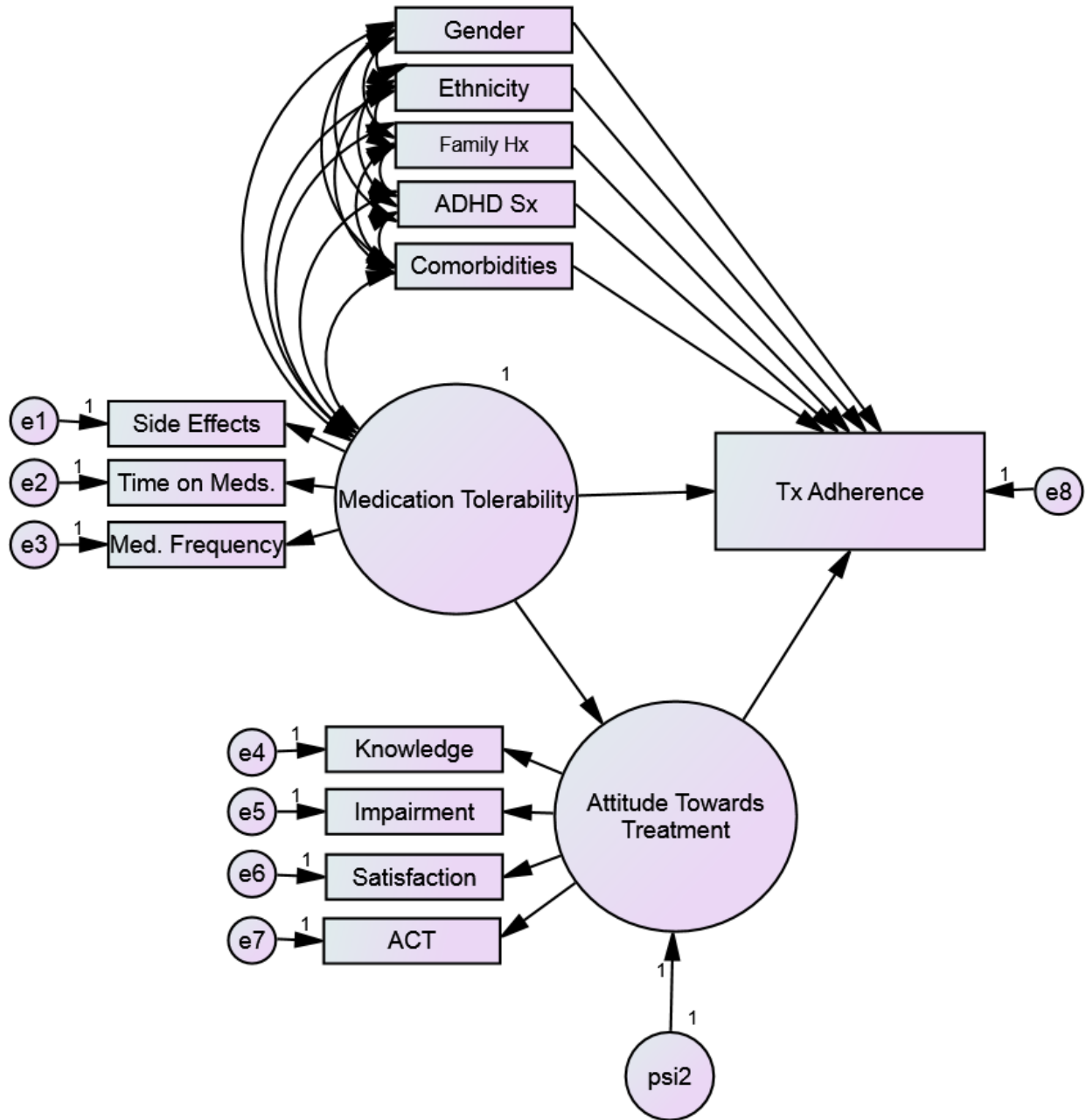


Figure 4. Modified primary mediation model.

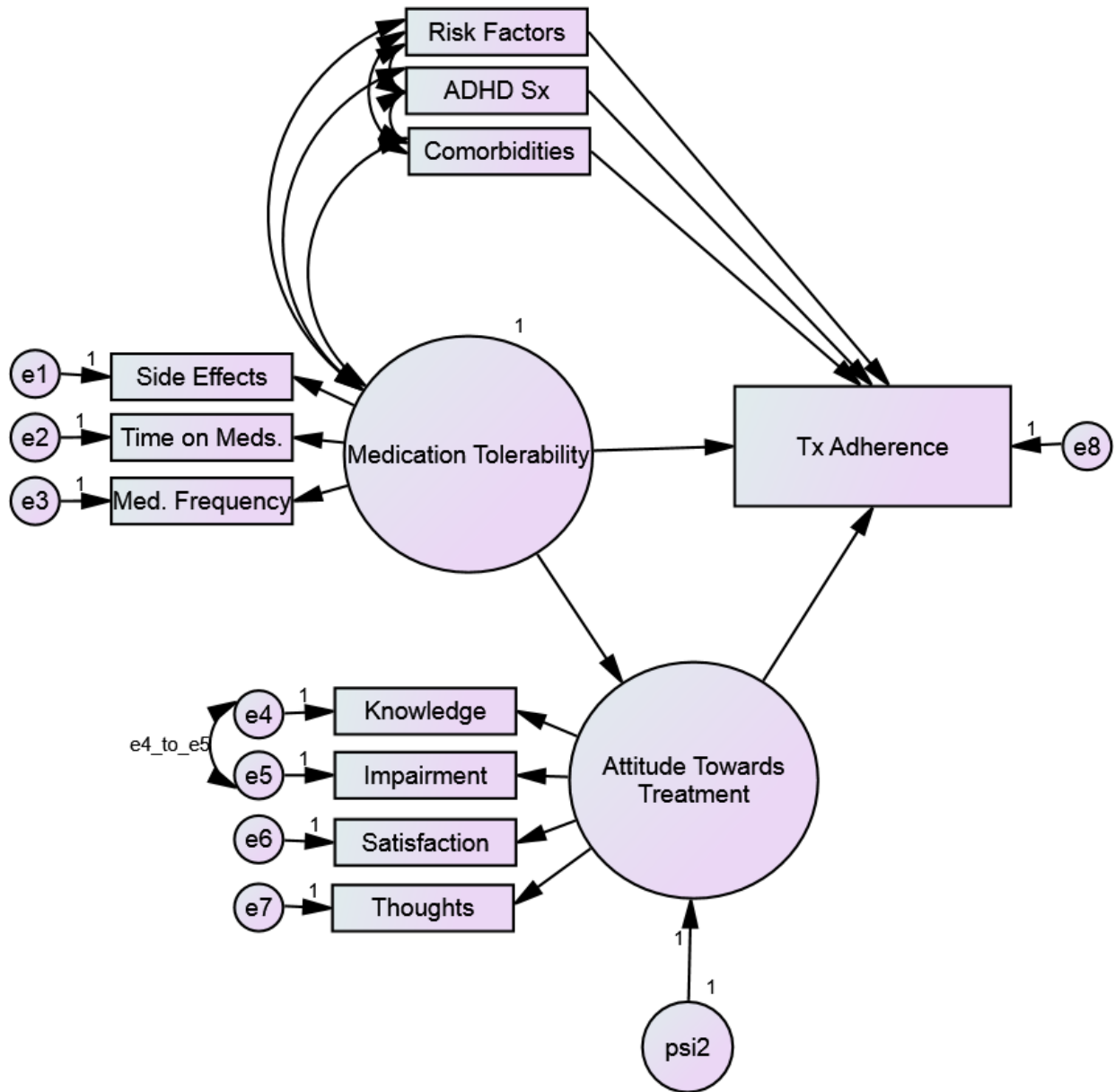
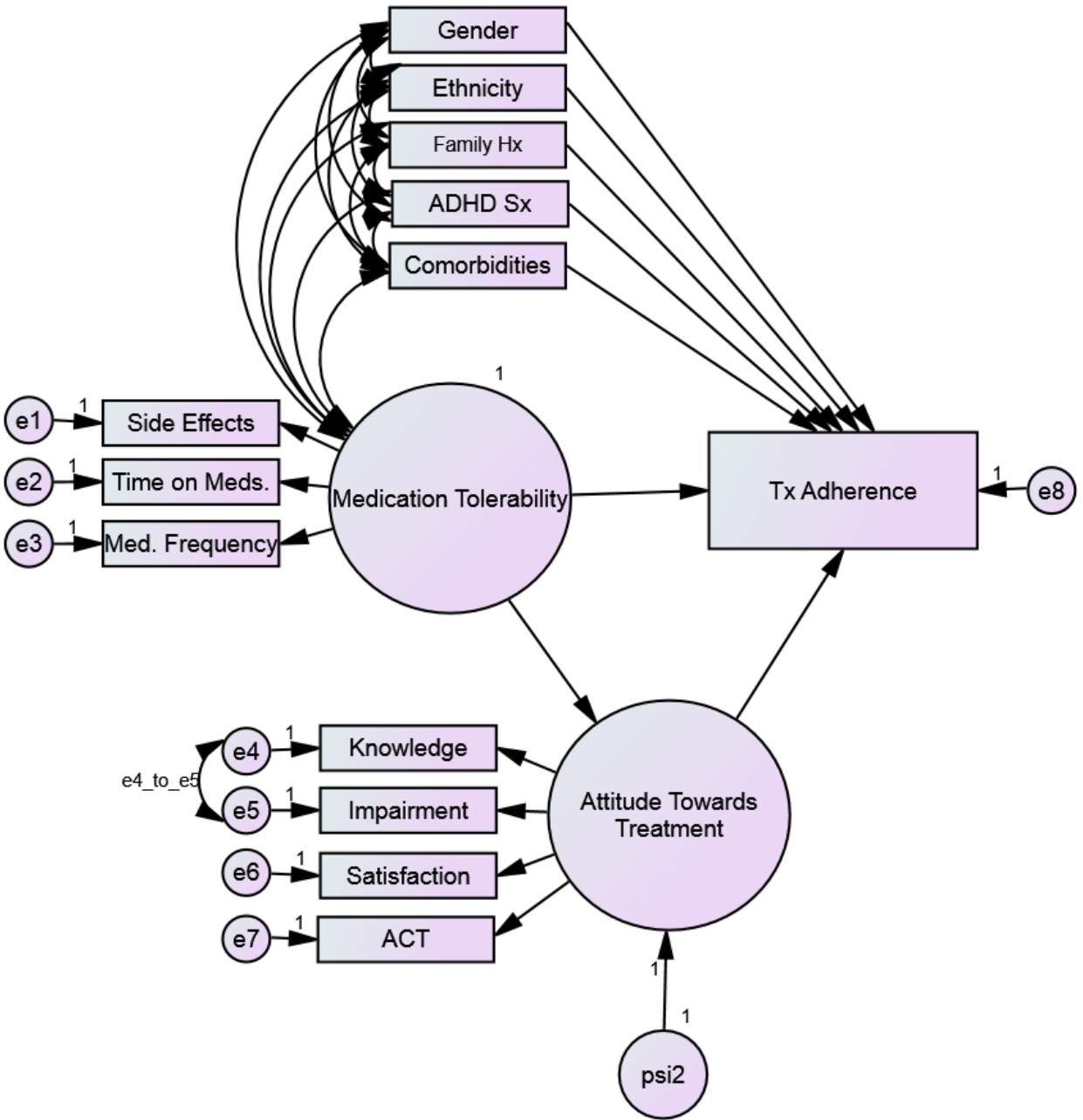


Figure 5. Modified alternative mediation model.



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Lehigh University, Bethlehem, PA
Cumulative G.P.A. 3.99; *expected completion August 2019*
- M.Ed. Human Development, Lehigh University, Bethlehem, PA
Cumulative G.P.A. 4.0; *received December 2014*
- B.A. Major: Psychology, Minor: Jewish Studies; Summa Cum Laude with
Honors
Muhlenberg College, Allentown, PA
Cumulative GPA: 3.95, *received May 2013*

CLINICAL EXPERIENCE:

Pre-Doctoral Internship at Nemours/A.I. DuPont Hospital for Children, Pediatric Psychology Track, APA Accredited, Wilmington, DE (August 2018-August 2019)

Specialty Clinic Rotation in Inpatient Cardiology: Provided psychosocial interventions for Infants, children, and adolescents with congenital heart defects and their families throughout hospital admissions. Participated in weekly multidisciplinary rounds and collaborated with other healthcare providers to support care. Supervised by Erica Sood, Ph.D.

Outpatient Pediatric/Child Therapy Clinic: Provided individual and family therapy for a broad range of psychosocial concerns (e.g., medical adherence, pain management, sleep hygiene, adjustment to chronic illness, ADHD, anxiety, neurological disorders, mood disorders, early child issues). Experiences included a combination of pediatric psychology and child-clinical cases. Supervised by Jennifer Pendley, Ph.D. and Maia Noeder, Ph.D.

Inpatient Consultation/Liaison Service: Provided inpatient consultative services to a variety of pediatric services and subspecialties. Conducted assessments, provided individual and family intervention, and identified needs and resources for outpatient follow-up. Participated in multidisciplinary rounds and collaborated with other health professionals. Supervised by alternating attending psychologists.

Inpatient Bone Marrow Transplant/Oncology Intervention: Provided inpatient services to

children and their families throughout multiple hospital admissions. Trained in the Surviving Cancer Competently Intervention Program- New Diagnosis (SCCIP-ND). Supervised by Karen Wohlheiter, Ph.D.

Family Centered Consultation Clinic Program: Provided outpatient consultative services for children and their families with developmental, behavioral, emotional, and social concerns. Conducted intake assessments and provided diagnostic impressions and recommendations to families. Administered brief follow-up assessments for ADHD related concerns. Supervised by Cami Winkelspecht, Ph.D.

Autism Behavior Consultation Clinic: Provided behavioral interventions for children with Autism Spectrum Disorder and/or other developmental disorders and their families to address concerns including parent behavioral management, social/functional communication, sleep hygiene, and other early childhood concerns. Supervised by Emily Bernabe, Ph.D.

Neuropsychological Testing: Conducted neuropsychological assessments of children/adolescents with known or suspected CNS compromise, wrote assessment reports, and collaborated with school systems and other professionals about recommendations. Supervised by Greg Witkin, Ph.D.

Complex Autism Spectrum Disorder/Developmental/Clinical Child Testing: Conducted assessments of children with developmental, behavioral, and emotional concerns. Supervised by Stephanie Chopko, Ph.D.

Integrated Primary Care Psychology: Provided warm hand-offs, consultation, and intervention services in conjunction with primary care providers through the hospital-based primary care clinic. Collaborated with other providers and community resources to provide care for children in their medical home. Supervised by Jennifer Kuhn, Ph.D.

Group Psychotherapy: ADHD Parent Child Conduct Group: Co-led parent and child groups addressing disruptive behaviors associated with ADHD (e.g., noncompliance, aggression). Supervised by Colleen Cullinan, Ph.D.

Psychology Externship in the Division of Gastroenterology, Hepatology, and Nutrition at the Children's Hospital of Philadelphia, Philadelphia, PA

Worked with children with a variety of GI conditions (e.g., Constipation, IBD, IBS, Celiac Disease) to support medical treatment and mental health outcomes. Interviewed patients; formulated treatment plans; provided behavioral and cognitive-behavioral therapeutic interventions; and shadowed inpatient treatment. Co-leader of Soiling, fecal Incontinence, and Toileting (I-SIT) group. Supervised by Kimberly Wesley, Psy.D. and Kelly Rodriguez, Ph.D. (July 2017-July 2018)

Psychology Externship in the Early Childhood Clinic at Nemours/A.I. duPont Hospital for Children, Wilmington, DE

Worked with children with a variety of behavioral and psychological disorders (e.g., ADHD, anxiety disorders) and their caregivers to provide formal Parent Child Interaction Therapy (PCIT) and exposure-based cognitive behavioral therapy. Taught, coded, and coached during Child-Directed Interaction and Parent-Directed Interaction sessions. Provided additional behavioral and cognitive behavioral interventions and recommendations to address other behavioral and psychological concerns. Supervised by Johanna Carpenter, Ph.D. (June 2017-June 2018).

Psychology Externship in the Sleep Center at the Children's Hospital of Philadelphia, Philadelphia, PA

Worked with children with obstructive sleep apnea and their families as part of an interdisciplinary team to promote adherence to continuous positive airway pressure (CPAP) machines. Interviewed patients, formulated treatment plans, and provided in-person and telephone follow-up. Supervised by Melissa Xanthopoulos, Ph.D. (September 2015-June 2017)

Psychology Externship in the Amplified Musculoskeletal Pain Syndrome (AMPS) Clinic at the Children's Hospital of Philadelphia, Philadelphia, PA

Worked with children with AMPS and their families as part of an interdisciplinary team to promote management of pain through psychological interventions. Interviewed patients, formulated treatment plans, and communicated with outpatient psychological providers. Supervised by Kimberly Miller, Ph.D. (August 2016-June 2017)

Practicum in School Psychology, Upper Darby School District, PA

Worked under a school psychologist at a middle school. Conducted observations; record reviews; parent, teacher, and child interviews; academic and behavioral interventions; and intelligence, neuropsychological, and achievement testing. Wrote integrated evaluation reports and presented case summaries to parents. Supervised by Kristin Bussone, Ph.D. (September 2016-December 2016)

Practicum in School Psychology, Allentown School District, PA

Worked under a school psychologist at an elementary school. Conducted observations; record reviews; parent, teacher, and child interviews; and intelligence, neuropsychological, and achievement testing. Wrote integrated evaluation reports and presented case summaries to parents. Supervised by Keith Youse, Ph.D. (September 2015-June 2016)

Camper Support at Residential Summer Camp, Cascade, MD

Provided support and intervention for girls between the ages of 7-24 at a residential summer camp with a range of emotional and behavioral difficulties. Worked with a variety of populations such as those with anxiety disorders, depression, and self-harm behaviors. Provided training to counselors on positive discipline, ADHD, and camper differences. Conducted anti-bullying interventions with campers. Communicated and

consulted with parents, counselors, social workers, and outside therapists to develop interventions and behavioral plans for children (June 2015-July 2015).

Practical Experience for Assessment and Intervention in Educational Consultation,

Bethlehem, PA

Worked with a child and teacher to develop an assessment report for a child with academic difficulties. Administered curriculum based measurements in math, reading, writing, and spelling. Conducted interviews and BOSS observations. (January 2015-May 2015)

Practical Experience for Behavioral Assessment, Bethlehem, PA

Worked with a child, teacher, and parent to develop a behavioral assessment report for a child with severe tantrum behaviors. Administered the *BASC-2 BESS* and conducted parent, teacher, and child interviews. Observed in the classroom and shadowed the school guidance counselor. (September 2014-December 2014)

Practical Experience for Consultation Procedures, Bethlehem, PA

Conducted conjoint behavioral consultation with a teacher and parent to develop a behavioral plan for a child with homework difficulties. Conducted interviews, observations, and meetings with parents, students, and teachers. (September 2014-December 2014)

Practical Experience for Assessment of Intelligence, Bethlehem, PA

Conducted IQ and achievement testing (WISC-IV, KABC-II, WAIS-III, WIAT-III, Woodcock Johnson IV), on children and adults and created reports. (January 2014-May 2014)

Practical Experience for Applied Behavior Analysis, Bethlehem, PA

Worked in a multiple disabilities classroom to develop a positive behavior intervention to reduce disruptive classroom behaviors. (September 2013-December 2013)

Leader, “Strong Start” Program, Vitalistic Therapeutic Charter School in Bethlehem, PA

Taught a small group of at risk students how to understand and manage emotions and actions using the “Strong Start” curriculum. (September 2011-December 2011)

RESEARCH EXPERIENCE:

Dissertation: Factors Related to Treatment Adherence for College Students with ADHD: Individual Characteristics, Medication Tolerability, and Attitudes, Lehigh University

Utilized data from the *Trajectories Related to ADHD in College Students* project to examine whether attitudes towards treatment mediate the relationship between medication tolerability and treatment adherence to psychopharmacological medication for ADHD. Supervised by George DuPaul, Ph.D. (defended June 2018).

Project Coordinator: Trajectories Related to ADHD in College Students, Lehigh University

Student project leader from 2016-2017. Assessed the academic, emotional, social, behavioral, and cognitive functioning of undergraduate students with and without ADHD. Participated in research analyses to learn more about college students with ADHD. Supervised by George DuPaul, Ph.D. (September 2013-July 2017)

Qualifying Project: Anxiety as a Protective Factor for ADHD, Lehigh University

Utilized data from the *Trajectories Related to ADHD in College Students* project to examine the ways in which anxiety may be able to serve as a protective factor for ADHD. Supervised by George DuPaul, Ph.D. and Robin Hojnoski, Ph.D. (completed December 2014).

National Living Laboratories, Allentown, PA

Participated in the National Living Laboratories Program, and conducted an experiment on early math skills at the Da Vinci Science Center to teach children about scientific research. Supervised by Robin Hojnoski, Ph.D. (January 2015-May 2015)

Data Entry: Obstructive Sleep Apnea (OSA) Database, Children's Hospital of Philadelphia

Reviewed electronic medical records in order to update clinical information from a quality improvement database to a research quality database. Classified the potential reasons for disordered breathing and severity of OSA. (July 2016-August 2016)

Senior Thesis: Effect of music on the behavior of elementary aged children

Independently designed and conducted a research study to determine the effect of music listening on the behavior and performance of kindergarten children. Supervised by Stefanie Sinno, Ph.D. (September 2012-May 2013)

Research Assistant, Neuropsychology Lab, Kennedy Krieger Institute, Baltimore, MD

Worked with and entered data on Microsoft Excel, attended clinical rounds and lab meetings, observed IQ and academic proficiency testing. Supervised by Alison Pritchard, Ph.D. (June 2012-August 2012)

Research Apprenticeship focusing on the BASC-2, Muhlenberg College

Scored and analyzed results from the BASC-2 to collect data on the students at the Vitalistic Therapeutic Charter School prior to running the "Strong Start" program. Supervised by Mark Sciutto, Ph.D. (September 2011-December 2011)

Research Assistant, Math Skills Development Project, Kennedy Krieger Institute, Baltimore, MD

Collected data by calling participants and their schools to gather appropriate consent forms and academic information. Supervised by Michele Mazzocco, Ph.D. (June 2011-August 2011)

Research Apprenticeship focusing on misconceptions of ADHD, Muhlenberg College

Collected and analyzed data using the Strength of Belief in ADHD Knowledge Scale and the Abbreviated Acceptability Rating Profile in order to study the knowledge and

misconceptions of ADHD that limit individuals from receiving certain treatments.
Supervised by Mark Sciotto, Ph.D. (January 2011-May 2011)

EDITORIAL EXPERIENCE:

Ad-hoc Reviewer, British Medical Journal of Paediatrics Open (2018)

Ad-hoc Reviewer, Journal of Developmental and Behavioral Pediatrics (2016)

Ad-hoc Reviewer, Health Psychology (2016)

PRESENTATIONS:

Franklin, M.K., Fletcher, K., Jaffe, A., DuPaul, G.J., Anastopoulos, A.D., & Weyandt, L.L. (2017, August). *Risky drug use as a treatment for college students with ADHD*. Poster presented at the annual convention of the American Psychological Association, Washington, D.C.

DuPaul, G.J., Fletcher, K.S., Jaffe, A.R., **Franklin, M.K.**, Pollack, B.L., Gormley, M.J., Anastopoulos, A.D., & Weyandt, L.L. (2017, February). *Trajectories and predictors of educational functioning in college students with and without ADHD*. Poster presented at the National Association of School Psychology Annual Conference, San Antonio, TX.

Franklin, M.K., DuPaul, G.J., Hojnosi, R., Anastopoulos, A.D., & Weyandt, L.L. (2015, February). *Comorbid ADHD and anxiety in college students: Implications for response inhibition and cognitive functioning*. Poster presented at the National Association of School Psychology Annual Conference, Orlando, FL.

Gormley, M.J., DuPaul, G.J., Pollack, B., **Franklin, M.**, Busch, C., Weyandt, L., Anastopoulos, A.D. (2015, November). *Psychosocial and psychopharmacological treatment of ADHD in college students: Longitudinal associations with psychological and behavioral outcomes*. Poster presented at the annual convention of the Association for Behavioral and Cognitive Therapies, Chicago, IL.

Gormley, M. J., Pinho, T., Pollack, B., Laracy, S. D., Busch, C., **Franklin, M.**, Puzino, K., Hollingsworth, K., & DuPaul, G. J. (2014, August). *First-year GPA for college students with and without ADHD: A moderated mediation model*. In A. D. Anastopoulos (Chair), *Longitudinal outcome of college students with ADHD: Initial findings from two studies*. Symposium presented at the annual convention of the American Psychological Association, Washington, D.C.

Gonzalez, J., **Franklin, M.K.**, Ring, A., Mansolillo, T., Wolfe, C. (2013, June). *Stigmatic implications associated with the symptomatology of schizophrenia*. Poster presented at the annual meeting of the Association for Psychological Science, Washington, DC.

Sciotto, M.J., Allegretti, F., Eyzarovich, E., **Franklin, M.K.**, & Hamilton, E.J. (2012, August).

The relationship of ADHD knowledge and misconceptions to treatment acceptability.
Poster presented at the annual meeting of the American Psychological Association,
Orlando, FL.

PUBLICATIONS:

- Busch, C.Z., DuPaul, G.J., Anastopoulos, A.D., **Franklin, M.**, Jaffe, A., Stack, K.F., & Weyandt, L.L. (Accepted). College students with ADHD: Risk for and correlates of alcohol and substance use. *Journal of Postsecondary Education and Disability*.
- DuPaul, G.J., **Franklin, M.K.**, Pollack, B.L., Fletcher, K.S., Jaffe, A.R., Gormley, M.J., Anastopoulos, A.D., & Weyandt, L.L. (2018). Predictors and trajectories of educational functioning in college students with and without Attention-Deficit/Hyperactivity Disorder. *Journal of Postsecondary Education and Disability*, 31, (161-178).
- DuPaul, G.J., & **Franklin, M.K.** (in press). Legal, ethical, and professional issues related to the use of psychotropic medications in school-aged populations. In J.S. Carlson & J.A. Barterian (Eds.), *School psychopharmacology: Translating research into practice*. New York: Springer International Publishing.
- Gormley, M.J., Pinho, T., Pollack, B., Puzino, K., **Franklin, M.K.**, Busch, C., DuPaul, G. J., Anastopoulos, A.D., & Weyandt, L.L. (2015). Impact of study skills and parent education on first-year GPA among college students with and without ADHD: A moderated mediation model. *Journal of Attention Disorders*, Advance online publication.

Professional Certifications

In-State Educational Specialist, Commonwealth of Pennsylvania (obtained August 2017)
Certified Positive Discipline Parent Educator (obtained July 2014)

Professional Memberships

American Psychological Association
Delaware Psychological Association
Society of Pediatric Psychology, Division 54 of the American Psychological Association

Academic Honors and Awards:

Psi Chi, International Honor Society in Psychology (Spring 2011-Present)
Omicron Delta Kappa, National Leadership Honor Society (Fall 2011-Present)
Muhlenberg Scholars Program (2009-2013)
Rosenberg Research Award: Stipend awarded for assistance with senior thesis (2012-2013)
Dean's List, Muhlenberg College (every semester)
Psychology Day Keynote Panelist (Fall 2012)