THE EFFECT OF EXECUTIVE FUNCTION DEFICITS ON TREATMENT RESPONSE IN CHILDREN WITH OPPOSITIONAL DEFIANT DISORDER

by

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ABSTRACT

Oppositional Defiant Disorder (ODD) occurs in childhood and is characterized by recurrent, developmentally inappropriate, negativistic, defiant, disobedient, and hostile behaviors directed towards authority figures. Such behaviors can significantly interfere with child-peer and child-adult interactions. If left untreated, ODD can result in social, emotional, and academic consequences throughout childhood and into adulthood. Behavioral and cognitive-behavioral interventions such as parent management training (PMT) and collaborative and proactive solutions (CPS) have been shown to be effective treatments for ODD. Previous studies have not yet investigated the role that executive functioning (EF) deficits play in treatment response for ODD symptomology. Since EF deficits often co-occur with ODD, it is important to consider whether those with such deficits respond differently to PMT and CPS, particularly given that an approach such as CPS relies more on EF skills than PMT. No study to date has examined whether EF deficits differentially predict treatment response to PMT or CPS. The current study investigated whether pre-treatment EF deficits predict differential response to treatment as indexed by a reduction in ODD symptoms. We hypothesized that pre-treatment levels of EF would influence treatment response such that those with greater EF deficits at baseline would not see as great a reduction in ODD symptoms in the CPS condition, while EF deficits would not affect response to PMT.

DEDICATION

This thesis is dedicated to everyone who helped me and guided me through the trials and tribulations of creating this manuscript. In particular, I would like to recognize and thank my family and close friends for their support throughout the time taken to complete this manuscript.

LIST OF ABBREVIATIONS AND SYMBOLS

α	Cronbach's alpha, an index of internal consistency
ADHD	Attention-deficit/hyperactivity disorder
ADIS-C/P	Anxiety Disorders Interview Schedule for DSM-IV, Child and Parent Versions
APA	American Psychological Association
BASC	Behavioral Assessment System for Children
BRIEF	Behavior Rating Inventory of Executive Function
CD	Conduct Disorder
CPS	Collaborative and Proactive Solutions
CSR	Clinician Severity Rating
df	Degrees of Freedom: number of values free to vary after certain restrictions have been placed on the data
EF	Executive Functioning
F	Fisher's *F* Ratio: A ratio of two variances
M	Mean: the sum of a set of measurements divided by the number of measurements in the set
MLE	Maximum Likelihood Estimation
ODD	Oppositional Defiant Disorder
p	Probability associated with the occurrence under the null hypothesis of a value as extreme as or more extreme than the observed value
PMT	Parent Management Training

r	Pearson product-moment correlation
t	Computed value of *t* test
SD	Standard Deviation
<	Less than
>	Greater than
=	Equal to

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CHAPTER 1

INTRODUCTION

Oppositional Defiant Disorder (ODD) is characterized by recurrent, developmentally inappropriate, negativistic, defiant, disobedient, and hostile behaviors directed towards authority figures (American Psychiatric Association [APA], 1994, 2013). Behaviors that are common with oppositional defiant disorder include active defiance, refusal to comply with adult commands, frequent temper outbursts, and excessive arguing. Such behaviors can significantly interfere with child-peer and child-adult interactions (Anderson, Lytton, & Romney, 1986; Burke, Rowe, & Boylan, 2014; Christenson, Crane, Malloy, & Parker, 2016; Stormschak, Speltz, DeKlyen, & Greenberg, 1997) and are one of the leading reasons for referral for mental health services in youth (Loeber, Burke, Lahey, Winters & Zera, 2000). The prevalence rates for ODD in community samples range from 2.6% to 15.6%, and in clinical samples from 28% to 65% (Boylan, Vaillancourt, Boyle, & Szatmari, 2007; Wolff & Ollendick, 2010). If left untreated, ODD can result in social, emotional, and academic consequences throughout childhood and into adulthood (Burke, Rowe, & Boylan, 2014; Mikolajewski, Taylor, & Iacono, 2017). Children who display frequent oppositional behavior in preschool are likely to go on to have ODD when they reach elementary age and are at greater risk for developing conduct disorder and antisocial personality disorder later in life (Hamilton & Armando, 2008).

ODD has also been shown to be highly comorbid with other childhood psychiatric disorders, especially attention-deficit/hyperactivity disorder (ADHD; Newcorn, Halperin, & Miller, 2009; Ollendick, Booker, Ryan, & Greene, 2017). For example, approximately 40% to 70% of children with ADHD also have a comorbid externalizing disorder such as oppositional defiant disorder (ODD) or conduct disorder (CD), and 40% to 60% of children with ODD and/or

CD have ADHD (Newcorn et al., 2009; Ollendick et al., 2017).

Treatments for ODD

Presently, the predominant "standard of care" for youth with ODD is Parent Management Training (PMT; Barkley, 1997; Brestan & Eyberg, 1998; Dunsmore, Booker, Ollendick, & Green, 2016; Eyberg, Nelson, & Boggs, 2008; Kazdin, 2005; McMahon, Long, & Forehand, 2011;). PMT emphasizes ineffective parenting practices as they contribute to oppositional behavior in youth. Some aspects of ineffective parenting include parental under involvement and harsh and inconsistent discipline on behalf of the parents (Loeber & Stouthamer-Loeber, 1986; Wootton, Frick, Shelton, & Silverthorn, 1997). The primary focus of the intervention is improving child compliance with adult commands. PMT includes interventions that aide parents with behavior management (i.e. effective commands, proper reinforcement, and time-out). Past literature has supported the efficacy of PMT, and it is considered an empirically supported psychosocial treatment (Brestan & Eyberg, 1998; Eyberg et al., 2008; Ollendick & King, 2012).

Despite evidence of its efficacy, limitations to PMT still exist. After the end of treatment, many children still show deviant behavior above normal levels, treatment gains are often lost when the intervention is stopped, and attrition rates are high (Frick, 2001; Kazdin, 2005; Ollendick & Cerny, 1981). Furthermore, Greene and colleagues (Greene, 1998, 2010; Greene & Doyle, 1999) have asserted that PMT does not fully address the reciprocal, adult-child processes that often contribute to oppositional behavior. In line with these criticisms of PMT, Greene (1998) developed an alternative model for the treatment of ODD, which he now calls Collaborative & Proactive Solutions (CPS). The CPS model emphasizes issues with flexibility, adaptability, and problem solving, as major contributors to the development of oppositional behavior. Unlike PMT, CPS focuses on helping parents and children learn to collaboratively and

proactively solve the problems that contribute to the child's oppositional behaviors (Ollendick, Greene, Austin, Fraire, et al., 2016). Based on preliminary research conducted by Greene and colleagues (2004), CPS has been shown to be an effective treatment for ODD. Response to CPS showed effects that were in line with PMT. A more recent clinical trial by Ollendick and colleagues (2016) examined the efficacy of CPS as a treatment for ODD by comparing it to the well-established PMT and a waitlist control. Both treatments were superior to the waitlist control, but showed no difference from one another. At the end of treatment, approximately 50% of those in either active treatment condition were deemed improved or very much improved compared to 0% in the waitlist control condition.

Executive Functioning

Executive functioning (EF) is a multidimensional construct encompassing meta-cognitive processes that contribute to effective planning, execution, verification, and regulation of goal-directed behavior (Banich, 2009; Oosterlaan, Scheres, & Sergeant, 2005). EF can be thought of as a set of skills that are necessary to guide behavior towards a goal (Banich, 2009). The various domains of EF include inhibition, emotional control, set shifting, planning, organization, and verbal and spatial working memory (Gioia, Isquith, Guy, & Kenworthy, 2000). Inhibition or inhibitory control is the ability to resist and not act on impulse. Set shifting is the ability to move from one situation, activity, or problem as required. Emotional control is conceptualized as one's ability to regulate emotional responses. Planning and organization encompass the ability to manage current and future tasks, as well as organize work, play, and storage spaces. Working memory is the ability to hold information in the mind for the purpose of completing a task (Gioia et al., 2000). The frontal cortex and its subcortical connections have been suggested to serve as the major neurological underpinnings for EF (Eslinger, 1996; Lezak, 1995; Pennington &

Ozonoff, 1996). Deficits in executive function are often associated with externalizing behaviors and are observed in a variety of disorders such as ADHD, ODD, and CD (Jarrett & Hilton, 2017; Van Goozen et al., 2004). In fact, executive dysfunction is thought to have a predisposing influence on impulsive and aggressive behavior (Pennington & Bennetto, 1993).

ODD and EF

While ADHD symptoms (particularly inattention symptoms) are strongly related to deficits in EF, the relation between EF and ODD symptoms is somewhat less studied. Further, recent literature has begun to distinguish between "cool" executive functions such as motor response inhibition, attention, and cognitive flexibility and "hot" executive functions that involve executive functioning in the context of emotional arousal (Matthys, Vanderschuren, Schutter, & Lochman, 2012; Zelazo & Muller, 2002). Generally, hot EFs include qualities of motivation and emotion, while cool EFs are cognitive tasks that do not explicitly activate motivation or emotion (Matthys et al., 2012). A growing body of literature has found that these "hot" executive functioning deficits are unique to ODD (Jarrett & Hilton, 2017). In one study investigating whether EF deficits are present only in ODD or just in those with ODD and comorbid ADHD, the researchers found no evidence of the more typically studied "cool" EF deficits in the ODD only group (Van Goozen et al., 2004). The same study also investigated whether children with ODD suffer from a more specific problem with motivational inhibitory control (i.e., "hot" EF). The researchers found that those with ODD have problems with regulating their behavior under motivational inhibitory conditions (Van Goozen et al., 2004).

In a more recent study that investigated abstract-cognitive and affective-motivational aspects of EF in ODD/CD, the researchers determined that when controlling for ADHD, those with ODD/CD still showed EF deficits (Hobson, Scott, & Rubia, 2011). The same researchers

found that ODD/CD was related to hot EFs, and ADHD was not (Hobson et al., 2011). Somewhat surprisingly, they also found that ODD/CD was related to cool EFs independently of ADHD (Hobson et al., 2011). Overall, research shows stronger support for hot EF deficits (those involving motivation and emotion) in individuals with ODD rather than ADHD (Jarrett & Hilton, 2017) and more mixed results in relation to cool EF relations. As a result of deficiencies in a variety of EF domains, children with ODD experience difficulty with problem solving and managing their behavior in changeable environments (Matthys et al., 2012).

ODD, EF, and Treatment Response

To date, few studies have investigated the effect of EF deficits on treatment response in ODD. In a review by Matthys and colleagues (2012), the authors concluded that the impaired neurocognitive functions seen in ODD might affect the implementation and success of some interventions with specific children. The authors posit that learning-based interventions may demonstrate limited effectiveness due to difficulties in social learning that stem from neurocognitive deficits in children and adolescents with ODD (Matthys et al., 2012). They go on to suggest that children with ODD might benefit from more individualized interventions that take into account associated neurocognitive deficits implying that these deficits may influence the way such individuals respond to treatment (Matthys et al., 2012). In a study that evaluated the effect of group vs. individual Coping Power, a cognitive-behavioral preventative intervention for at-risk aggressive youth, the researchers found that children's baseline level of inhibitory control moderated treatment effects (Lochman et al., 2015). More specifically, children with low levels of inhibitory control at the start of treatment had worse outcomes in the group treatment condition compared to the individual treatment condition as measured by teacher ratings (Lochman et al., 2015). This may indicate that levels of EF effect how individuals respond to

particular treatments for ODD. Given the lack of studies that have investigated EF deficits and treatment response in ODD, more research on the subject is warranted.

Current Study

The present study builds upon research by Ollendick and colleagues (2016) who tested the effects of PMT, CPS, and a waitlist control condition in a large sample of youth with ODD. In that study, the researchers examined several predictors of treatment response including age, gender, socioeconomic status, and the presence of comorbid ADHD or anxiety disorders. Of these predictors, younger age and the presence of an anxiety disorder predicted better treatment response in both conditions (Ollendick et al., 2016). Although both PMT and CPS were found to be similarly efficacious for treating ODD in youth, it is unclear how EF deficits relate to treatment outcomes. The current study sought to test whether pre-treatment EF deficits predict and/or moderate response to PMT vs. CPS. As noted earlier, previous research has not yet examined the effect of EF deficits on treatment response for those with ODD.

As previously described, PMT strives to improve a child's compliance with adult commands by modifying ineffective parenting practices (Kazdin, 2005; McMahon et al., 2011). On the other hand, CPS seeks to help parents and children collaboratively and proactively solve problems that are contributing to oppositional behaviors (Greene, 1998, 2010). Considering these differences in treatments, it is probable that EF abilities will affect treatment response. In order to effectively engage in CPS, EF skills are necessary. CPS requires children to work collaboratively and proactively with their parents and think critically and flexibly about the problems at hand in order to generate solutions (Greene, 1998, 2010). As previously noted, ODD is uniquely associated with a variety of EF deficits (Hobson et al., 2011; Jarrett & Hilton, 2017; Matthys et al., 2012). Due to those EF deficits associated with ODD and the nature of CPS, we

hypothesized that EF deficits would affect differential response to treatment (i.e., PMT vs. CPS). Specifically, we expected that EF deficits would predict a less robust response to CPS but would not affect response to PMT (i.e., a significant treatment group x EF interaction). Additionally, we investigated how EF deficits related to attrition rates in order to determine whether EF deficits affect treatment engagement. Given the aforementioned components of CPS, we hypothesized that those with greater EF deficits would be more likely to drop out of a treatment like CPS, which requires greater EF demands.

CHAPTER 2

METHOD

Participants

Participating families included parents and children who entered a study offering treatment for children's oppositional behavior problems (Ollendick et al., 2016). Families were referred by mental health professionals, family physicians, school personnel, and targeted via local advertisements. Potentially eligible families participated in a phone screen (n = 164) and were given relevant information about the study goals and procedures. Parents and children then gave written informed consent and assent as approved by the university's institutional review board. Parents and children completed a comprehensive assessment to confirm a diagnosis of ODD and determine any comorbid diagnoses prior to the start of intervention. Children between the ages of 7 and 14 who met full diagnostic criteria for ODD were included in the study. Almost all (99%) children presented with one comorbid disorder and most (83%) presented with a third disorder. The most common comorbid diagnosis was ADHD (67.9%). Exclusionary criteria included a diagnosis of conduct disorder (CD), autism spectrum disorder, a psychotic disorder, intellectual impairment, or current suicidal or homicidal ideation. Overall, 134 children met inclusion criteria and participated in the study.

Procedure

Eligible children were randomly assigned to one of two treatment groups (n = 67 per group). Eleven children were assigned to a waitlist control condition prior to treatment. Children who still met criteria for an ODD diagnosis following the waiting period (100%) were randomly assigned to one of the two active treatments. Children and parents participated in a post-treatment assessment 1 – 2 weeks after completing the final treatment session as well as a 6-

month follow-up and year-1 follow-up. Families were compensated $50 at all assessments for a total of $200.

At all assessments, each family was assigned two clinicians. Clinicians were supervised graduate students in an American Psychological Association (APA)-approved clinical psychology doctoral program, or postdoctoral fellows, and were trained to high levels of competence to ensure the reliability and validity of interview data. None of these clinicians served as individual therapists for the families they assessed. The university's institutional review board approved all procedures.

Measures

Clinician Administered

Anxiety Disorders Interview Schedule for DSM-IV, Child and Parent Versions (ADIS-C/P; Silverman & Albano, 1996). All study participants were assessed using the ADIS-C/P. The ADIS-C/P is a semi-structured diagnostic interview designed to diagnose a range of psychiatric disorders in children and adolescents. Clinicians interviewed parents to determine the presence of ODD symptoms. The clinician assesses symptoms and obtains frequency, intensity, and interference ratings on a scale ranging from 0-8. The ratings are then used by the clinicians to identify diagnostic criteria and to develop a clinician severity rating (CSR). A CSR of 4 or greater on a 0 – 8 scale is indicative of a clinical diagnosis. All clinicians were trained in administering the ADIS-C/P via a 3-hour workshop, two practice interviews, and two live observations of administration with a trained clinician.

The ADIS-C/P has been shown to be reliable and valid for the diagnosis of ODD and ADHD, the diagnoses of particular interest in the current study (Anderson & Ollendick, 2012; Jarrett, Wolff, & Ollendick, 2007). Additionally, the ADIS-C/P has shown acceptable test–retest

reliability (Silverman, Saavedra, & Pina, 2001) and interrater agreement (Grills & Ollendick, 2003). All diagnostic interviews with families were videotaped, and 20% of pre-treatment interviews were reviewed by a second clinician to compute agreement. Using Cohen's kappa, agreements on diagnoses were .77, .85, and .86 for primary, secondary, and tertiary diagnoses, respectively. For assessments at each timepoint, consensus diagnoses were formed based on independent reports from the ADIS-C and ADIS-P. Consensus meetings were held weekly with the two ADIS clinicians and the doctoral-level clinical psychologist supervising the assessments. At pre-treatment, the full ADIS-C/P was administered. At post-treatment, only the ADIS-C/P modules for diagnoses endorsed at pre-treatment were administered. For the current study, we focused on ODD symptoms reported in the parent interview at each timepoint (range = 0 – 8.

Parent-Report

Demographics. A comprehensive demographics questionnaire was used to assess numerous variables including age, race, ethnicity, socioeconomic status, and family structure.

Behavior Rating Inventory of Executive Function (BRIEF; Gioia, Isquith, Guy, & Kenworthy, 2000). The BRIEF is an 86-item self-report questionnaire completed by parents. Respondents are asked to indicate how often the behavior described in each item is true of their child. Items are rated on a 3-point Likert type scale with 1 corresponding to *Never,* 2 corresponding to *Sometimes,* and 3 corresponding to *Often.* Higher scores on the BRIEF are indicative of greater executive dysfunction. The reliability (α = .80-.98) and validity of the BRIEF are well-established (Gioia et al., 2000). For the parent report form, the internal consistency was high, with αs ranging from .80 to .98. The raw score for the Global Executive Composite (GEC) was utilized in the current study as a predictor of treatment response.

Behavior Assessment System for Children – Second Edition (BASC; Reynolds & Kamphaus, 1992) The BASC is a parent-report questionnaire. The BASC evaluates the behaviors, thoughts, and emotions of children and adolescents with *T* scores greater than or equal to 70 falling in the clinically significant range and *T* scores from 60 to 69 being considered ‘‘at risk.’’ The Attention Problems scale possesses acceptable internal consistency (Kamphaus & Frick, 2005; Cronbach’s $\alpha = .90$ in the current study) and test–retest reliability over a 2- to 8-week period (.74– .94; Reynolds & Kamphaus, 1992). In the present study, the Attention Problems scale was used as a predictor of treatment response.

Treatments

Parent Management Training (PMT; Barkley, 1997). In the PMT condition, six therapists (two male, four female) provided treatment based on Barkley’s (1997) training. This structured program provides nine consecutive weekly sessions for parents with one additional session four weeks following the last session to review and consolidate treatment gains. Based on pilot work in the community, the program was extended to twelve 75-minute sessions and implemented the follow-up session two weeks after the last session. In addition, the program was modified to include the child in each session so that parents could practice the skills learned prior to implementing them in the home. The program includes an explicit and detailed description of the goals and content for each session along with standardized handouts. Treatment consisted of the following components: (a) educating parents about the causes of defiant, noncompliant behavior; (b) instructing parents on positive attending through use of “special time”; (c) training parents to use attending skills to increase complaint behavior; (d) increasing the effectiveness of parental commands; (e) implementing a contingency management program; (f) using the time-out procedure; (g) managing children’s behaviors in public places; and (h) using a daily school-

home "report-card." Therapists received a 4-hour training workshop in PMT prior to the start of the project and participated in live supervision for 75-minute each week with a doctoral-level clinical psychologist with extensive experience in applying PMT.

Collaborative and Proactive Solutions (CPS; Green, 1998). In the CPS condition, eight therapists (four male, four female) provided treatment based on Greene's CPS model (Green, 1998, 2010). CPS is organized into four separate treatment modules: (a) identification of lagging skills and unsolved problems (such as completing chores and homework) that contribute to oppositional episodes, and discussion of how current parental responses may be counterproductive; (b) prioritization – helping parents prioritize which problems will be the focal point of initial problem-solving discussions; (c) introduction of the Plans framework which helps organize parent's responses to problems: Plan A (solving a problem unilaterally, through imposition of the adult and often with adult-imposed consequences), Plan B (solving a problem collaboratively and proactively), Plan C (setting aside the problem for now); and (d) implementing Plan B – helping parents and children successfully use Plan B and discontinuing the use of Plan A. Although the clinician actively guides the problem-solving process, the goal of treatment is to help the child and parent(s) to increasingly implement Plan B independently. CPS was implemented in twelve, 75-minute sessions with a follow-up session two weeks after the last session. As with PMT, the child and parent(s) were present in each session so that the skills could be practiced prior to implementing them in the home. The therapists received a 4-hour training workshop in the treatment before the start of the project and participated in supervision for 75 minutes each week with a doctoral-level clinical psychologist experienced in applying CPS.

Attrition. Defined as having completed six or fewer treatment sessions, 13 of the 67 families randomly assigned to PMT dropped of treatment (19.4%), and 15 of the 67 families randomly assigned to CPS dropped out of treatment (22.4%). The remaining 106 participants completed treatment. Of these, 89 completed the post-treatment assessment (83.3%).

Treatment Adherence. Treatment fidelity for both PMT and CPS was assessed with a six-item checklist completed by the clinical supervisors and based off the verbalizations and behaviors of the therapists as observed in session videotapes that were reviewed during supervision. The checklist was completed at the end of each treatment session and included three proscriptive and three prescriptive items for each treatment. Items included "Therapists and the parents discussed implementation of a contingency contracting system to monitor specific behaviors and to reinforce and consequate behaviors according to the contracting system" for PMT and "Therapists instructed parents on three potential response options for dealing with their child's behaviors and helped them implement Plan B strategies (e.g., how to solve problems collaboratively taking into consideration identifying lagging skills in the child)" for CPS.

CHAPTER 3

RESULTS

Data Analysis

Preliminary data analyses were carried out using SPSS statistical software. We first examined the data for distributional characteristics and outliers using standardized *z* scores. We did not identify any significant outliers or abnormal distributional characteristics. Therefore, it was not necessary to correct for any outliers or atypical distributions. Next, we evaluated descriptive statistics and correlations among variables. Full descriptive statistics and bivariate correlations are reported in Table 1. Bivariate correlations between treatment condition and ODD symptoms at each time point were not significant (*p*s > .05). Surprisingly, treatment condition and parent-reported Attention Problems were significantly correlated ($r = -.21$, $p < .05$), with PMT associated with greater parent-reported Attention Problems. Parent-reported EF deficits at pre-treatment were significantly associated with Attention Problems ($r = .61$, $p < .05$), pre-treatment ODD Symptoms ($r = .25$, $p < .05$), ODD Symptoms at post-treatment ($r = .25$, $p < .05$), ODD Symptoms at 1-year follow-up ($r = .39$, $p < .05$), and both age ($r = .22$, $p < .05$) and gender (male = 1; female = 2; $r = .23$, $p < .05$). Next, treatment groups (PMT and CPS) were compared on key demographic variables by using chi-square tests for any categorical variables (e.g., gender) and *T* tests for continuous variables (e.g., age). In addition, the groups were also compared with regards to scores on the predictors and outcome measures at pre-treatment to determine if there were any significant differences between the two groups on any of the measures at the outset of the study (e.g., EF deficits). Independent-samples t-tests were conducted to compare Attention Problems, EF deficits, and ODD symptoms in both the PMT and CPS conditions. Consistent with correlational analyses, there was a significant difference in the

BASC Attention Problem scores for PMT (M = 66.7, SD = 5.93) and CPS (M = 63.8, SD = 7.85) conditions; t (121) = 2.31, $p < .05$. The two treatment groups did not differ significantly on EF deficits or ODD symptoms. See Table 2 for full descriptive statistics and independent samples t-tests.

Table 1.
Zero-order correlation, means, and standard deviations.

	M (SD)	1	2	3	4	5	6	7	8	9
1. Condition	-	-	-	-	-	-	-	-	-	-
2. BRIEF_GEC	70.74 (9.74)	-.18	-	-	-	-	-	-	-	-
3. BASC_Attention	65.18 (7.45)	-.21*	.61*	-	-	-	-	-	-	-
4. Pre_ADIS_ODD	6.17 (1.55)	.09	.25*	.01	-	-	-	-	-	-
5. Post_ADIS_ODD	3.83 (2.49)	-.02	.25*	.18	.11	-	-	-	-	-
6. M6_ADIS_ODD	3.97 (2.26)	.05	.08	.11	.08	.46*	-	-	-	-
7. Y1_ADIS_ODD	4.03 (2.43)	.08	.39*	.27	.41*	.48*	.66*	-	-	-
8. Age	9.61 (1.77)	-.04	.22*	.01	.15	.13	-.02	.14	-	-
9. Gender	1.38 (.49)	-.11	.23*	.14	.15	.18	.22	.15	.11	-
10. Attrition	-	-.04	-.12	-.04	-.08	-	-	-	-.08	.06

Note. n = 134, * = $p < .05$. Treatment condition was coded as 1 = PMT, 2 = CPS. Gender was coded 1 = male, 2 = female.

Table 2.
T-values, means, and standard deviations for treatment groups.

	PMT	CPS	
	M (SD)	M (SD)	t
1. BRIEF_GEC	71.9 (9.04)	68.6 (9.34)	1.98
2. BASC_Attention	66.7 (5.93)	63.8 (7.85)	2.31*
3. Pre_ADIS_ODD	6.0 (1.49)	6.3 (1.46)	-1.05
4. Post_ADIS_ODD	3.9 (2.60)	3.8 (2.40)	.21
5. M6_ADIS_ODD	3.9 (2.39)	4.1 (2.16)	-.35
6..Y1_ADIS_ODD	3.9 (2.49)	4.3 (2.40)	-.59

Note. n = 134, * = $p < .05$

Main Data Analyses

In our first analysis, we examined whether EF deficits were related to attrition. EF deficits and attrition status were not significantly correlated ($p > .05$; see Table 1 for correlations). In addition, it should be noted that pre-treatment ODD symptoms were not

correlated with attrition status ($p > .05$). A logistic regression was performed to determine if the relation between EF and attrition was moderated by treatment condition. The overall model was non-significant, suggesting the relationship between EF and attrition was not moderated by treatment condition.

In order to investigate change in ODD symptoms over time, we first attempted to run a repeated measures ANOVA, but given that this approach utilizes listwise deletion, the degree of missing data in the sample resulted in a very small sample size for this analysis. Thus, we proceeded to latent growth curve analyses that utilize maximum likelihood estimation (MLE) for missing data.

The individual growth curve approach hypothesizes that, for each individual, the outcome variable is a specified function of time called the individual growth trajectory, along with error. This trajectory is defined as a simple linear function of time that contains an intercept and a slope, two unknown growth parameters. The intercept and slope determine the shape of actual growth over time. The intercept represents the net elevations of the trajectory over time, whereas the slope represents the rate of change over time.

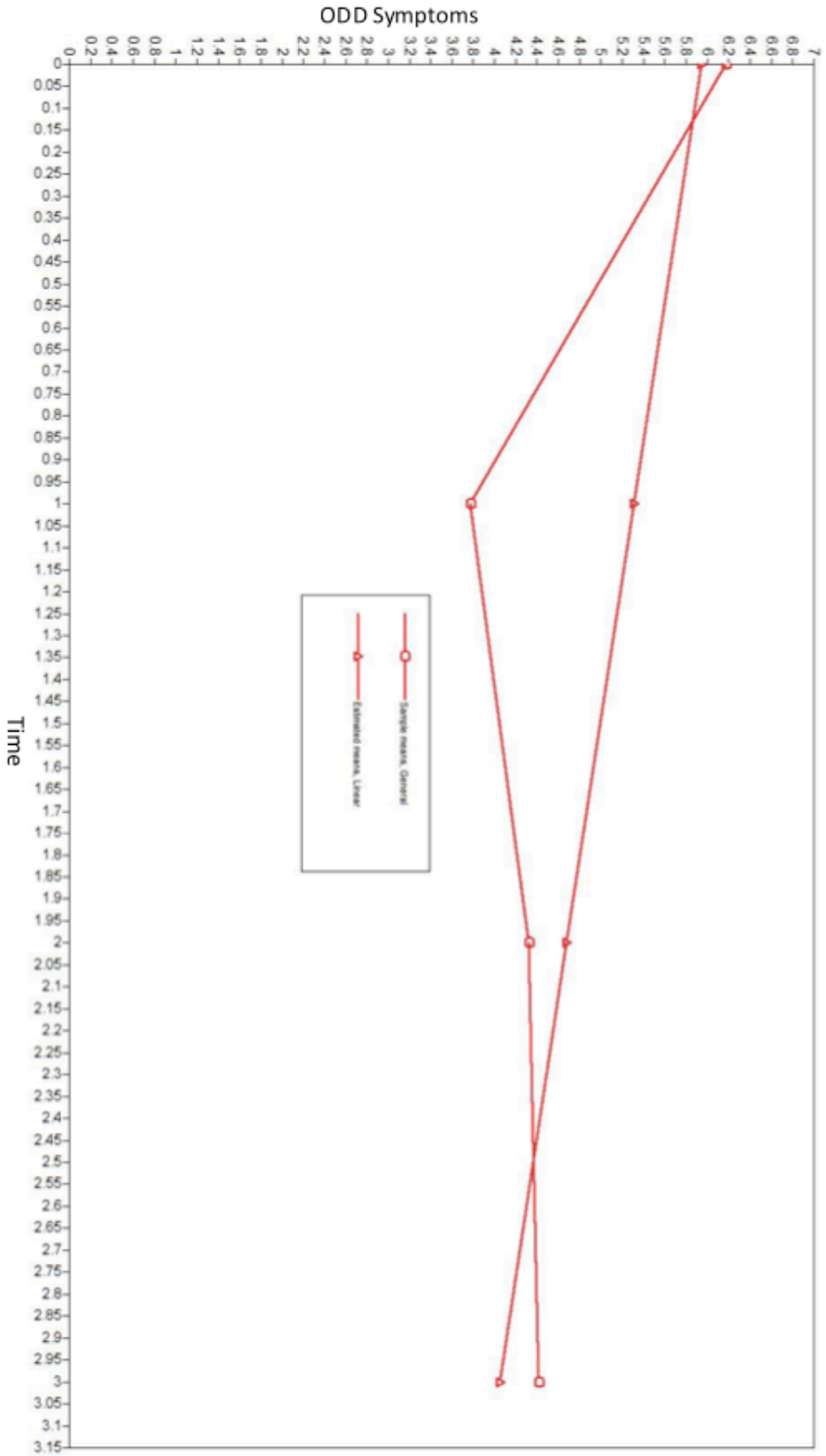
We used growth curve modeling to examine change in ODD symptoms over time along with predictors to account for individual differences in change over time. All available data were used in the analyses. Longitudinal analyses were conducted in MPlus using MLE with robust standard errors to account for missing data. MLE is a commonly used approach and well-established method (Garson, 2013).

These analyses involved multiple steps. First, we investigated change in ODD symptoms as a function of time, without predictors (i.e., an unconditional growth model) in which we first posited a linear trajectory. Both the intercepts and slopes were allowed to vary. In the

unconditional growth model, the estimated linear slope was significantly negative, indicating that ODD symptoms decreased over time (Estimate = -.63, $p < .05$). A visual representation of the linear model can be seen in Figure 1.

Figure 1.

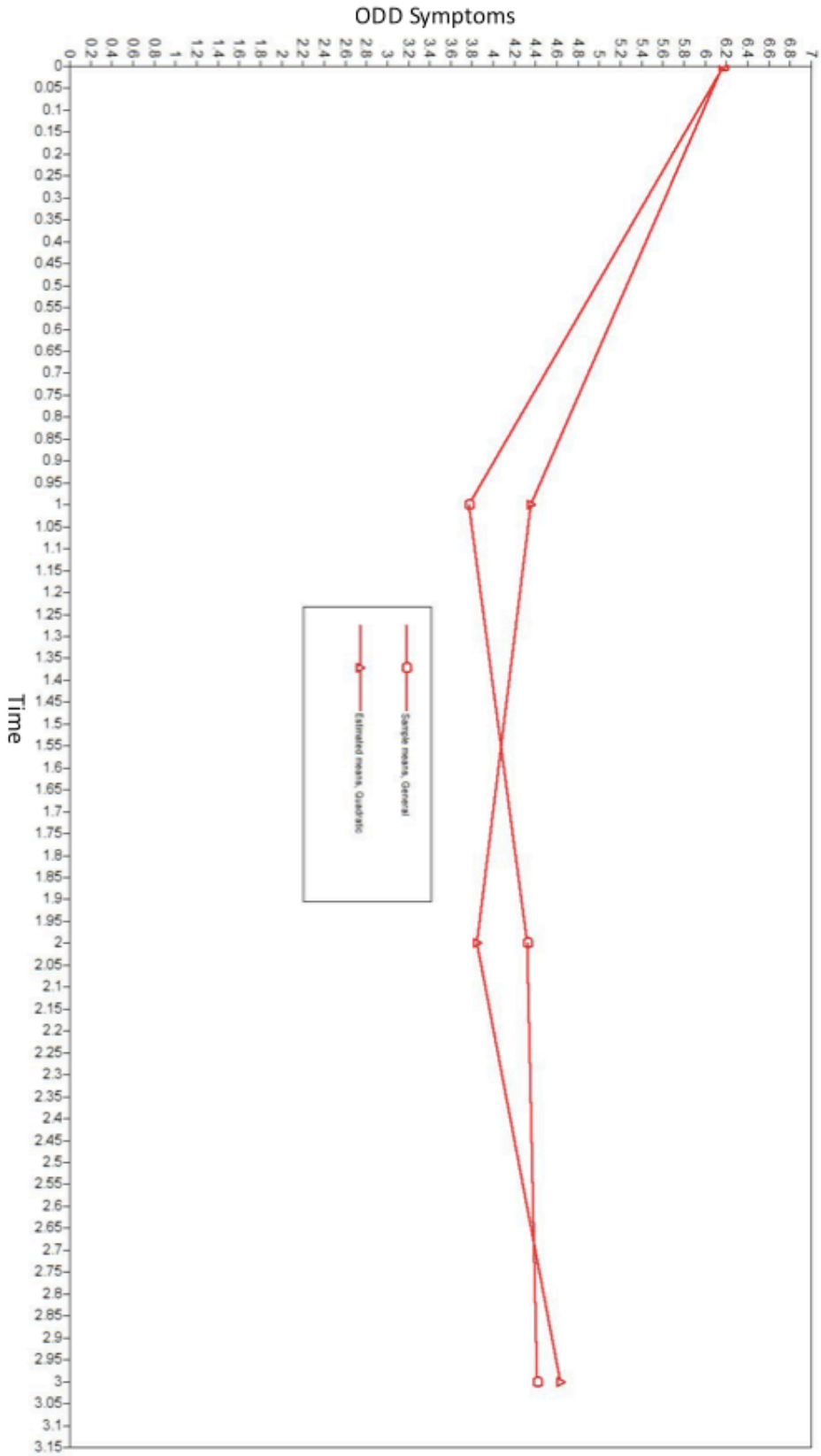
Linear Growth Curve Model



Next, we tested a second unconditional growth model with a quadratic term. In this model, both the linear slope (Estimate = -3.77, $p < .05$) and quadratic slope (Estimate = 1.48; $p < .05$) were significant. Given that we utilized MLE with robust standard errors due to missing data, direct model comparison is not possible using a χ^2 difference test. Given that the quadratic effect was significant, we retained a quadratic effect in the subsequent conditional model with predictors. A visual representation of the quadratic model can be seen in Figure 2.

Figure 2.

Quadratic Growth Curve Model



Prior to running the conditional model, we removed the following nonsignificant paths: linear slope with intercept, quadratic slope with intercept, and quadratic slope with linear slope. Although the variances for intercept, linear slope, and quadratic slope were not significant (*p*s > .05), we still chose to pursue our planned analyses. The conditional model included the following initial predictor variables: Treatment condition, EF deficits at pre-treatment (Global Executive Composite *T* score), parent-reported attention problems (BASC Attention Problems *T* score), and the interaction between EF and treatment condition. Adding these variables as predictors allowed us to determine how these variables affected the slope and intercept of ODD symptoms. It should be noted that the interaction term was only estimated for slope and not intercept, since this term was not predicted to relate to intercept. For intercept, both attention problems (Estimate = -.04) and EF (Estimate = .07) were significant predictors of intercept (*p*s < .05) with greater attention problems associated with a lower ODD pre-treatment score and greater EF deficits associated with a higher ODD pre-treatment score. A reduced model was run again without treatment condition as an intercept in the model. Both attention problems (Estimate = -.05) and EF problems (Estimate = .06) remained as significant predictors of intercept (*p*s < .05). In relation to slope, none of our predictors were significant using either a linear slope or quadratic slope. We further explored reduced models without the interaction terms and without both attention problems and EF deficits in the model due to possible shared variance and power concerns. Following these steps, we explored an interaction term between attention problems and condition both with and without EF in the model. None of these exploratory models resulted in significant predictors of slope. Finally, we also ran all the analyses described above with ODD symptoms modeled as a count variable. In general, results were very similar to the results described above.

CHAPTER 4

DISCUSSION

Previous research has indicated that both PMT and CPS are similarly efficacious for treating ODD in youth; however, it remains unclear how EF deficits relate to treatment outcomes, specifically in the reduction of ODD symptomology. We sought to test whether pre-treatment EF deficits predict or moderate response to PMT vs. CPS. PMT seeks to improve a child's compliance with adult commands by modifying ineffective parenting practices (Kazdin, 2005; McMahon et al., 2011), whereas CPS aims to help parents and children collaboratively and proactively solve problems that are contributing to oppositional behaviors (Greene, 1998, 2010). Considering these differences in treatments, the EF deficits associated with ODD, and the nature of CPS, we hypothesized that EF deficits would affect differential response to treatment (i.e., PMT vs. CPS). More specifically, we expected that EF deficits would predict a less robust response to CPS (given its EF demands) but would not affect response to PMT. We predicted that group status would interact with EF deficits such that those in the CPS condition would show less of a decline on ODD symptoms over time as pre-treatment EF deficits increase while EF deficits would be unrelated to PMT treatment response. Our initial results indicated that overall, ODD symptoms decreased over time. When we investigated how treatment condition, EF deficits, and attention problems contributed to the reduction of ODD symptoms over the course of time, we found that none of these constructs predicted change in ODD symptoms even though EF deficits and attention problems were both related to the level of pre-treatment ODD symptoms. We considered the possibility that attention problems and EF deficits might represent overlapping constructs, so we investigated models with only one of these predictors to address shared variance concerns; however, the results were still nonsignificant indicating that neither

construct influenced change in ODD symptoms over time.

Additionally, given the challenging nature of the CPS treatment, we hypothesized that those with greater EF deficits would be more likely to drop out of a treatment like CPS, which requires greater cognitive flexibility and working memory demands. To address this hypothesis, we performed a logistic regression to determine if the interaction of group status and pre-treatment EF deficits predicted attrition status. The results were nonsignificant, suggesting that families were equally likely to drop out of treatment regardless of EF deficits.

Overall, the results did not align with our initial hypotheses. There are several possible explanations for what was observed. Perhaps individuals are successful in both PMT and CPS regardless of EF deficits. If our hypotheses were supported, it would be important to consider EF deficits when selecting a treatment for ODD; however, our findings support the view that both PMT and CPS both result in improvements in ODD symptoms. Therefore, it might not matter which of these evidence-based treatments are used (at least in relation to pre-treatment EF deficits).

Although our analyses used well-established methods to account for missing data, this was still a significant limitation of the current study. Maximum likelihood estimation estimates missing data based on trends in the existing data; therefore, the predicted data values are similar to other values in the dataset. Due to the degree of missing data in this study, it is possible that MLE reduced natural variance in the data that might have yielded predictions of treatment response. If examined in the future, a larger sample size would be imperative. Furthermore, additional measures of EF deficits throughout treatment would help to shed light on whether EF deficits are changing during the course of treatment. Given that previous research has found that levels of inhibitory control moderate treatment response, perhaps it is a more specific component

of EF that affects how individuals differentially respond to treatment. Future studies might examine specific facets of EF that might predict treatment response for ODD.

Despite insignificant findings, future research should continue to investigate the role that EF deficits play in treatment response for ODD. Additionally, studies should examine whether a treatment like CPS, which requires the participants to generate and modify mutually satisfactory solutions, might change EF deficits throughout the course of treatment.

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APPENDIX

THE UNIVERSITY OF ALABAMA | Office of the Vice President for Research & Economic Development
Office for Research Compliance

February 22, 2019

Savannah King
Psychology
Box 870348

Re: IRB # EX-19-CM-027: "The Effect of Executive Function Deficits on Treatment Response in Children with Oppositional Defiant Disorder"

Dear Ms. King,

The University of Alabama Institutional Review Board has granted approval for your proposed research. Your application has been given exempt approval according to 45 CFR part 46. Approval has been given under exempt review category 4 as outlined below:

(4) Research involving the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens, if these sources are publicly available or if the information is recorded by the investigator in such a manner that subjects cannot be identified, directly or through identifiers linked to the subjects.

The approval for your application will lapse on February 21, 2020. If your research will continue beyond this date, please submit the continuing review to the IRB as required by University policy before the lapse. Please note, any modifications made in research design, methodology, or procedures must be submitted to and approved by the IRB before implementation. Please submit a final report form when the study is complete.

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