THE DYNAMICAL SYSTEMS APPROACH FOR STUDYING CHANGE IN YOUTH RECEIVING TREATMENT FOR ANXIETY DISORDERS

A Dissertation
Submitted to
the Temple University Graduate Board

In Partial Fulfillment
of the Requirements for the Degree
DOCTOR OF PHILOSOPHY

---

by
Matthew M. Carper, M.A.
Diploma Date (August 2019)

Examining Committee Members:

Philip C. Kendall, PhD, ABPP Advisory Chair, Department of Psychology, Temple University
Deborah Drabick, PhD, Department of Psychology, Temple University
Thomas Olino, PhD, Department of Psychology, Temple University
Lauren Alloy, PhD, Department of Psychology, Temple University
Tania Giovannetti, PhD, Department of Psychology, Temple University
Jennifer Silk, PhD, External Member, Department of Psychology, University of Pittsburgh

ABSTRACT

Cognitive behavioral therapy (CBT) has been shown to be an efficacious treatment for youth anxiety, but we do not have a satisfactory understanding of how CBT achieves its beneficial effects. The present study used a dynamical systems framework to model ecological momentary assessment (EMA) data collected via a cellular telephone and to examine patterns of affective variability over time and across CBT and client-centered therapy (CCT) treatments. Dynamical systems are systems that change over time in response to input from the environment and from itself at an earlier time. Associations between pretreatment variables and patterns of affect at pretreatment and over the course of the treatments were also examined. Results revealed significant decreases in affective variability over the course of treatment for participants in the CBT condition, but not for those in the CCT condition. Several variables (i.e., emotion regulation coping related to anger, depressive symptoms, and affiliative temperament) predicted initial affective variability ratings and changes in affective variability over time. Findings provide initial support for the dynamical systems approach to examining changes that occur during treatment. Implications for the examination of mechanisms of change are discussed.

To John Carper, MD, who inspired me to dedicate my career to improving the lives of youth, and to my family, friends, and mentors who have supported me during this long journey. I am forever grateful for your love and support.

ACKNOWLEDGMENTS

Thank you to all the faculty mentors who have helped me complete this project, the research assistants who helped gather these important data, and my fellow graduate students who provided moral support through the dissertation process.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

Anxiety disorders are common in youth, affecting between 3% and 24% of youth (Cartwright-Hatton, McNicol, & Doubleday, 2006). The DSM-5 (American Psychiatric Association, 2013) lists eight anxiety disorders: Generalized Anxiety Disorder (GAD), Social Anxiety Disorder (SAD), Specific Phobia (SP), Panic Disorder (PD), Agoraphobia (AG), Separation Anxiety Disorder (SepAD), Selective Mutism (SM), and Anxiety Not Elsewhere Classified (NEC). The disorders are often comorbid (Kendall et al., 2010), and are associated with a variety of adverse outcomes, including impairment in school, family, and social situations (Ialongo, Edelsohn, Werthamer-Larsson, Crockett, & Kellam, 1994; Swan & Kendall, 2016). Left untreated, these disorders rarely remit on their own (Compton, Burns, Egger, & Robertson, 2002) and put individuals at greater risk for anxiety, depression, substance abuse, educational underachievement, and suicidality later in life (O'Neil, Puleo, Bejamin, Podell, & Kendall, 2012; Swan et al., 2018; Wolk, Kendall, & Beidas, 2015; Woodward & Fergusson, 2001).

Cognitive behavioral therapy (CBT) has been identified as a well-established empirically supported treatment (EST) for childhood anxiety (Hollon & Beck, 2013), typically achieving response rates of 60% in large randomized clinical trials (e.g., Kendall, Hudson, Gosch, Flannery-Schroeder, & Suveg, 2008; Walkup et al., 2008). In some community settings, response rates have been less favorable (Wei et al., 2014). However, much remains to be understood about the mechanisms of change that render CBT for youth anxiety effective; that is, how CBT achieves its positive results and what

factors (pretreatment and within treatment) differentiate treatment responders from nonresponders (Shirk, Jungbluth, & Karver, 2012; Stiles & Shapiro, 1994). Knowledge of these factors would allow researchers and practitioners to personalize and improve treatment effectiveness by enhancing treatments around their mechanisms of change (Kazdin & Kendall, 1998). For a discussion of predictors, moderators, and mediators of treatment response for internalizing youth, including future directions for understanding of mechanisms of change, please see Appendix A.

Current research aimed at understanding the mechanisms of change in CBT for youth anxiety has taken a nomothetic approach to analysis, aggregating large samples to understand what predicts, moderates, and mediates outcome for the "average" anxious youth (Kazdin, 2003; Nock, Janis, & Wedig, 2008). Deviations from the "average" youth, or *intra*-individual variability, are typically viewed as error variance in common data analytic techniques (Collins & Sayer, 2000; Molenaar, 2004). However, it can be stated that only a small number of youth present for treatment similarly to the "average" anxious youth, which limits the transportability of strategies from research to clinical settings. Additionally, many analytical approaches used in treatment outcome research assume that change is linear, which is rarely the case in practice (Hayes & Feldman, 2007; Hayes, Laurenceau, Feldman, Strauss, & Cardaciotto, 2007). To successfully model nonlinear change, multiple assessments from the same individual must be collected prior to, during, and after treatment. Various models could then be constructed to test various change processes specific to certain parts of treatment or active throughout treatment. Simply put, an alternative approach to data collection and data analysis offers

an opportunity to improve the ability to identify predictors of differential treatment gain and elucidate the mechanisms through which positive change occurs during CBT for youth anxiety; this information could then be used to personalize treatments to individual client presentations. This approach is consistent with the call to take idiographic approaches to treatment outcome research (Barlow & Nock, 2009; Molenaar, 2004; Molenaar & Campbell, 2009) in general, and increased excitement around the dynamical systems approach, in particular. Given the adverse outcomes associated with untreated youth anxiety, there is a need for studies that examine mechanisms of change in CBT idiographically and nomothetically.

Brief Overview of Dynamical Systems Approaches

Originally developed for the hard sciences, a dynamical systems approach has been used in a variety of scientific disciplines to model the nonlinear behavior of a variety of systems. Dynamical systems approaches have been used in mental health (Vallacher, Coleman, Nowak, & Bui-Wrzosinska, 2010; Vallacher & Nowak, 1997), as well as to study mechanisms of change in CBT (A.J. Fisher, Newman, & Molenaar, 2011; Hayes & Feldman, 2007; Hayes et al., 2007; Hayes & Strauss, 1998; Hayes & Yasinski, 2015; Hayes, Yasinski, Ready, Laurenceau, & Chen, under review; Newman & Fisher, 2013) and other forms of psychological treatment (Pascual-Leone, 2009). A dynamical system is a system that changes over time in response to input from the environment and from itself at an earlier time; these dynamical systems are often studied through the use of differential equations to model individual trajectories (Boker, 2001; Boker & Laurenceau, 2006; Salvatore & Tschacher, 2012; Thelen & Smith, 2006).

Further, dynamical systems approaches tend to treat the unit of analysis as a pattern rather than a specific variable. Patterns serve as a better unit of analysis than single variables because they emphasize the relationships both within and between constructs (Kelso, 1995). Thus, patterns describe not only how one construct is related to another, but also how a single construct changes across time.

Dynamical systems approaches posit that although numerous patterns of cognition and affect are possible, individuals will only display a limited number of these patterns. Simply put, individuals prefer to operate in a manner consistent with their most salient underlying pattern of cognition and affect. In dynamical systems terminology, these particularly salient patterns that govern action are labeled attractor states. The stronger the attractor state is (i.e., the more ingrained the underlying pattern of affect, cognition, and behavior), the more energy is required to move a system from this preferred state. In the context of anxiety, youth with anxiety disorders who do not respond to treatment may have particularly strong anxious attractor states that prevent them from responding to available treatments or bring them back to an anxious state when treatment is temporarily effective. In clinical terms, these youth may have particularly stable patterns of affect and behavior that are hard to break with existing treatment approaches.

Dynamical systems approaches involve studying the tension between states of stability (order) and variability (flexibility). As such, the dynamical systems approach emphasizes the study of attractors (stable patterns of affect); what happens when attractors become perturbed (for example, through psychological treatment); and how some attractors become replaced by new attractors (termed “phase changes”). Many

psychological treatments for anxiety, including those for anxious youth such as the Coping Cat (Kendall & Hedtke, 2006a), are designed to dislodge stable and maladaptive patterns of cognition (e.g., through cognitive restructuring) and behavior that maintain anxiety (e.g., by decreasing avoidance behaviors and parental accommodation) and replace these patterns with more adaptive ways of functioning (e.g., increasing approach to feared stimuli through exposure tasks). Thus, dynamical systems approaches provide a useful framework for quantifying the phenomenological processes active prior to, during, and after receiving psychological treatment (for review, see Carper, Makover, & Kendall, 2018). Hayes and Yasinski (2015) echo this point in saying, "[successful therapy] involves the activation of these pathological patterns, together with exposure to corrective information and new experiences that induce dissonance…that challenges patients to develop new cognitive-affective-behavioral-somatic patterns" (p. 2). The use of a dynamical systems approach to study mechanisms of change in CBT allows for novel experimental paradigms designed to inform us about how CBT achieves its beneficial effects. Through a better understanding of how CBT achieves its beneficial effects and what differentiates treatment responders from nonresponders, interventions can be personalized to target treatment-refractory youth.

Benefits of Ecological Momentary Assessment

Research taking a dynamical systems perspective requires intensive longitudinal data. Ecological momentary assessment (EMA) collects real-time data in participants' natural environments, assessing changes over time and across situations (Shiffman, Stone, & Hufford, 2008). These rich longitudinal data emphasize the uniqueness of the

individual, how the individual responds to their environment, and the interaction of these factors with the passage of time. Additionally, EMA methods reduce retrospective recall bias associated with self-report questionnaires (Piasecki, Hufford, Solhan, & Trull, 2007; Solhan, Trull, & Wood, 2009). Thus, studies using EMA methods invite inquiry into previously difficult-to-answer research questions with a high degree of measurement precision.

The benefits that EMA methods offer to researchers are numerous and the approach is being used to a greater extent within the field. EMA methods allow participants to respond in real time, reducing the recall bias prevalent in self-report instruments. Additionally, EMA data allow for the modeling of both *inter*- and *intra*-individual change by gathering repeated assessments of the same individual over time. Thus, researchers modeling EMA data can draw on a plethora of time series analytical techniques that psychological treatment researchers were previously unable to use because these techniques required a high density of assessments.

Whereas EMA began with beepers, daily diaries, and automated phone calls, the rapid rate at which technology has evolved has changed the face of EMA data collection. Smartphones and tablets are extremely common, with nearly three quarters of teenage youth having regular access to a smartphone and 94% of youth with smartphones accessing the internet daily or more often (Pew Research Center, 2015). Given the penetration smartphones have in our society, scientists have teamed with application ("app") developers to develop smartphone apps capable of improving the scientific process, including the collection of EMA data (Estrin & Sim, 2010; Kendall, Carper,

Khanna, & Harris, 2015; Luxton, McCann, Bush, Mishkind, & Reger, 2011). These apps have the potential to increase the reach of psychological interventions and assessments through the high degree of scalability offered by technological approaches. Though EMA data have been used to examine the process of change in CBT for youth previously (e.g., Silk et al., 2011; Tan et al., 2012), previous research has not examined the process of change both idiographically (person-centered) and nomothetically (group-based), which limits the ability to generalize results beyond the "average" anxious youth.

The Present Study

The present study used a dynamical systems approach to examine the process of change that occurs during two forms of treatment for youth anxiety (CBT and Client Centered Therapy [CCT]). Findings from a randomized controlled trial (Silk et al., 2018) from which the data for the present study were taken revealed that although most youth in both CBT and CCT conditions responded to treatment, youth treated with CBT were more likely to fully recover (defined as no longer meeting criteria for any targeted anxiety disorder and no longer experiencing residual anxiety symptoms [Pediatric Anxiety Rating Scale scores ≤ 10]) than those treated with CCT. This differential finding was maintained at one-year follow up.

The specific construct under examination in the present study is affective variability, which quantifies the level of fluctuation in positive and negative affect (simultaneously or separately). The dynamical systems approach was used (a) to model affective variability from EMA data collected over the course of CBT and CCT treatments for youth anxiety and (b) to examine changes in affective variability over the

course of CBT for youth anxiety as compared to a control condition (client-centered therapy [CCT]). The present study also explored associations between pretreatment variables and patterns of affect, cognition, and behavior prior to treatment, as well as the relationship between these variables and changes that occur during two treatments. We hypothesized that (a) a dynamical systems approach could be used to model change in affective variability that occurred over the course of two treatments, and (b) that the shape of change in affective variability over the course of CBT treatment would be quadratic whereby an initial increase in affective variability would be followed by decreases in affective variability for participants in the CBT condition. As an exploratory aim, we also examined youth anxiety symptom severity, depressive symptom severity, emotion regulation, youth temperament, and comorbidity as predictors of (a) initial affective variability as well as (b) changes in affective variability over the course of treatment. Given that this aim was purely exploratory, there are no specific hypotheses related to the direction of effects for these variables.

CHAPTER 2

METHODS

The present study examined data from the Child Anxiety Treatment Study (CATS; NC00774150). The CATS was designed to examine neurobehavioral and social correlates of treatment response among youth (aged 9 to 14 years) with anxiety disorders (GAD, SepAD, and/or Social Phobia).

Participants

Participants in CATS were 135 youth aged 9 to 14 years (M_{age} = 10.49 years, SD = 1.26). Potential participants were recruited through community advertisements (84%) and referrals from pediatricians, school counselors, or mental health professionals (16%). Four participants were randomized, but excluded from any analyses *a priori* because of the development of a medical condition (n = 2) or discovery of exclusionary criteria (see below; n = 2) during treatment. Fifty-six percent of the sample was female and the sample was predominantly Caucasian (89%), but also included African American (4%), Latinx (1%), and Biracial (6%) youth. Table 1 presents demographic information from the present sample, including comparisons between the two treatment conditions.

Table 1. *Participant demographic information.*

Variable Name	**CCT**	**CBT**	***p*-value**
	***M*(*SD*)**	***M*(*SD*)**	
Age	10.85 (1.55)	10.95 (1.42)	0.82
Female Gender (N[%])	23(61%)	46(58%)	0.06
Number of diagnoses	1.58(0.79)	1.44(0.67)	0.34
Number of anxiety diagnoses	1.32(0.62)	1.30(0.49)	0.91
Number of non-anxiety diagnoses	0.26(0.60)	0.14(0.18)	0.27
Child-Reported Variables			
EATQ-R – Activation control	3.32(0.67)	3.25(0.66)	0.64
EATQ-R – Activity Level	3.14(0.77)	3.23(0.76)	0.61
EATQ-R – Attention	3.10(0.60)	3.07(0.65)	0.81
EATQ-R – Fear	3.43(0.81)	3.26(0.90)	0.39
EATQ-R – Inhibitory Control	3.28(0.53)	3.29(0.69)	0.98
EATQ-R – Frustration	3.45(0.63)	3.32(0.92)	0.41
EATQ-R – High Intensity Pleasure/Surgency	2.72(0.73)	2.93(0.65)	0.18
EATQ-R – Shyness	3.52(0.91)	3.31(0.90)	0.31
CEMS – Angry Inhibition	7.44(1.91)	7.34(2.13)	0.83
CEMS – Angry Emotion Regulation Coping	8.11(2.29)	7.94(1.91)	0.71
CEMS - Angry Dysregulated Expression	5.19(1.36)	5.28(1.57)	0.79
CEMS – Sad Inhibition	8.00(2.04)	7.32(2.32)	0.19
CEMS – Sad Emotion Regulation Coping	10.15(2.14)	9.71(1.88)	0.33

Table 1. *Participant demographic information (continued)*

Child-Reported Variables (continued)	**CCT** ***M*(*SD*)**	**CBT** ***M*(*SD*)**	***p*-value**
CEMS – Sad Dysregulated Expression	5.67(1.78)	6.00(1.57)	0.38
MFQ Total – Child	20.38(14.27)	18.39(10.07)	0.47
SCARED-C	42.75(13.25)	37.68(12.40)	0.06
Pretreatment Dispersion	0.67(0.18)	0.68(0.18)	0.88
Parent-Reported Variables			
EATQ-R- Activation Control	2.74(0.68)	2.95(0.67)	0.13
EATQ-R – Attention	2.87(0.60)	3.13(0.58)	0.03*
EATQ-R – Fear	3.25(0.63)	3.37(0.57)	0.29
EATQ-R – Inhibitory Control	3.75(0.64)	3.66(0.65)	0.52
EATQ-R – Frustration	3.51(0.71)	3.46(0.66)	0.71
EATQ-R – High Intensity Pleasure/Surgency	2.60(0.67)	2.64(0.64)	0.78
EATQ-R – Shyness	2.87(0.64)	3.01(0.87)	0.35
EATQ-R – Affiliation	3.37(0.54)	3.52(0.69)	0.24
EATQ-R – Aggression	2.65(0.66)	2.60(0.63)	0.74
EATQ-R – Depressive Mood	3.10(0.83)	2.91(0.62)	0.19
MFQ Total – Parent	13.93(8.89)	14.98(10.02)	0.59
SCARED-P	35.93(12.17)	36.48(11.81)	0.82

Note: EATQ-R = Early Adolescent Temperament Questionnaire – Revised; MFQ = Mood and Feelings Questionnaire; SCARED = Screen for Child Anxiety Related Emotional Disorders.

Inclusion criteria. Participants in CATS were required to (a) meet DSM-IV (American Psychiatric Association, 1994) criteria for current Generalized Anxiety Disorder (GAD; n = 92), Separation Anxiety Disorder (SepAD; n = 33), and/or Social Anxiety Disorder (SAD; n = 28). Youth with comorbid disorders were not generally excluded (see exclusion criteria for several exceptions). The final sample included 51 youth diagnosed with multiple anxiety disorders and 35 youth with other comorbid disorders including Tourette's or Tic Disorders (n = 5), Major Depressive Disorder (n = 1), Attention-Deficit/Hyperactivity Disorder (ADHD), Inattentive Subtype (n = 4), and Oppositional Defiant Disorder (n = 3).

Exclusion criteria. Youth were excluded from the CATS if they (a) had an IQ below 70 as assessed by the Weschler Abbreviated Scale of Intelligence (WASI), (b) required current ongoing treatment with psychoactive medications including anxiolytics or antidepressants, (c) were acutely suicidal or at risk for harm to self or others, (d) experienced motor impairments or eye-hand coordination problems, (e) were not suited for fMRI procedures, (f) had a history of head injury, (g) had a neuromuscular or neurological disorder, or (h) had vision that is 20/40 and below and cannot be corrected by glasses. Diagnostic exclusion criteria included a current primary diagnosis of Major Depressive Disorder, a current diagnosis of Obsessive-Compulsive Disorder (OCD),

Posttraumatic Stress Disorder (PTSD), Conduct Disorder, Substance Abuse or Dependence, and ADHD Combined or Predominantly Hyperactive-Impulsive subtype. Youth were also excluded if they had evidence of an Autism Spectrum Disorder or a lifetime diagnosis of Bipolar Disorder, Psychotic Depression, Schizophrenia, or Schizoaffective Disorder.

Procedure

All study procedures were approved by the Institutional Review Board at the University of Pittsburgh. Potential participants contacted study staff members to indicate their interest in the study. A study staff member then completed a brief phone screen with interested families to determine potential eligibility for study entry. Following the phone screen, participants were scheduled for an intake assessment. During the intake assessment, an independent evaluator (IE) administered a structured diagnostic interview and anxiety rating scale. Youth participants and their primary caregivers each completed a set of self-report questionnaires. Immediately following the intake assessment, youth completed five days of EMA (see EMA procedures below) to assess pre-treatment functioning in their daily lives.

Following these intake procedures, youth were randomized to one of two treatment conditions: CBT or CCT. Restricted randomization was used to match participants across conditions by age and sex. Additionally, a 2:1 randomization ratio was used to randomize participants to CBT and CCT, respectively. This randomization ratio was chosen because the aims of the larger CATS study was to evaluate mechanisms involved in CBT treatment response.

Treatment was delivered by M.A. and doctoral level therapists who delivered both treatments in order to control for therapist characteristics. Both treatments (16 sessions) followed manuals and included 14 sessions with the child and two parent sessions; consultation with parents also occurred on a regular basis. Therapists were trained by experts in each protocol and participated in weekly supervision with expert therapists. Roughly 16% of therapy tapes were rated for treatment integrity and fidelity by the expert therapists using standardized checklists. Ratings indicated 98% integrity for CBT and 99% integrity for CCT. Throughout treatment, youth completed five days of EMA after every fourth treatment session.

Following treatment, youth and their families completed a post-treatment assessment. The procedures for the post-treatment assessment mirrored the pre-treatment assessment, including IE's completing a structured interview, parents and youth completing self-report questionnaires, and youth completing five days of EMA assessment.

CBT intervention. CBT was delivered using the *Coping Cat* therapist manual (Kendall & Hedtke, 2006a) and child workbook (Kendall & Hedtke, 2006b). The *Coping Cat* is a 16-session protocol that targets SAD, GAD, SepAD, and Specific Phobias. The initial 8 sessions focus on psychoeducation and skills training (e.g., relaxation, cognitive restructuring, and problem solving), whereas the second 8 sessions are comprised of graduated exposure tasks. The treatment also includes two parent meetings at sessions 4 and 9 where the therapist introduces parents to the CBT model, obtains additional targeted information from parents about their primary concerns and goals, and

encourages parents to assist in the completion of exposure tasks at home. Throughout treatment, youth are encouraged to practice the skills learned in session through homework assignments.

CCT intervention. Child-Centered Therapy (CCT; Cohen, Deblinger, Mannarino, & Steer, 2004; Cohen, Mannarino, & Knudsen, 2005) is a manualized nondirective, supportive psychotherapy based on humanistic principles such as unconditional positive regard, empathy, and therapist genuineness. CCT uses a variety of humanistic techniques such as active listening, reflection, accurate empathy, and encouragement to talk about feelings. CCT was developed to be analogous to typical supportive therapy that anxious children and adolescents receive in the community. Previous research has demonstrated that CCT is associated with significant decreases in PTSD symptoms at posttreatment, though not to as great an extent as CBT (Cohen et al., 2004). Child and parent satisfaction has also been shown to be comparable between CCT and CBT (Cohen & Mannarino, 1998). Given that CCT was originally developed as a treatment for youth with PTSD, content was adapted to be suitable for anxious youth.

Measures

Independent-evaluator administered measures. Independent-evaluators (IEs) blind to treatment condition administered the following measure.

Schedule for Affective Disorders and Schizophrenia in School-Age Children—Present and Lifetime version (K-SADS-PL; Kaufman, Birmaher, Brent, & Rao, 1997). Diagnoses were based on the K-SADS-PL, consistent with DSM-IV criteria (American Psychiatric Association, 1994). Parents and youth were interviewed separately, with IE's

integrating information from both interviews to determine the final diagnoses. Inter-rater reliability data were calculated for 16% of interviews. Reliability for the anxiety diagnoses was high (Kappa = 0.97).

Child-rated measures. Children completed a battery of self-report measures assessing their anxiety symptoms and other relevant variables.

Screen for Child Anxiety Related Emotional Disorders—Child version (SCARED-C; Birmaher et al., 1997). The SCARED is a 41-item (e.g., "I am nervous") measure of anxiety severity. Youth rate responses on a scale of 0 (not true or hardly ever true) to 2 (true or often true). The SCARED has demonstrated adequate psychometric properties, including internal consistency (α's range from 0.78 to 0.87) and discriminant validity between anxiety and depressive disorders, between anxiety and disruptive behavior disorders, and within anxiety disorders (Birmaher et al., 1999). In the present sample, Crohnbach's alpha ranged from 0.64 to 0.88.

Mood and Feelings Questionnaire (MFQ; Messer et al., 1995). The MFQ is a measure of depressive symptom severity that consists of 33-items of descriptive phrases regarding how the youth has been feeling or acting recently (e.g., "I felt miserable or unhappy"). Responses are rated on a scale from 0 (not true) to 3 (true). The MFQ has demonstrated adequate psychometric properties, including excellent internal consistency (α = 0.94) and convergent validity with diagnostic criteria for Major Depressive Disorder (diagnostic accuracy of 0.91) in clinical samples (Wood, Kroll, Moore, & Harrington, 1995). Internal consistency in the present sample was 0.91 for the child-reported version and 0.90 for the parent-report.

Children's Emotion Management Scales (CEMS): Anger, sadness, and worry (Zeman, Cassano, Suveg, & Shipman, 2008; Zeman, Shipman, & Penza-Clyve, 2001). The CEMS assesses children's self-report of sadness and anger. Children indicate the frequency with which they engage in a variety of emotion management strategies (e.g., "I can stop myself from losing my temper") using a Likert scale ranging from 1 (hardly ever) to 3 (often). Three subscales have been identified for each emotion, including Inhibition, Dysregulated Expression, and Emotion Regulation Coping. The CEMS has demonstrated adequate psychometric properties, including internal consistency (α's range from 0.62 to 0.77) and retest reliability (*r*'s range from 0.61 to 0.80). In the present sample, alpha ranged from 0.50 to 0.78.

Early Adolescent Temperament Questionnaire—Revised (Capaldi & Rothbart, 1992). The EATQ-R is a 65-item measure that assesses adolescents' temperament (e.g., "Likes taking care of other people"). Responses are rated on a 5-point Likert scale ranging from 1 (almost never true) to 5 (almost always true). Temperament scores are computed by summing ratings across relevant items. The EATQ-R has demonstrated adequate psychometric properties, including internal consistency (α's ranged from 0.61 to 0.74) and retest reliability (*r*'s ranged from 0.55 to 0.85) (Muris & Meesters, 2009). In the present study, all subscales were used as the aim examining predictors of changes in affective variability was purely exploratory. Crohnbach's alpha ranged from 0.60 to 0.78 for the child version and 0.14 to 0.91 for the parent version.

Parent-rated measures. Parents completed a battery of self-report measures assessing their anxiety symptoms and other relevant variables.

SCARED-P (Birmaher et al., 1999; Birmaher et al., 1997). The SCARED-P is the parent version of the SCARED (described above). The SCARED-P is comprised of 41-items that ask parents to rate how often specific statements are true about their child on a scale of 0 (not true or hardly ever true) to 2 (true or often true). The SCARED has demonstrated adequate psychometric properties, including internal consistency (α's range from 0.78 to 0.87) and discriminant validity between anxiety and depressive disorders, between anxiety and disruptive behavior disorders, and within anxiety disorders (Birmaher et al., 1999). In the present sample, the internal consistency ranged from 0.69 to 0.89.

EMA protocol. EMA data were collected via answer-only cellular phones provided by study staff at participants' baseline assessment. Prior to receiving the answer-only phones, youth underwent an orientation session where they were familiarized with the phone and the interview questions. The EMA protocol consisted of a five-day block (Thursday to Monday afternoon) at baseline, every fourth treatment session (after sessions 4, 8, and 12), and posttreatment. Calls were made randomly within a pre-specified 3-hour time window and were completed by trained research assistants who had prior experience administering the EMA protocol (Silk et al., 2011). Youth received two calls on weekdays and four calls on weekends, for a total of 14 calls per block and 70 calls total (14 calls per block * 5 blocks). The mean call length was 6.22 minutes (SD = 2.27 minutes). One participant reported difficulty understanding the questions and thus, EMA data are unavailable for one participant. Roughly 89% of

scheduled calls were completed and call completion rates did not differ significantly between treatment conditions.

During each call, youth were asked to respond to a series of questions assessing their emotional functioning in daily life. Youth were asked to identify their momentary negative emotion at the time of the call, their most negative experience over the past hour, and to rate their peak affect in association with this negative experience. Previous research has demonstrated that a time window of 1 hour maximizes the chances of assessing naturally-occurring emotions while minimizing retrospective recall biases (Silk, Steinberg, & Morris, 2003). Current and peak negative affect ratings were made using 4 items (upset, nervous, angry, sad) adapted from the Positive and Negative Affect Scale for Children (PANAS-C; Laurent et al., 1999), which asks participants to rate how often they have been feeling each emotion on a scale of 1 (very slightly or not at all) to 5 (extremely). Current positive affect ratings were also made using 4 items (happy, cheerful, interested, excited) adapted from the PANAS-C and peak affect ratings were made using one item (happy) adapted from the PANAS-C. PANAS-C ratings were used to create positive and negative affective network activation ratings as described below in the statistical analyses section. A copy of the EMA script is presented in Appendix A.

Statistical Analyses

Primary Aim 1. Use a dynamical systems approach to model EMA-collected positive and negative affect activation ratings. To use a dynamical systems approach to model EMA data collected over the course of two treatments for youth anxiety, we used the program GridWare (Lamey, Hollenstein, Lewis, & Granic, 2004). GridWare allows

for the construction of state space grids (SSGs), which are two-dimensional planes formed by the intersection of two axes (Hollenstein, 2013). The two axes represent two distinct variables, such as positive and negative affect, and users can plot the activation (i.e., score) of each variable that each individual endorses over time. In this manner, GridWare is able to capture activation of one variable (i.e., a single attractor), activation of multiple variables (i.e., multiple attractors), and the movement from the activation of one variable to the activation of another variable (i.e., phase changes). The program uses multiple methods to quantify attractors, phase changes, and other variables relevant to dynamical systems approaches (see, DiDonato, England, Martin, & Amazeen, 2013; Granic, Hollenstein, Dishion, & Patterson, 2003; Granic & Lamey, 2002; Hayes & Yasinski, 2015; Hayes et al., under review; Hollenstein, 2013).

For the present analyses, we are interested in understanding changes in affective variability, or how the activation of participants' positive and negative affect changes over the course of two treatments. Thus, the axes of our SSGs were positive and negative affect activation. For both positive and negative affect ratings, the activation of these variables was defined as a rating of 3 (moderately) or higher on each emotion assessed by EMA using the PANAS. Ratings were not considered activated when scored 1 (very slightly) or 2 (a little). Because participants provided ratings for four emotions representative of positive affect (happy, cheerful, interested, excited) and four emotions representative of negative affect (upset, nervous, sad, angry), activation scores were summed yielding a total activation score of 0 to 4 activated emotions for both negative affect and positive affect. These activations scores were the axes of the SSGs.

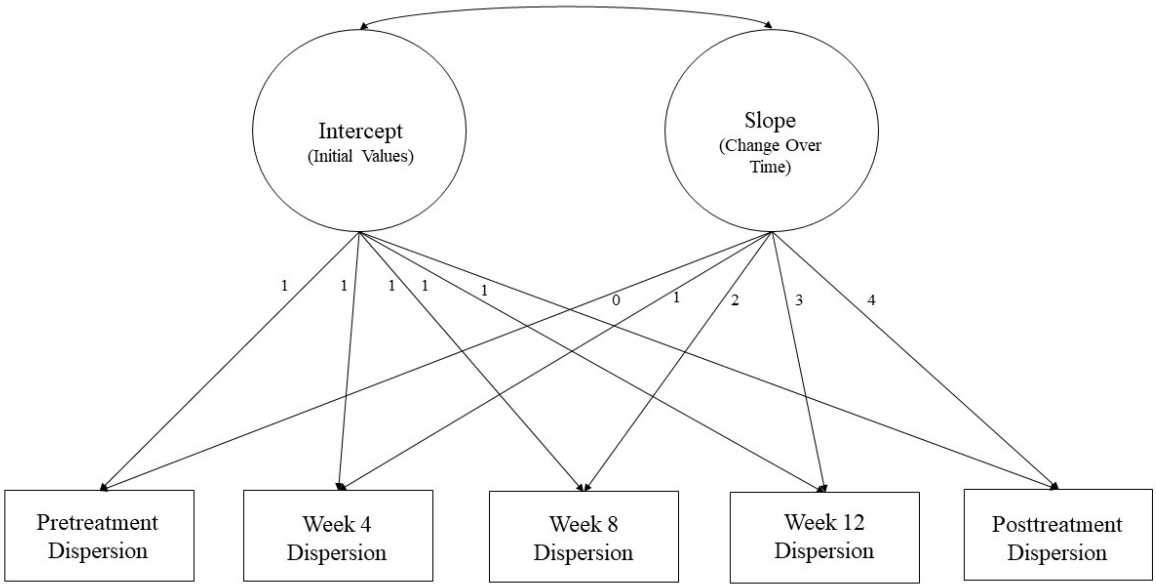
SSGs were constructed separately for each individual participant at each EMA block. Thus, each participant (assuming full adherence to the EMA protocol) had a total of 5 SSGs. The distribution of the activation scores can be used to calculate the extent of pattern stability or variability. As discussed above, the GridWare program allows for the extraction of a variety of relevant variables to dynamical systems approaches. "Dispersion" is one variable that has been recommended to quantify patterns of variability (see, Gates & Liu, 2016; Hollenstein, 2013; Lamey et al., 2004), has been recently used in the literature (e.g., Hayes & Yasinski, 2015; Hayes et al., under review), and was the primary focus of the present analyses. Dispersion operationalizes the level of instability in the relationship between two variables for each participant, such that low dispersion values are representative of stable relationships and indicative of what dynamical systems researchers term attractors. GridWare calculates dispersion by taking the sum of the squared proportional durations across all cells in the grid, corrected for the total number of cells and inverted so that the values range from 0 (no dispersion–all observations in one cell) to 1 (maximum dispersion—all behavior distributed across different cells. Dispersion is calculated using the following formula:

$$1 - [(n \sum (\frac{di}{D})^2) - 1]/(n - 1)$$

D represents the total duration (in the present study, the total number of EMA assessments in that block), di is the number of sessions spent in a given cell, and n is the total number of cells or states in the grid. Once dispersion values were calculated for each participant at each EMA block, they were extracted and entered into a nomothetic dataset for further analyses.

Primary Aim 2. To examine changes in patterns of affect over the course of two treatments and to examine whether there were differences in these changes between treatment conditions, we fit latent growth curve (LGC) models to positive/negative affect activation dispersion values at baseline, week 4, week 8, week 12, and posttreatment (see Figure 1).

Figure 1. *Diagram of LGC model*



Linear and quadratic models were tested. Final model fit was examined using traditional fit indices (Chi Squared, Root Mean Square Error of Approximation [RMSEA], Bentler Comparative Fit Index [CFI], Tucker-Lewis Index [TLI], Standardized Root Mean Square Residual [SRMR]). Acceptable fit was determined based on recommendations

from Kline (2011) and Hu and Bentler (1999), including a nonsignificant Chi Squared test, RMSEA ≤ 0.05, CFI ≥ 0.95, TLI ≥ 0.95, and SRMR ≤ 0.08. Models were still considered to have acceptable fit of 4 of the 5 fit indices met these thresholds. Models were compared between the two study conditions using multi-group procedures available in MPlus 8 and chi-squared differences testing (Muthen & Muthen, 1998-2017). Multi-group procedures compare a model where parameters are allowed to vary across groups to models where these parameters are constrained to be equal. Significant chi-squared difference scores reflect a significant difference between the two groups in the parameters that were constrained. In the present study, mean slope and intercept values were constrained to be equal and a significant chi squared difference test would indicate that the intercept and slope of the LGC model differed between treatment and control groups.

Exploratory Aims. We explored associations between pretreatment variables and patterns of affect prior to beginning treatment and changes in these patterns over time. Models were evaluated separately for parent- and child-reported variables. Paths were freed between pretreatment variables of interest and the intercept and slope of the latent growth curve. Comorbidity (i.e., number of diagnoses, comorbid anxiety diagnoses [yes vs. no], comorbid non-anxiety diagnoses [yes vs. no]), emotion regulation (CEMS), temperament (EATQ-R), depressive symptoms (MFQ), and anxiety severity (SCARED) were entered as predictor variables. Nonsignificant variables were removed and the models rerun in an iterative fashion until a final model was determined.

CHAPTER 3

RESULTS

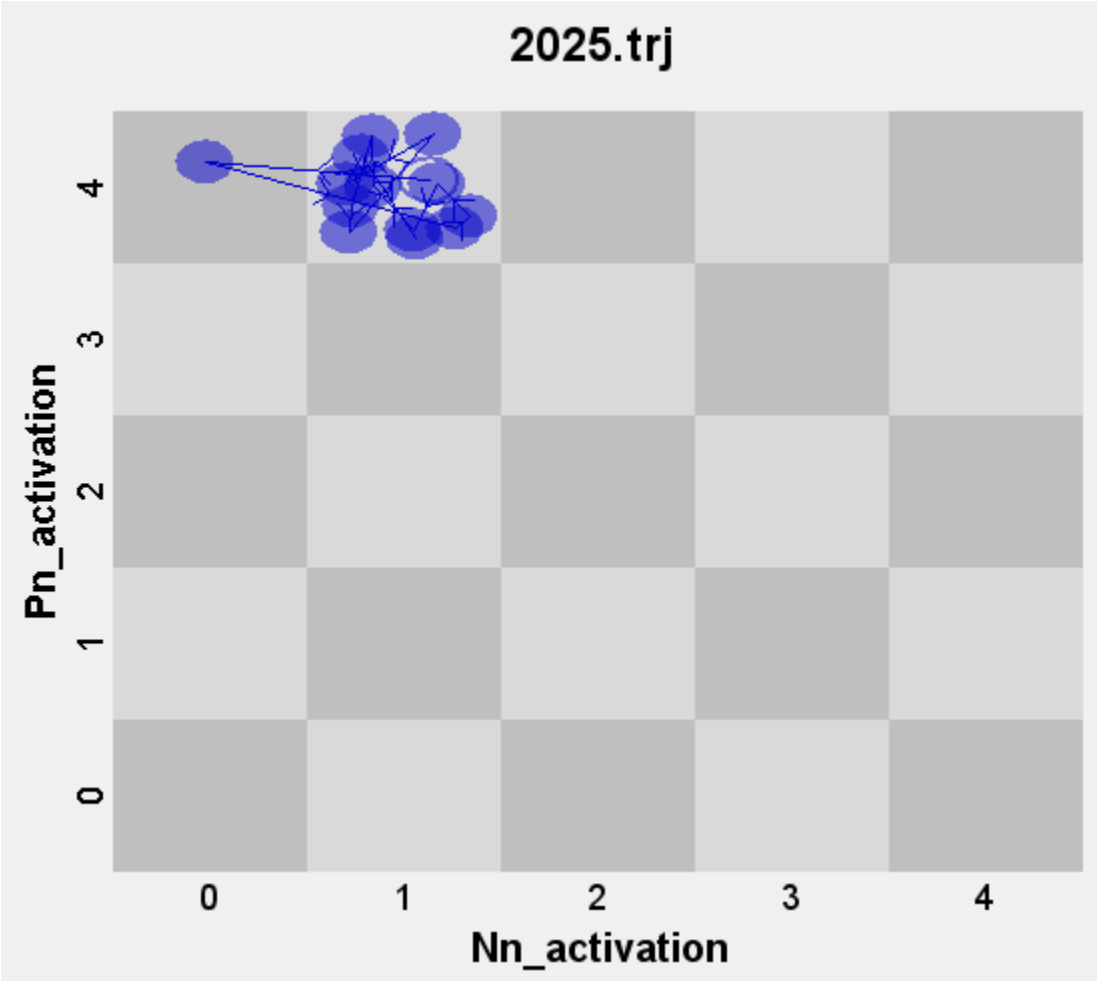
Data Management and Sample Characteristics

All study variables were examined for skewness and kurtosis and were found to be within normal limits. Outliers were removed yielding a final sample of 117 youth aged 9 to 15 (M_{age} = 10.93, SD = 1.46). Missingness was examined using Little's MCAR test (Little, 1988) and was nonsignificant (χ^2 [615] = 617.46, p = 0.47), indicating analyses can proceed as though data were missing at random.

Preliminary Analyses

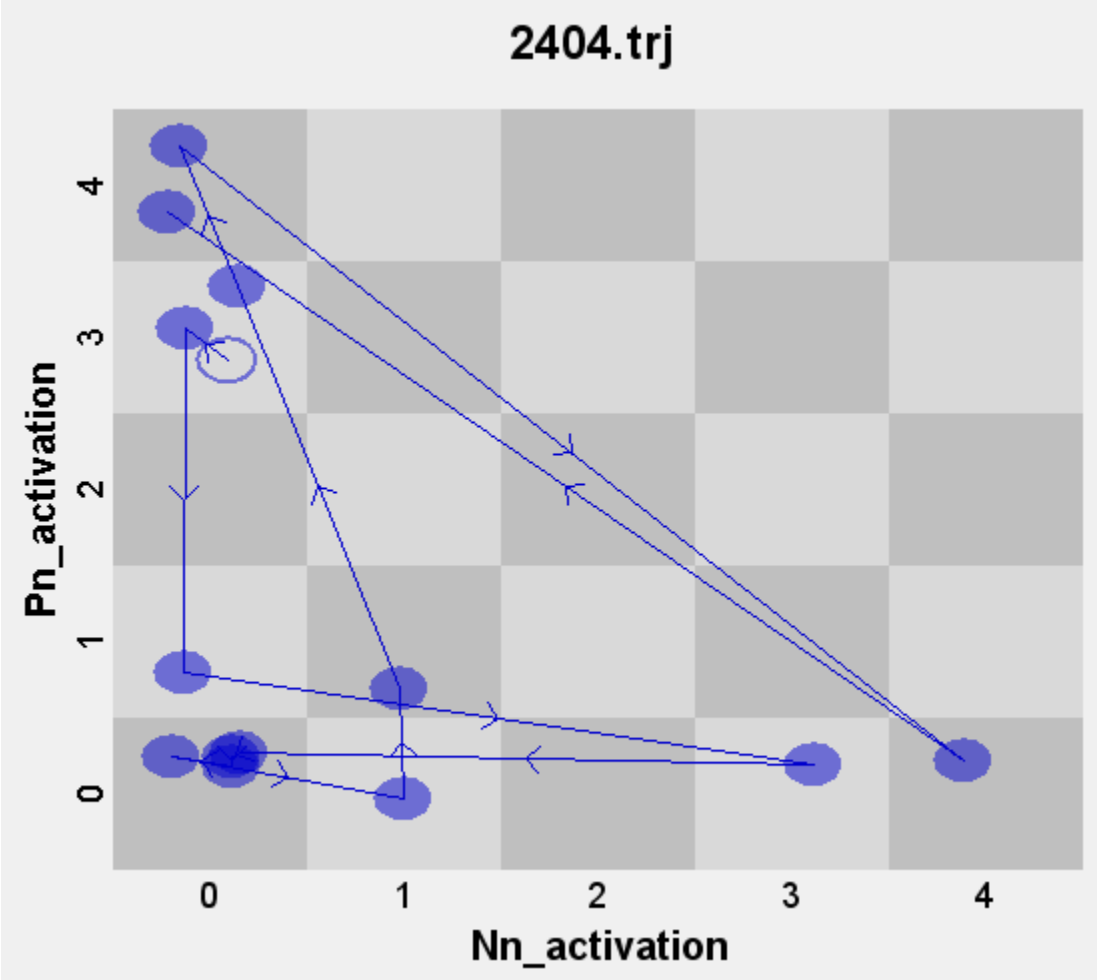
Once positive and negative affect activation scores were created, these data were entered into GridWare for further analyses. SSGs were created for each individual participant at each EMA block. Sample SSGs for a participant with low dispersion and a participant with high dispersion are provided in Figures 2 and 3, respectively.

Figure 2. *Sample SSG for a participant with low dispersion.*



Note: Nn_activation represents negative network activation. Pn_activation represents positive network activation.

Figure 3. *Sample SSG for a participant with high dispersion.*



Note: Nn_activation represents negative network activation. Pn_activation represents positive network activation.

Latent Growth Curve of Dispersion Values

Linear and quadratic LGC models were fit separately to individuals in the CBT condition and the CCT condition. Fit statistics from these models are presented in Table 2. Linear models were found to best fit the data for both conditions, so a multigroup LGC was created to model change in dispersion values across the course of treatment for all participants in the present study. This model was an excellent fit to the data, χ^2 (20) =

17.72, $p = 0.61$, RMSEA < 0.001, 90% CI RMSEA 0.000-0.10, CFI = 1.00, TLI = 1.03, SRMR = 0.09. Pairwise chi-squared difference testing revealed significant differences in the slope of the LGC between the CBT and CCT conditions, $\chi^2_{diff}(1) = 6.37$, $p < 0.05$. Pairwise chi-squared difference testing did not reveal significant differences in the intercept of the LGC between the two study conditions, $\chi^2_{diff}(1) = 2.26$, $p > 0.05$.

Table 2. *Fit statistics for linear and quadratic models in CBT and CCT conditions*

	Linear	**Quadratic**
CBT	$\chi^2_{diff}(4) = 1.817$, $p > 0.05$	
χ^2 (*df*)	6.10 (10)	4.28 (6)
p-value for χ^2	0.81	0.64
RMSEA	0.000	0.000
CFI	1.00	1.00
TLI	1.06	1.05
SRMR	0.08	0.05
CCT	$\chi^2_{diff}(4) = 4.89$, $p > 0.05$	
χ^2 (*df*)	12.14 (10)	7.25 (6)
p-value for χ^2	0.28	0.30
RMSEA	0.08	0.08
CFI	0.87	0.93
TLI	0.87	0.88
SRMR	0.10	0.10

Note: χ^2 = model chi square; χ^2_{diff} = Chi square difference test between linear and quadratic models; RMSEA = Root Mean Square Error of Approximation; CFI = Bentler Comparative Fit Index; TLI = Tucker-Lewis Index; SRMR = Standardized Root Mean Square Residual

CBT Condition. The intercept of the LGC for the CBT condition was significant (M = 0.64, SE = 0.02, $p < 0.001$). Similarly, the slope of the LGC for the CBT condition

was significant (M = -0.014, SE = 0.007, p = 0.03), suggesting dispersion scores decreased over the course of treatment for individuals in the CBT condition. The variance of the intercept (0.01 [0.005]) in the LGC model was significant, p = 0.01, suggesting significant differences at pretreatment between participants in the CBT condition. However, the variance of the slope (0.001 [0.001]) was not significant, p = 0.13.

CCT Condition. The intercept of the LGC for the CCT condition was significant (M = 0.59, SE = 0.02, $p < 0.001$). However, the slope was not significant (M = 0.01, SE = 0.01, p = 0.12), suggesting dispersion values did not change over time for participants in the CCT condition. The variances of the intercept (0.008 [0.006]) and slope (0.000 [0.001]) of the LGC for the CCT condition were not significant (all p's > 0.05), suggesting nonsignificant variability in dispersion values among participants in this condition.

Predictors of Latent Growth Curve

Models were constructed separately for parent- and child-reported variables. Analyses were run in a multi-group LGC format to allow for differences in predictive ability between conditions. All variables of interest were entered simultaneously and nonsignificant variables were removed in an iterative fashion until the final model was identified. Significant variables were retained in the models if they were significant predictors of the intercept or slope in either study condition. Predictor analyses were run even when the variance of the slope of the LGC was not significant given that the

inclusion of predictor variables could influence the slope (P.A. Fisher & Kim, 2007). Results of these analyses are summarized in Table 3.

Table 3. *Predictors of intercept and slope of latent growth curve models of dispersion values.*

Variable	**CBT**			**CCT**		
	b	*SE*	*p*	*b*	*SE*	*p*
Child Model						
Intercept ON CEMS Emotion Regulation Coping to Anger	0.02	0.01	0.02	-0.005	0.01	0.679
Intercept ON MFQ Total	0.006	0.001	<0.001	0.001	0.002	0.641
Slope ON CEMS Emotion Regulation Coping to Anger	-0.008	0.004	0.02	-0.003	0.003	0.308
Parent Model						
Intercept ON Affiliation	0.04	0.02	0.08	-0.09	0.03	0.006

Child-Report Models. The final LGC model was an excellent fit to the data, χ^2 (34) = 35.99, p = 0.38, RMSEA = 0.03, 90% CI RMSEA = 0.00-0.10, CFI = 0.98, TLI = 0.97, SRMR = 0.10. For the CCT condition, there were no variables that significantly predicted the intercept or the slope of the LGC (all p's > 0.05). For the CBT condition, the CEMS subscale Emotion Regulation Coping related to anger was a significant predictor of both the intercept (b = 0.02, SE = 0.01, p = 0.02) and slope (b = -0.01, SE = 0.004, p = 0.02) of the LGC. Furthermore, MFQ total scores significantly predicted the intercept of the LGC, b = 0.01, SE = 0.001, p < 0.001. No other child-reported variables significantly predicted either the intercept or slope of the LGC.

Parent-Report Models. The final LGC model was an excellent fit to the data, χ^2 (30) = 23.01, p = 0.81, RMSEA < 0.001, 90% CI RMSEA = 0.00-0.06, CFI = 1.00, TLI = 1.10, SRMR = 0.09. For the CCT condition, the EATQ-R subscale Affiliation

significantly predicted the intercept of the LGC, b = -0.09, SE = 0.03, p = 0.006. No other parent-reported variables significantly predicted the intercept or the slope of the LGC in the CCT condition. For the CBT condition, there were no parent-reported variables that significantly predicted the intercept or the slope of the LGC (all p's > 0.05).

CHAPTER 4

DISCUSSION

The present study used a dynamical systems approach to quantify changes in affective variability that occurred during a randomized controlled trial (RCT) for child anxiety. Results revealed that participants in the CBT condition experienced decreases in their affective variability over the course of treatment while participants in CCT did not. Furthermore, initial affective variability ratings were significantly predicted by child rated depressive symptoms for participants in the CBT condition, but not the CCT condition. Child-rated perceptions of the ability to cope with anger through constructive control over emotional behaviors significantly predicted both initial affective variability ratings, as well as changes in affective variability over time for CBT, but not CCT participants. Finally, parent ratings of their child's desire for warmth and closeness to others significantly predicted initial affective variability ratings for CCT but not CBT participants. Taken together, the present findings provide evidence for the use of the dynamical systems approach for quantifying changes that occur during treatment for youth anxiety.

Dynamical systems, as an approach to data analysis, has been used to study change among adult populations (Boker & Laurenceau, 2006; DiDonato et al., 2013; A.J. Fisher, 2015; A.J. Fisher et al., 2011; Hayes et al., under review; Newman & Fisher, 2013; Vallacher et al., 2010; Vallacher & Nowak, 1997), and in a variety of other scientific disciplines. The present study is among the first to do so with regard to treatment of youth anxiety. An advantage of such an approach is that it can capture

changes in patterns of affect that would not be picked up in ANOVA-based strategies that examine single variables rather than relationships between two variables. For example, variable-centered strategies and analytic methods focus on how one variable changes in response to another variable for an average person. However, in aggregating across individuals, this approach fails to capture intraindividual variability (variability within the person). Person-centered research focuses on how variables change across time for each individual in a system (see, Molenaar & Campbell, 2009) and the dynamical systems approach emphasizes the relationships between two (or more) variables. Understanding the underlying patterns of each individual specifically and then aggregating this information across individuals to understand patterns of the system provides an innovative method for examining research questions both idiographically (person-centered) and nomothetically (variable-centered). By combining both positive and negative affect in a SSG and calculating a single variable that represents changes in both positive and negative affect (rather than analyzing each separately), the present approach is better able to operationalize the simultaneous activation of both positive and negative affect, the activation of one of these affective variables, and the activation of neither positive nor negative affective networks. As a result, this approach is likely more reflective of the affective experience of anxious youth than capturing the activation of these variables separately. Though dispersion was the only metric used in the present study, it was chosen because it has the most frequently examined variable from the Gridware program in the extant literature and most closely captures the construct of affective variability.

Beyond the measurement utility of the dynamical systems approach, there are important clinical implications from the present findings. CBT, but not CCT, experienced significant decreases in affective variability over the course of treatment, which suggests that there is something within CBT that changes youth's ability to respond to daily stimuli more consistently. Previous research with anxious youth has found that anxious youth report higher peak affective ratings than non-anxious youth (Tan et al., 2012) and that anxious youth treated with CBT experience increased emotional awareness following treatment (Suveg, Sood, Comer, & Kendall, 2009). Additionally, high positive affect (PA), low negative affect (NA), and a high PA:NA ratio at pretreatment has been found to predict lower anxiety symptoms at the end of treatment in a sample with both anxiety and depressive disorder diagnoses (Forbes et al., 2012). Taken together, these findings highlight the impact of youth's affective experience on treatment outcomes. It is possible that over the course of CBT, youth became better able to report on their emotional experiences and that changes that occurred were a result of this improved insight rather than actual changes in affective variability. However, increased emotional awareness found in previous work (e.g., Suveg, Sood, et al., 2009) would likely lead to increases in affective variability as youth become better able to identify lower-level emotional experiences rather than the decreases in affective variability observed in the present study.

Research with anxious adults has revealed that the degree of order in a dynamic system established during therapy promotes positive therapeutic gains one year after therapy (A.J. Fisher et al., 2011). Though the present study did not examine how changes

in affective variability predict and/or mediate outcomes, this is an important area for future research. Despite this limitation, the superior outcomes observed from the CBT condition over the CCT condition (Silk et al., 2018) coupled with the decreases in affective variability found in participants who received CBT in the present study suggest that interventions for youth anxiety that incorporate a component specifically targeting affective responses (such as an emotion regulation-based approach) may achieve better response rates than CBT that does not have such a focus. Indeed, previous research has found positive associations between anxiety symptoms and poor emotion regulation in meta analyses (Schafer, Naumann, Holmes, Tuschen-Caffier, & Samson, 2017), and that emotion regulation abilities change throughout CBT for anxious youth (Suveg, Sood, et al., 2009). Furthermore, unified approaches for treating anxiety and depression include a large emotion regulation component (Trosper, Buzzella, Bennett, & Ehrenreich, 2009).

Affective variability decreased over the course of treatment for participants in the CBT condition, which was contrary to the study hypothesis that affective variability would exhibit a quadratic pattern whereby affective variability would increase early on in treatment and then decrease during later parts of treatment. The present sample exhibited relatively high levels of affective variability at the beginning of treatment and affect ratings were only gathered every four weeks. It is likely that the measurement resolution of these EMA "bursts" may not have been high enough to detect more short-term changes. Future work could collect EMA data throughout treatment to determine whether the linear decrease in affective variability observed over the course of treatment is a result of a lack of measurement resolution or indicative of the change that actually

occurs during treatment. This line of research would have the added benefit of allowing for the investigation of optimal measurement windows for EMA data collection to maximize the signal to noise ratio.

The predictor analyses, though exploratory, revealed an interesting pattern of associations. Specifically, higher perceptions of one's ability to cope with anger through constructive control over emotional behaviors was associated with higher affective variability at pretreatment. One might expect the opposite direction of effect, whereby lower perceptions of coping would be associated with increased affective variability. However, it is possible that youth perceptions of their ability to exert constructive control over their emotional behaviors may not translate into actual behavioral control prior to additional intervention. Thus, youth may initially perceive their coping abilities to be better than they are (see, Levine & Safer, 2002; Wirtz, Kruger, Napa Scollon, & Diener, 2003) and gain a more accurate appraisal of their emotion regulation abilities over the course of treatment, particularly during exposure tasks when this ability is directly tested. This notion is consistent with previous work showing that anxious youth gain greater emotional awareness over the course of CBT (e.g., Suveg, Sood, et al., 2009). Alternatively, it is possible that youth who are highly variable in their affect are required to exert constructive control over their emotional behaviors more frequently than those with less variable affect. As a result, they may have more practice exerting this control and as a result, rated their perceptions higher by misattributing attempts at self-regulation to having more self-regulatory control. Further research is needed to examine how

perceptions of emotion regulation abilities change over the course of treatment and whether they are prospectively associated with changes in affective variability.

Findings from the present study revealed that higher perceptions of one's ability to cope with anger through constructive control over emotional behaviors was associated with accelerated decreases in affective variability over time. Given that CBT is proposed to reduce anxious symptoms through experiential practice (i.e., exposure; Baker et al., 2010; Craske et al., 2008; Craske, Liao, Brown, & Vervliet, 2012; Foa & Kozak, 1986; Foa & McNally, 1996), it is possible that youth with a predisposition to being able to exert constructive control over their emotional behaviors improve this ability through repeated practice, and this practice regulating their emotions in specific contexts leads to greater reductions in affective variability more generally. Indeed, among adults, therapy that specifically targets emotion regulation has been found to lead to improvements in symptom severity, impairment, and quality of life (Mennin, Fresco, Ritter, & Heimberg, 2015) among patients with GAD and depression. Further research is needed that collects both emotion regulation and affective variability ratings over time to elucidate the true nature of the effects observed in the present study.

Higher self-reported depressive symptoms were found to be associated with higher affective variability at pretreatment. This finding is not surprising given that poor emotion regulation has consistently been linked with depressive symptoms in youth (Ebner-Priemer & Trull, 2009; Schafer et al., 2017; Silk et al., 2003; Suveg, Hoffman, Zeman, & Thomassin, 2009) and depressed youth can often present as emotionally dysregulated (Forbes & Dahl, 2005). Depressive symptoms were not associated with

changes in affective variability, suggesting that despite deficits in emotion regulation abilities among anxious youth with depressive symptoms, these deficits do not prevent more stable affective responses to stimuli from developing following treatment.

The present study is not without limitations. First, EMA data were collected in "bursts," which limited our ability to detect more fine-grained changes in affective variability over the course of treatment. Second, predictor analyses were limited by the CCT sample size. Third, although we were able to determine that affective variability decreased over the course of treatment, the nature of the present analyses precluded us from determining whether decreased variability was associated with increased positive affect and decreased negative affect. Future research should employ methods to directly test the emotional valence of the decreases in affective variability throughout CBT. Finally, the present sample was comprised of a relatively narrow age range, which limits the generalizability of findings to school-aged youth and younger adolescents.

Despite these limitations, the present study provides readers with a novel analytical framework for quantifying variability between two distinct constructs and modeling change in that variability that occurs over time. Future work should use higher resolution data collection instruments (i.e., EMA throughout treatment rather than in bursts or passive data collection strategies such as wearables) to examine affective variability to determine whether the linear shape of change we observed in the present study can be replicated. Mediation models could also be created whereby affective variability is treated as a mediating variable. If mediation is found, additional work could compare a treatment protocol of CBT compared to CBT + emotion regulation strategies

to determine whether changes in affective variability may be a mechanism of change in CBT for child anxiety. Although readers may view these methods as more difficult to implement than standard ANOVA-based approaches, they do not require expensive software, as all analyses in the present study can be implemented in free statistical software packages such as R and GridWare. As our statistical repertoire improves, researchers should take advantage of these newer methods in order to better understand the process of change in behavioral treatments for youth.

REFERENCES CITED

Alfano, C. A., Pina, A. A., Villalta, I. K., Beidel, D. C., Ammerman, R. T., & Crosby, L. E. (2009). Mediators and moderators of outcome in the behavioral treatment of childhood social phobia. *Journal of the American Academy of Child and Adolescent Psychiatry, 48*, 945-953.

American Psychiatric Association. (1994). *Diagnostic and statistical manual of mental disorders* (4th ed.). Washington, DC: Author.

American Psychiatric Association. (2000). *Diagnostic and Statistical Manual of Mental Disorders* (Vol. 4th. ed., text revision). Washington, DC: Author.

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Washington, DC: Author.

Angold, A., Costello, E. J., & Erkanli, A. (1999). Comorbidity. *Journal of Child Psychology and Psychiatry, 40*, 57-87.

Avenevoli, S., Stolar, M., Li, J., Dierker, L., & Merikangas, K. (2001). Comorbidity of depression in children and adolescents: Models and evidence from a prospective high-risk family study. *Biological Psychiatry, 49*, 1071-1081.

Axelson, D. A., & Birmaher, B. (2001). Relation between anxiety and depressive disorders in childhood and adolescence. *Depression and Anxiety, 14*, 67-78.

Baker, A., Mystkowski, J., Culver, N., Yi, R., Mortazavi, A., & Craske, M. G. (2010). Does habituation matter? Emotional processing theory and exposure therapy for acrophobia. *Behaviour Research and Therapy, 48*, 1139-1143.

Barlow, D. H., & Nock, M. K. (2009). Why can't we be more idiographic in our research. *Perspectives on Psychological Science, 4*, 19-21. doi: 10.1111/j.1745-6924.2009.01088.x

Baron, R. M., & Kenny, D. A. (1986). The moderator-mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology, 51*, 1173-1182.

Benjamin, C. L., Harrison, J., Settipani, C., Brodman, D., & Kendall, P. C. (2013). Anxiety and related outcomes in young adults 7 to 19 years after receiving treatment for child anxiety. *Journal of Consulting and Clinical Psychology, 81*, 865-876.

Berman, S. L., Weems, C. F., Silverman, W. K., & Kurtines, W. M. (2000). Predictors of outcome in exposure-based cognitive and behavioral treatments for phobic and anxiety disorders in children. *Behavior Therapy, 31*, 713-731.

Birmaher, B., Brent, D., Chiappetta, L., Bridge, J., Monga, S., & Baugher, M. (1999). Psychometric properties of the Screen for Child Anxiety Related Emotional Disorders (SCARED): A replication study. *Journal of the American Academy of Child and Adolescent Psychiatry, 38*, 1230-1236.

Birmaher, B., Khetarpal, S., Brent, D., Cully, M., Balach, L., & Kaufman, J. (1997). The Screen for Child Anxiety Related Emotional Disorders (SCARED): Scale construction and psychometric characteristics. *Journal of the American Academy of Child and Adolescent Psychiatry, 36*, 545-553.

Bodden, D. H. M., Bögels, S. M., Nauta, M. H., De Haan, E., Ringrose, J., Appelboom, C., . . . Appelboom-Geerts, K. C. M. M. J. (2008). Child versus family cognitive-behavioral therapy in clinically anxious youth: An efficacy and partial effectiveness study. *Journal of the American Academy of Child and Adolescent Psychiatry, 47*, 1384-1394.

Boker, S. M. (2001). Differential structural equation modeling of intraindividual variability. In L. M. Collins & A. G. Sayer (Eds.), *New methods for the analysis of change* (pp. 3-28). Washington, DC: American Psychological Association.

Boker, S. M., & Laurenceau, J. (2006). Dynamical systems modeling: An application to the regulation of intimacy and disclosure in marriage. In T. A. Walls & J. L. Schafer (Eds.), *Models for intensive longitudinal data*. New York: Oxford University Press.

Borkenau, P., & Ostendorf, F. (1998). The Big Five as states: How useful is the Five-Factor Model to describe intraindividual variations over time? *Journal of Research in Personality, 32*, 202-221. doi: 10.1006/jrpe.1997.2206

Brent, D. A., Kolko, D. J., Birmaher, B., Baugher, M., Bridge, J., Roth, C., & Holder, D. (1998). Predictors of treatment efficacy in a clinical trial of three psychosocial treatments for adolescent depression. *Journal of the American Academy of Child and Adolescent Psychiatry, 37*, 906-914.

Capaldi, D. M., & Rothbart, M. K. (1992). Development and validation of an early adolescent temperament measure. *Journal of Early Adolescence, 12*, 153-173.

Carper, M. M., & Kendall, P. C. (2014). *A dynamical systems approach to understanding outcomes from CBT for youth anxiety.* Paper presented at the 48th annual convention for the Association for Behavioral and Cognitive Therapies, Philadlephia, PA.

Carper, M. M., Makover, H. B., & Kendall, P. C. (2018). Future directions for the examination of mediators of treatment outcomes in youth. *Journal of Clinical Child and Adolescent Psychology, 47,* 345-356. doi: 10.1080/15374416.2017.1359786

Cartwright-Hatton, S., McNicol, K., & Doubleday, E. (2006). Anxiety in a neglected population: Prevalence of anxiety disorders in pre-adolescent children. *Clinical Psychology Review, 26,* 817-833.

Chambless, D. L., & Hollon, S. D. (1998). Defining empirically supported therapies. *Journal of Consulting and Clinical Psychology, 66,* 7-18.

Chu, B. C., & Harrison, T. L. (2007). Disorder-specific effects of CBT for anxious and depressed youth: A meta-analysis of candidate mediators of change. *Clinical Child and Family Psychology Review, 10,* 352-372.

Cobham, V. E., Dadds, M. R., & Spence, S. H. (1998). The role of parental anxiety in the treatment of childhood anxiety. *Journal of Consulting and Clinical Psychology, 66,* 893-905.

Cohen, J. A., Deblinger, E., Mannarino, A. P., & Steer, R. A. (2004). A multisite, randomized controlled trial for children with sexual abuse-related PTSD

symptoms. *Journal of the American Academy of Child and Adolescent Psychiatry, 43*, 393-402.

Cohen, J. A., & Mannarino, A. P. (1998). Interventions for sexually abused children: Initial treatment outcome findings. *Child Maltreatment, 3*, 135-145.

Cohen, J. A., Mannarino, A. P., & Knudsen, K. (2005). Treating sexually abused children: 1 year follow-up of a randomized controlled trial. *Child Abuse and Neglect, 29*, 135-145.

Collins, L. M., & Sayer, A. G. (2000). Growth and change in social psychology research: Design, measurement, and analysis. In H. Reis & C. Judd (Eds.), *Handbook of research in social psychology* (pp. 478-495). Cambridge: Cambridge University Press.

Collins, L. M., & Sayer, A. G. (2001). *New methods for the analysis of change*. Washington, DC: American Psychological Association.

Compton, S. N., Burns, B. J., Egger, H. L., & Robertson, E. (2002). Review of the evidence base for treatment of childhood psychopathology: Internalizing disorders. *Journal of Consulting and Clinical Psychology, 70*, 1240-1266.

Compton, S. N., Peris, T. S., Almirall, D., Birmaher, B., Sherrill, J. T., Kendall, P. C., . . . Albano, A. M. (2014). Predictors and moderators of treatment response in childhood anxiety disorders: Results from the CAMS trial. *Journal of Consulting and Clinical Psychology, 82*, 212-224.

Compton, S. N., Walkup, J. T., Albano, A. M., Piacentini, J. C., Birmaher, B., Sherrill, J. T., . . . March, J. S. (2010). Child/Adolescent Anxiety Multimodal Study

(CAMS): Rationale, design, and methods. *Child and Adolescent Psychiatry and Mental Health, 4*, 1-15.

Costello, E. J., Egger, H. L., & Angold, A. (2005). 10-year research update review: I. The epidemiology of child and adolescent psychiatric disorders: Methods and public health burden. *Journal of the American Academy of Child and Adolescent Psychiatry, 44*, 972-986.

Costello, E. J., Erkanli, A., & Angold, A. (2006). Is there an epidemic of child or adolescent depression? *Journal of Child Psychology and Psychiatry, 47*, 1263-1271.

Costello, E. J., Mustillo, S., Erkanli, A., Keeler, G., & Angold, A. (2003). Prevalence and development of psychiatric disorders in childhood and adolescence. *Archives of General Psychiatry, 60*, 837-844. doi: 10.1001/archpsyc.60.8.837

Craske, M. G., Kircanski, K., Zelikowsky, M., Mystkowski, J., Chowdhury, N., & Baker, A. (2008). Optimizing inhibitory learning during exposure therapy. *Behaviour Research and Therapy, 46*, 5-27.

Craske, M. G., Liao, B., Brown, L., & Vervliet, B. (2012). Role of inhibition in exposure therapy. *Journal of Experimental Psychopathology, 3*, 322-345. doi: 10.5127/jep.026511

Cummings, C. M., Caporino, N. E., & Kendall, P. C. (2014). Comorbidity of anxiety and depression in children and adolescents: 20 years after. *Psychological Bulletin, 140*, 816-845.

Cummings, C. M., Caporino, N. E., Settipani, C. A., Read, K. L., Compton, S. N., March, J., . . . Kendall, P. C. (2013). The therapeutic relationship in cognitive-behavioral therapy and pharmacotherapy for anxious youth. *Journal of Consulting and Clinical Psychology, 81*, 859-864. doi: 10.1037/a0033294

Curry, J. F., Rohde, P., Simons, A., Silva, S. G., Vitiello, B., Kratochvil, C., . . . The TADS Team. (2006). Predictors and moderators of acute outcome in the Treatment for Adolescents with Depression Study (TADS). *Journal of the American Academy of Child and Adolescent Psychiatry, 45*, 1427-1439.

DiDonato, M. D., England, D., Martin, C. L., & Amazeen, P. G. (2013). Dynamical analyses for developmental science: A primer for intrigued scientists. *Human Development, 56*, 59-75.

Dour, H. J., Chorpita, B. F., Lee, S., Weisz, J. R., & The Research Network on Youth Mental Health. (2013). Sudden gains as a long-term predictor of treatment improvement among children in community mental health organizations. *Behaviour Research and Therapy, 51*, 564-572.

Ebner-Priemer, U. W., & Trull, T. J. (2009). Ecological momentary assessment of mood disorders and mood dysregulation. *Psychological Asssessment, 21*, 463-475. doi: 10.1037/a0017075

Emslie, G. J., Kennard, B. D., & Mayes, T. L. (2011). Predictors of treatment response in adolescent depression. *Pediatric Annals, 40,* 300-306.

Emslie, G. J., Mayes, T. L., Laptook, R. S., & Batt, M. (2003). Predictors of response to treatment in children and adolescents with mood disorders. *The Psychiatric Clinics of North America, 26*, 435-456.

Emslie, G. J., Mayes, T. L., Porta, G., Vitiello, B., Clarke, G., Wagner, K. D., . . . Brent, D. (2010). Treatment of resistant depression in adolescents (TORDIA): Week 24 outcomes. *American Journal of Psychiatry, 167*, 782-791.

Essau, C. A. (2008). Comorbidity of depressive disorders among adolescents in community and clinical settings. *Psychiatry Research, 158*, 35-42.

Estrin, D. E., & Sim, I. (2010). Open mHealth architecture: An engine for health care innovation. *Science, 330*, 759-760.

Feeny, N. C., Silva, S. G., Reinecke, M. A., McNulty, S., Findling, R. L., Rohde, P., . . . March, J. S. (2009). An exploratory analysis of the impact of family functioning on treatment for depression in adolescents. *Journal of Clinical Child and Adolescent Psychology, 38*, 814-825.

Fisher, A. J. (in press). Toward a dynamic model of psychological assessment: Implications for personalized care. *Journal of Consulting and Clinical Psychology*.

Fisher, A. J., & Bosley, H. G. (in press). Personalized assessment and treatment of depression. *Current Opinion in Psychology*. doi: 10.1016/j.copsyc.2015.03.031

Fisher, A. J. (2015). Toward a dynamic model of psychological assessment: Implications for personalized care. *Journal of Consulting and Clinical Psychology, 83,* 825-836. doi: 10.1037/ccp0000026

Fisher, A. J., Newman, M. G., & Molenaar, P. C. M. (2011). A quantitative method for the analysis of nomothetic relationships between idiographic structures: Dynamic patterns create attractor states for sustained posttreatment change. *Journal of Consulting and Clinical Psychology, 79*, 552-563. doi: 10.1037/a0024069

Fisher, P. A., & Kim, H. K. (2007). Intervention effects on foster preschoolers' attachment-related behaviors from a randomized trial. *Prevention Science, 8,* 161-170. doi: 10.1007/s11121-007-0066-5

Fletcher, J. M. (2008). Adolescent depression and educational attainment: Results using sibling fixed effects. *Health Economics, 17,* 1215-1235.

Foa, E. B., & Kozak, M. J. (1986). Emotional processing of fear: Exposure to corrective information. *Psychological Bulletin, 99,* 20-35. doi: 10.1037/0033-2909.99.1.20

Foa, E. B., & McNally, R. J. (1996). Mechanisms of change in exposure therapy. In R. M. Rapee (Ed.), *Current controversies in the anxiety disorders* (pp. 329-343). New York, NY: The Guilford Press.

Forbes, E. E., & Dahl, R. E. (2005). Neural systems of positive affect: Relevance to understanding child and adolescent depression? *Development and Psychopathology, 17,* 827-850. doi: 10.10170S095457940505039X

Forbes, E. E., Olino, T. M., Ryan, N. D., Birmaher, B., Axelson, D., Moyles, D. L., & Dahl, R. E. (2010). Reward-related brain function as a predictor of treatment

response in adolecents with major depressive disorder. *Cognitive, Affective, & Behavioral Neuroscience, 10,* 107-118.

Forbes, E. E., Stepp, S. D., Dahl, R. E., Ryan, N. D., Whalen, D. J., Axelson, D. A., . . . Silk, J. S. (2012). Real-wolrd affect and social context as predictors of treatment response in child and adolescent depression and anxiety: An ecological momentary assessment study. *Journal of Child and Adolescent Psychopharmacology, 22,* 37-47. doi: 10.1089/cap.2011.0085

Garber, J., & Weersing, V. R. (2010). Comorbidity of anxiety and depression in youth: Implications for treatment and prevention. *Clinical Psychology: Science and Practice, 17,* 293-306.

Gates, K. M., & Liu, S. (2016). Methods for quantifying patterns of dynamic interactions in dyads. *Assessment, 23,* 459-471. doi: 10.1177/1073191116641508

Gollob, H. F., & Reichardt, C. S. (1991). Interpreting and estimating indirect effects assuming time lags really matter. In L. M. Collins & J. L. Horn (Eds.), *Best methods for the analysis of change: Recent advances, unanswered questions, future directions* (pp. 243-259). Washington, D.C.: American Psychological Association.

Granic, I., Hollenstein, T., Dishion, T. J., & Patterson, G. R. (2003). Longitudinal analysis of flexibility and reorganization in early adolescence: A dynamic systems study of family interactions. *Developmental Psychology, 39,* 606-617.

Granic, I., & Lamey, A. (2002). Combining dynamic systems and multivariate analyses to compare the mother-child interactions of externalizing subtypes. *Journal of Abnormal Child Psychology, 30*, 265-283.

Gunlicks-Stoessel, M., Mufson, L., Jekal, A., & Turner, J. B. (2010). The impact of perceived interpersonal functioning on treatment for adolescent depression: iPT-A versus treatment as usual in school-based health clinics. *Journal of Consulting and Clinical Psychology, 78*, 260-267. doi: 10.1037/a0018935

Guy, W. (1976). Clinical Global Impressions *ECDEU Assessment Manual for Psychopharmacology* (Vol. Revised DHEW Pub. (ADM), pp. 218-222). Rockville, MD: National Institute for Mental Health.

Halldorsdottir, T., Ollendick, T. H., Ginsburg, G. S., Sherrill, J. T., Kendall, P. C., Walkup, J. T., . . . Piacentini, J. (in press). Treatment outcomes in anxious youth with and without comorbid ADHD in the CAMS. *Journal of Clinical Child and Adolescent Psychology*. doi: 10.1080/15374416.2014.952008

Harris Interactive. (2013, October 17). Sexts, lies, and smartphones: Harris poll uncovers the not-so-secret lives of young smartphone users and their parents. from http://www.harrisinteractive.com/vault/Harris%20Poll%2073%20-%20Youth%20Smartphone%20Behaviors_10.17.13.pdf

Hasler, G., Pine, D. S., Kleinbaum, D. G., Gamma, A., Luckenbaugh, D., Ajdacic, V., . . . Angst, J. (2005). Depressive symptoms during childhood and adult obesity: The Zurich cohort study. *Molecular Psychiatry, 10*, 842-850.

Hawton, K., & van Heeringen, K. (2009). Suicide. *Lancet, 373*, 1372-1381.

Hayes, A. M., & Feldman, G. (2007). Discontinuous patterns of change in psychotherapy. *Clinical Psychology Review, 27,* 715-723. doi: 10.1016/j.cpr.2007.01.008.change

Hayes, A. M., Laurenceau, J., Feldman, G., Strauss, J. L., & Cardaciotto, L. (2007). Change is not always linear: The study of nonlinear and discontinuous patterns of change in psychotherapy. *Clinical Psychology Review, 27,* 715-723. doi: j.cpr.2007.01.008

Hayes, A. M., & Strauss, J. L. (1998). Dynamic systems theory as a paradigm for the study of change in psychotherapy: An application to cognitive therapy for depression. *Journal of Consulting and Clinical Psychology, 66,* 939-947.

Hayes, A. M., & Yasinski, C. (2015). Pattern destabilization and emotional processing in cognitive therapy for personality disorders. *Frontiers in Psychology, 6,* 1-13. doi: 10.3389/fpsyg.2015.00107

Hayes, A. M., Yasinski, C., Ready, C. B., Laurenceau, J., & Chen, F. F. (under review). A method for studying change in psychotherapy from a dynamical systems perspective: Emotional processing, associative networks, and state space grids.

Haynes, S. N., Mumma, G. H., & Pinson, C. (2009). Idiographic assessment: Conceptual and psychometric foundations of individualized behavioral assessment. *Clinical Psychology Review, 29,* 179-191. doi: 10.1016/j.cpr.2008.12.003

Hogendoorn, S. M., Prins, P. J. M., Boer, F., Vervoort, L., Wolters, L. H., Moorlag, H., . . . de Haan, E. (2014). Mediators of cognitive behavioral therapy for anxiety-disordered children and adolescents: Cognition, perceived control, and coping. *Journal of Clinical Child and Adolescent Psychology, 43,* 486-500.

Hollenstein, T. (2013). *State space grids: Depicting dynamics across development*. New York: Springer.

Hollon, S. D., & Beck, A. T. (2013). Cognitive and cognitive-behavioral therapies. In M. J. Lambert (Ed.), *Handbook of psychotherapy and behavior change* (6th ed.). Hoboken, NJ: John Wiley & Sons.

Holmbeck, G. N. (1997). Toward terminological, conceptual, and statistical clarity in the study of mediators and moderators: Examples from the child-clinical and pediatric psychology literatures. *Journal of Consulting and Clinical Psychology, 65*, 599-610.

Hu, L., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling, 6*, 1-55. doi: 10.1080/10705519909540118

Ialongo, N., Edelsohn, L., Werthamer-Larsson, L., Crockett, L., & Kellam, S. (1994). The significance of self-reported anxious symptoms in first-grade children. *Journal of Abnormal Child Psychology, 22*, 441-455.

Jayson, D., Wood, A., Kroll, L., Fraser, J., & Harrington, R. (1998). Which depressed patients respond to cognitive-behavioral treatment? *Journal of the American Academy of Child and Adolescent Psychiatry, 37*, 35-39. doi: 10.1097/00004583-199801000-00013

Judd, C. M., & Kenny, D. A. (1981). Process analysis: Estimating mediation in treatment evaluations. *Evaluation Review, 5*, 602-619.

Kaufman, J., Birmaher, B., Brent, D., & Rao, U. (1997). Schedule for Affective Disorders and Schizophrenia for School-Age Children (K-SADS-PL): Initial reliability and validity data. *Journal of the American Academy of Child and Adolescent Psychiatry, 36*, 980-988.

Kazdin, A. E. (2000). Developing a research agenda for child and adolescent psychotherapy. *Archives of General Psychiatry, 57*, 829-835.

Kazdin, A. E. (2003). *Research design in clinical psychology* (4th Ed.). Boston, MA: Allyn & Bacon.

Kazdin, A. E. (2007). Mediators and mechanisms of change in psychotherapy research. *Annual Review of Clinical Psychology, 3*, 1-27.

Kazdin, A. E., & Kendall, P. C. (1998). Current progress and future plans for developing treatments: Comments and perspectives. *Journal of Clinical Child Psychology, 27*, 217-226.

Kazdin, A. E., & Nock, M. K. (2003). Delineating mechanisms of change in child and adolescent therapy: Methodological issues and research recommendations. *Journal of Child Psychology and Psychiatry, 44*, 1116-1129.

Keenan-Miller, D., Hammen, C. L., & Brennan, P. A. (2007). Health outcomes related to early adolescent depression. *Journal of Adolescent Health, 41*, 256-262.

Kelso, J. A. S. (1995). *Dynamic patterns: The self-organization of brain and behavior*. Cambridge, MA: MIT Press.

Kendall, P. C., Carper, M. M., Khanna, M. S., & Harris, M. S. (2015). Computer technology and children's mental health. In R. Scott & S. Kosslyn (Eds.), *Emerging trends in the social and behavioral sciences* (pp. 1-16). Hoboken, NJ: John Wiley and Sons.

Kendall, P. C., & Comer, J. S. (2011). Research methods in clinical psychology. In D. H. Barlow (Ed.), *Oxford handbook of clinical psychology*. New York, NY: Oxford University Press.

Kendall, P. C., Compton, S. N., Walkup, J. T., Birmaher, B., Albano, A. M., Sherrill, J. T., . . . Piacentini, J. (2010). Clinical characteristics of anxiety disordered youth. *Journal of Anxiety Disorders, 24,* 360-365. doi: 10.1016/j.janxdis.2010.01.009

Kendall, P. C., Cummings, C., Villabo, M. A., Narayanan, M. K., Treadwell, K. R. H., Birmaher, B., . . . Albano, A. M. (under review). Mediators of change in the Child/Adolescent Anxiety Multimodal Treatment Study.

Kendall, P. C., & Hedtke, K. A. (2006a). *Cognitive-behavioral therapy for anxious children: Therapist manual* (3rd ed.). Ardmore, PA: Workbook Publishing.

Kendall, P. C., & Hedtke, K. A. (2006b). *Coping Cat workbook* (2nd ed.). Ardmore, PA: Workbook Publishing.

Kendall, P. C., Hudson, J. L., Gosch, E., Flannery-Schroeder, E., & Suveg, C. (2008). Cognitive-behavioral therapy for anxiety disordered youth: A randomized clinical trial evaluating child and family modalities. *Journal of Consulting and Clinical Psychology, 76,* 282-297. doi: 10.1037/0022-006X.76.2.282

Kendall, P. C., Kortlander, E., Chansky, T. E., & Brady, E. U. (1992). Comorbidity of anxiety and depression in youth: Treatment implications. *Journal of Consulting and Clinical Psychology, 60*, 869-880. doi: 10.1037/0022-006X.60.6.869

Kendall, P. C., O'Neil, K., Villabo, M. A., Martinsen, K., Stark, K., & Banneyer, K. (2014). Therapy with children and adolescents: Cognitive-behavioral therapy offers a transdiagnostic perspective. In J. Ehrenreich-May & B. C. Chu (Eds.), *Transdiagnostic mechanisms and treatment for youth psychopathology*. New York, NY: Guilford Press.

Kendall, P. C., & Treadwell, K. R. H. (2007). The role of self-statements as a mediator in treatment for youth with anxiety disorders. *Journal of Consulting and Clinical Psychology, 75*, 380-389.

Kerns, C. M., Read, K. L., Klugman, J., & Kendall, P. C. (2013). Cognitive behavioral therapy for youth with social anxiety: Differential short- and long-term treatment outcomes. *Journal of Anxiety Disorders, 27*, 210-215. doi: 10.1016/j.janxdis.2013.01.009

Kiesler, D. J. (1966). Some myths of psychotherapy research and the search for a paradigm. *Psychological Bulletin, 65*, 110-136.

Klein, J. S., Jacobs, R. H., & Reinecke, M. A. (2007). Cognitive behavioral therapy for adolescent depression: A meta-analytic investigation of changes in effect-size estimates. *Journal of the American Academy of Child and Adolescent Psychiatry, 46*, 1403-1413.

Kley, H., Heinrichs, N., Bender, C., & Tuschen-Caffier, B. (2012). Predictors of outcome in a cognitive-behavioral group program for children and adolescents with social anxiety disorder. *Journal of Anxiety Disorders, 26*, 79-87.

Kline, R. B. (2011). *Principles and practice of structural equation modeling* (3rd ed.). New York: Guilford Press.

Kolko, D. J., Brent, D. A., Baugher, M., Bridge, J., & Birmaher, B. (2000). Cognitive and family therapies for adolescent depression: Treatment specificity, mediation, and moderation. *Journal of Consulting and Clinical Psychology, 68*, 603-614.

Kovacs, M. (1981). Rating scales to assess depression in school aged children. *Acta Paedopsychiatrica, 46*, 305-315.

Kraemer, H. C., Kazdin, A. E., Offord, D. R., Kessler, R. C., Jensen, P. S., & Kupfer, D. J. (1997). Coming to terms with the terms of risk. *Archives of General Psychiatry, 54*, 337-343.

Kraemer, H. C., Wilson, G. T., Fairburn, C. G., & Agras, W. S. (2002). Mediators and moderators of treatment effects in randomized clinical trials. *Archives of General Psychiatry, 59*, 877-883.

Lamey, A., Hollenstein, T., Lewis, M. D., & Granic, I. (2004). Gridware (Version 1.1). Retrieved from http://statespacegrids.org

Lau, W., Chan, C. K., Li, J. C., & Au, T. K. (2010). Effectiveness of group cognitive-behavioral treatment for childhood anxiety in community clinics. *Behaviour Research and Therapy, 48*, 1067-1077.

Laurenceau, J. P., Hayes, A. M., & Feldman, G. C. (2007). Some methodological and statistical issues in the study of change processes in psychotherapy. *Clinical Psychology Review, 27,* 682-695.

Laurent, J., Catanzaro, S. J., Joiner, T. E., Rudolph, K. D., Potter, K. I., Lambert, S., . . . Gathright, T. (1999). A measure of positive and negative affect for children: Scale development and preliminary validation. *Psychological Asssessment, 11,* 326-338. doi: 10.1037/1040-3590.11.3.326

Levine, L. J., & Safer, M. A. (2002). Sources of bias in memory for emotions. *Current Directions in Psychological Science, 11,* 169-173. doi: 10.1111/1467-8721.00193

Lewinsohn, P. M., Rohde, P., & Seeley, J. R. (1988). Major depressive disorder in older adolescents: Prevalence, risk factors, and clinical implications. *Clinical Psychology Review, 18,* 765-794.

Little, R. J. A. (1988). A test of missing completely at random for multivariate data with missing values. *Journal of the American Statistical Association, 83,* 1198-1202.

Luxton, D. D., McCann, R. A., Bush, N. E., Mishkind, M. C., & Reger, G. M. (2011). mHealth for mental health: Integrating smartphone technology in behavioral healthcare. *Professional Psychology: Research and Practice, 42,* 505-512.

MacKinnon, D. P., Lockwood, C. M., Hoffman, J. M., West, S. G., & Sheets, V. (2002). A comparison of methods to test mediation and other intervening variable effects. *Psychological Methods, 7,* 83-104.

MacKinnon, D. P., Lockwood, C. M., & Williams, J. (2004). Confidence limits for the indirect effect: Distribution of the product and resampling methods. *Multivariate Behavioral Research, 39*, 99-128.

Manassis, K., Mendlowitz, S. L., Scapillato, D., Avery, D., Fiksenbaum, L., Freire, M., . . . Owens, M. (2002). Group and individual cognitive-behavioral therapy for childhood anxiety disorders: A randomized trial. *Journal of the American Academy of Child and Adolescent Psychiatry, 41*, 1423-1430.

Maric, M., Wiers, R. W., & Prins, P. J. M. (2012). Ten ways to improve the use of statistical mediation analysis in the practice of child and adolescent treatment research. *Clinical Child and Family Psychology Review, 15*, 177-191. doi: 10.1007/s10567-012-0114-y

Marker, C. D., Comer, J. S., Abramova, V., & Kendall, P. C. (2013). The reciprocal relationship between alliance and symptom improvement across the treatment of childhood anxiety. *Journal of Clinical Child and Adolescent Psychology, 42*, 22-33.

McArdle, J. J. (2009). Latent variable modeling of differences and changes with longitudinal data. *Annual Review of Psychology, 60*, 577-605.

McArdle, J. J., & Hamagami, F. (2001). Latent difference score structural models for linear dynamic analyses with incomplete longitudinal data. In L. M. Collins & A. G. Sayer (Eds.), *New methods for the analysis of change*. Washington, DC: American Psychological Association.

McArdle, J. J., Hamgami, F., Jones, K., Ferenc, J., Kikinis, R., Spiro, A., & Albert, M. S. (2004). Structural brain modeling of dynamic changes in memory nad brain structure using longitudinal data from the Normative Aging Study. *Journal of Gerontology, 59B*, 294-304.

McArdle, J. J., & Nesselroade, J. R. (1994). Stucturing data to study development and change. In S. H. Cohen & H. W. Reese (Eds.), *Lifespan developmental psychology: Methodological innovations*. Hillsdale, NJ: Erlbaum.

McClure, E. B., Adler, A., Monk, C. S., Cameron, J., Smith, S., Nelson, E. E., . . . Pine, D. S. (2007). fMRI predictors of treatment outcome in pediatric anxiety disorders. *Psychopharmacology, 191*, 97-105. doi: 10.1007/s00213-006-0542-9

Mennin, D. S., Fresco, D. M., Ritter, M., & Heimberg, R. G. (2015). An open trial of emotion regulation therapy for generalized anxiety disorder and co-occurring depression. *Depression and Anxiety, 32,* 614-623. doi: 10.1002/da.22377

Messer, S. C., Angold, A., Costello, E. J., Loeber, R., Van Kammen, W., & Stouthamer, M. (1995). Development of a short questionnaire for use in epidemiological studies of depression in children and adolescents: Factor composition and structure across development. *International Journal of Methods in Psychiatric Research, 5,* 251-262. doi: 1049-8931/95/040251-12

Molenaar, P. C. M. (2004). A manifesto on psychology as idiographic science: Bringing the person back into scientific psychology, this time forever. *Measurement, 2,* 201-218.

Molenaar, P. C. M., & Campbell, C. G. (2009). The new person-specific paradigm in psychology. *Current Directions in Psychological Science, 18*, 112-117. doi: 10.1111/j.1467-8721.2009.01619.x

Mufson, L., Dorta, K. P., Wickramaratne, P., Nomura, Y., Olfson, M., & Weissman, M. M. (2004). A randomized effectiveness trial of interpersonal psychotherapy for depressed adolescents. *Archives of General Psychiatry, 61*, 577-584. doi: 10.1001/archpsyc.61.6.577

Muris, P., & Meesters, C. (2009). Reactive and regulative temperament in youths: Psychometric evaluation of the Early Adolescent Temperament Questionnaire-Revised. *Journal of Psychopathology and Behavioral Assessment, 31*, 7-19.

Muthen, L. K., & Muthen, B. O. (1998-2017). *MPlus user's guide. 8th Edition*. Los Angeles, CA: Muthen & Muthen.

Nesselroade, J. R., Gerstorf, D., Hardy, S. A., & Ram, N. (2007). Idiographic filters for psychological constructs. *Measurement, 5*, 217-235.

Newman, M. G., & Fisher, A. J. (2013). Mediated moderation in combined cognitive behavioral therapy versus component treatments for generalized anxiety disorder. *Journal of Consulting and Clinical Psychology, 81*, 405-414.

Nilsen, T. S., Eisemann, M., & Kvernmo, S. (2013). Predictors and moderators of outcome in child and adolescent anxiety and depression: A systematic review of psychological treatment studies. *European Child and Adolescent Psychiatry, 22*, 69-87.

Nock, M. K., Janis, I. B., & Wedig, M. M. (2008). Research designs. In A. M. Nezu & M. Nezu (Eds.), *Evidence-based outcome research: A practical guide to conducting randomized controlled trials for psychosocial interventions* (pp. 201-218). New York: Oxford University Press.

Ollendick, T. H., Jarrett, M. A., Grills-Taquechel, A. E., Hovey, L. D., & Wolff, J. C. (2008). Comorbidity as a predictor and moderator of treatment outcome in youth with anxiety, affective, attention deficit/hyperactivity disorder, and oppositional/conduct disorders. *Clinical Psychology Review, 28*, 1447-1471.

O'Neil, K. A., Puleo, C. M., Bejamin, C. L., Podell, J. L., & Kendall, P. C. (2012). Suicidal ideation in anxiety-disordered youth. *Suicide and Life-Threatening Behavior, 42*, 305-317.

Pascual-Leone, A. (2009). Dynamic emotional processing in experiential therapy: Two steps forward, one step back. *Journal of Consulting and Clinical Psychology, 77*, 113-126. doi: 10.1037/a0014488

Paul, G. L. (1967). Strategy of outcome research in psychotherapy. *Journal of Consulting Psychology, 31*, 109-118.

Peris, T. S., Compton, S. N., Kendall, P. C., Birmaher, B., Sherrill, J. T., March, J., . . . Piacentini, J. (2015). Trajectories of change in youth anxiety during cognitive-behavior therapy. *Journal of Consulting and Clinical Psychology, 83*, 239-252. doi: 10.1037/a0038402

Pew Research Center. (2015). Teens, Social Media, & Technology Overview 2015. Retrieved November 23, 2016, from http://www.pewinternet.org/2015/04/09/teens-social-media-technology-2015/

Piasecki, T. M., Hufford, M. R., Solhan, M. B., & Trull, T. J. (2007). Assessing clients in their natural environments with electronic diaries: Rationale, benefits, limitations, and barriers. *Psychological Asssessment, 19,* 25-43.

Podell, J. L., Kendall, P. C., Gosch, E. A., Compton, S. N., March, J. S., Albano, A. M., . . . Piacentini, J. C. (2013). Therapist factors and outcomes in CBT for anxiety in youth. *Professional Psychology: Research and Practice, 44,* 89-98. doi: 10.1037/a0031700

Pramana, G., Parmanto, B., Kendall, P. C., & Silk, J. S. (2014). The SmartCAT: An mHealth platform for ecological momentary intervention (EMI) in child anxiety treatment. *Telemedicine and e-Health, 20,* 419-427. doi: 10.1089/tmj.2013.0214

Preacher, K. J., & Hayes, A. F. (2008). Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. *Behavior Research Methods, 40,* 879-891.

Prins, P. J. M., & Ollendick, T. H. (2003). Cognitive change and enhanced coping: Missing mediational links in cognitive behavior therapy with anxiety-disordered children. *Clinical Child and Family Psychology Review, 6,* 87-105.

Puleo, C. M., & Kendall, P. C. (2011). Anxiety disorders in typically developing youth: Autism spectrum symptoms as a predictor of cognitive-behavioral treatment. *Journal of Autism and Developmental Disorders, 41,* 275-286.

Reinecke, M. A., Ryan, N. E., & DuBois, D. L. (1998). Cognitive-behavioral therapy of depression and depressive symptoms during adolescence: A review and meta-analysis. *Journal of the American Academy of Child and Adolescent Psychiatry, 37*, 26-34.

Reynolds, S., Wilson, C., Austin, J., & Hooper, L. (2012). Effects of psychotherapy for anxiety in children and adolescents: A meta-analytic review. *Clinical Psychology Review, 32*, 251-262.

Rohde, P., Lewinsohn, P. M., & Seeley, J. R. (1994). Response of depressed adolescents to cognitive-behavioral treatment: Do differences in initial severity clarify the comparison of treatments? *Journal of Consulting and Clinical Psychology, 62*, 851-854.

Salvatore, S., & Tschacher, W. (2012). Time dependency of psychotherapeutic exchanges: The contribution of the Theory of DYnamic Systems in analyzing process. *Frontiers in Psychology, 3*, 1-14.

Schafer, J. O., Naumann, E., Holmes, E. A., Tuschen-Caffier, B., & Samson, A. C. (2017). Emotion regulation strategies in depressive and anxiety symptoms in youth: A meta-analytic review. *Journal of Youth and Adolescence, 46,* 261-276. doi: 10.1007/s10964-016-0585-0

Shiffman, S., Stone, A. A., & Hufford, M. R. (2008). Ecological momentary assessment. *Annual Review of Clinical Psychology, 4*, 1-32.

Shirk, S. R., Crisostomo, P. S., Jungbluth, N., & Gudmundsen, G. R. (2013). Cognitive mechanisms of change in CBT for adolescent depression: Associations among client involvement, cognitive distortions, and treatment outcome. *International Journal of Cognitive Therapy, 6*, 311-324.

Shirk, S. R., Gudmundsen, G., Kaplinski, H. C., & McMakin, D. L. (2008). Alliance and outcome in cognitive-behavioral therapy for adolescent depression. *Journal of Clinical Child and Adolescent Psychology, 37,* 631-639. doi: 10.1080/15374410802148061

Shirk, S. R., Jungbluth, N., & Karver, M. S. (2012). Change processes and active components. In P. C. Kendall (Ed.), *Child and adolescent therapy: Cognitive-behavioral procedures* (4th ed.). New York: Guilford Press.

Shirk, S. R., Karver, M. S., & Brown, R. (2011). The alliance in child and adolescent psychotherapy. *Psychotherapy, 48*, 17-24.

Silk, J. S., Forbes, E. E., Whalen, D. J., Jakubcak, J. L., Thompson, W. K., Ryan, N. D., . . . Dahl, R. E. (2011). Daily emotional dynamics in depressed youth: A cell-phone ecological momentary assessment study. *Journal of Experimental Child Psychology, 110*, 241-257.

Silk, J. S., Steinberg, L., & Morris, A. S. (2003). Adolescents' emotion regulation in daily life: Links to depressive symptoms and problem behavior. *Child Development, 74*, 1869-1880. doi: 10.1046/j.1467-8624.2003.00643.x

Silk, J. S., Tan, P. Z., Ladouceur, C. D., Meller, S., Siegle, G. J., McMakin, D. L., . . . Ryan, N. D. (2018). A randomized clinical trial comparing individual cognitive

behavioral therapy and child-centered therapy for child anxiety disorders. *Journal of Clinical Child and Adolescent Psychology, 47*, 542-554. doi: 10.1080/15374416.2016.1138408

Silverman, W. K., Kurtines, W. M., Ginsburg, G. S., Weems, C. F., Lumpkin, P. W., & Carmichael, D. H. (1999). Treating anxiety disorders in children with group cognitive-behavior therapy: A randomized clinical trial. *Journal of Consulting and Clinical Psychology, 67*, 995-1003.

Silverman, W. K., Kurtines, W. M., Ginsburg, G. S., Weems, C. F., Rabian, B., & Serafini, L. T. (1999). Contingency management, self-control, and education support in the treatment of childhood phobic disorders: A randomized clinical trial. *Journal of Consulting and Clinical Psychology, 67*, 675-687.

Sobel, M. E. (1982). Asymptotic confidence intervals for indirect effects in structural equation models. In S. Leinhart (Ed.), *Sociological methodology 1982*. San Francisco, CA: Jossey-Bass.

Solhan, M. B., Trull, T. J., & Wood, P. K. (2009). Clinical assessment of affective instability: Comparing EMA indices, questionnaire reports, and retrospective recall. *Psychological Asssessment, 21*, 425-436.

Southam-Gerow, M. A., Kendall, P. C., & Weersing, V. R. (2001). Examining outcome variability: Correlates of treatment response in a child and adolescent anxiety clinic. *Journal of Clinical Child Psychology, 30*, 422-436.

Stiles, W. B., & Shapiro, D. A. (1994). Disabuse of the drug metaphor: Psychotherapy process-outcome correlations. *Journal of Consulting and Clinical Psychology, 62*, 942-948.

Suveg, C. M., Hoffman, B., Zeman, J. L., & Thomassin, K. (2009). Common and specific emotion-related predictors of anxious and depressive symptoms in youth. *Child Psychiatry & Human Development, 40*, 223-239. doi: 10.1007/s10578-008-0121-x

Suveg, C. M., Sood, E., Comer, J. S., & Kendall, P. C. (2009). Changes in emotion regulation following cognitive-behavioral therapy for anxious youth. *Journal of Clinical Child and Adolescent Psychology, 38*, 390-401. doi: 10.1080/15374410902851721

Swan, A. J., & Kendall, P. C. (2016). Fear and missing out: Youth anxiety and functional outcomes. *Clinical Psychology: Science and Practice, 23*, 417-435. doi: 10.1111/cpsp.12169

Swan, A. J., Kendall, P. C., Olino, T. M., Ginsburg, G. S., Keeton, C., Compton, S. N., . . . Albano, A. M. (2018). Results from the Child/Adolescent Anxiety Multimodal Longitudinal Study (CAMELS): Functional outcomes. *Journal of Consulting and Clinical Psychology, 86*, 738-750. doi: 10.1037/ccp0000334

Tan, P. Z., Forbes, E. E., Dahl, R. E., Ryan, N. D., Siegle, G. J., Ladouceur, C. D., & Silk, J. S. (2012). Emotional reactivity and regulation in anxious and nonanxious youth: A cell-phone ecological momentary assessment study. *Journal of Child Psychology and Psychiatry, 53*, 197-206.

Tang, T. Z., & DeRubeis, R. J. (1999). Sudden gains and critical sessions in cognitive-behavioral therapy for depression. *Journal of Consulting and Clinical Psychology, 67*, 894-904.

Thelen, E., & Smith, L. B. (2006). Dynamic Systems Theories. In W. Damon & R. M. Lerner (Eds.), *Handbook of child psychology: Theoretical models of human development* (6th ed., pp. 258-312). Hoboken, NJ: John Wiley & Sons.

Tiwari, S., Kendall, P. C., Hoff, A. L., Harrison, J. P., & Fizur, P. (2013). Characteristics of exposure sessions as predictors of treatment response in anxious youth. *Journal of Clinical Child and Adolescent Psychology, 42*, 34-43.

Treadwell, K. R. H., & Kendall, P. C. (1996). Self-talk in youth with anxiety disorders: Content specificity and treatment outcome. *Journal of Consulting and Clinical Psychology, 64*, 941-950.

Trosper, S. E., Buzzella, B. A., Bennett, S. M., & Ehrenreich, J. T. (2009). Emotion regulation in youth with emotional disorders: Implications for a unified treatment approach. *Clinical Child and Family Psychology Review, 12*, 234-254. doi: 10.1007/s10567-009-0043-6

Vallacher, R. R., Coleman, P. T., Nowak, A., & Bui-Wrzosinska, L. (2010). Rethinking intractable conflict: The perspective of dynamical systems. *American Psychologist, 65*, 262-278. doi: 10.1037/a0019290

Vallacher, R. R., & Nowak, A. (1997). The emergence of dynamical social psychology. *Psychological Inquiry, 8*, 73-99.

Walkup, J. T., Albano, A. M., Piacentini, J., Birmaher, B., Compton, S. N., Sherrill, J. T., . . . Kendall, P. C. (2008). Cognitive Behavioral Therapy, Sertraline, or a combination in childhood anxiety. *New England Journal of Medicine, 359*, 2753-2766.

Webb, C. A., Auerbach, R. P., & DeRubeis, R. J. (2012). Processes of change in CBT of adolescent depression: Review and recommendations. *Journal of Clinical Child and Adolescent Psychology, 41*, 654-665. doi: 10.1080/15374416.2012.704842

Weersing, V. R., & Weisz, J. R. (2002). Mechanisms of action in youth psychotherapy. *Journal of Child Psychology and Psychiatry, 43*, 3-29.

Wei, C., Cummings, C., Herres, J., Read, K. L., Swan, A., Carper, M. M., . . . Kendall, P. C. (2014). Dissemination and implementation of empirically supported treatments for anxious youth in community settings. In R. S. Beidas & P. C. Kendall (Eds.), *Child and adolescent therapy: Dissemination and implementation of empirically supported treatments*. New York: Oxford University Press.

Weisz, J. R., Chorpita, B. F., Frye, A., Ng, M. Y., Lau, N., Bearman, S. K., . . . The Research Network on Youth Mental Health. (2011). Youth Top Problems: Using idiographic, consumer-guided assessment to identify treatment needs and to track change during psychotherapy. *Journal of Consulting and Clinical Psychology, 79*, 369-380. doi: 10.1037/a0023307

Weisz, J. R., McCarty, C. A., & Valeri, S. M. (2006). Effects of psychotherapy for depression in children and adolescents: A meta-analysis. *Psychological Bulletin, 132*, 132-149.

Wirtz, D., Kruger, J., Napa Scollon, C., & Diener, E. (2003). What to do on spring break? The role of predicted, on-line, and remembered experience in future choice. *Psychological Science, 14,* 520-524. doi: 10.1111/1467-9280.03455

Wolk, C. B., Kendall, P. C., & Beidas, R. S. (2015). Cognitive-behavioral therapy for child anxiety confers long-term protection from suicidality. *Journal of the American Academy of Child and Adolescent Psychiatry, 54,* 175-179.

Wood, A., Kroll, L., Moore, A., & Harrington, R. (1995). Properties of the Mood and Feelings Questionnaire in adolescent psychiatric outpatients: A research note. *Journal of Child Psychology and Psychiatry, 36,* 327-334.

Woodward, L. J., & Fergusson, D. M. (2001). Life course outcomes of young people with anxiety disorders in adolescence. *Journal of the American Academy of Child and Adolescent Psychiatry, 40,* 1086-1093.

Yorbik, O., Birmaher, B., Axelson, D., Williamson, D. E., & Ryan, N. D. (2004). Clinical characteristics of depressive symptoms in children and adolescents with major depressive disorder. *Journal of Clinical Psychiatry, 65,* 1654-1659.

Young, J. F., Makover, H. B., Cohen, J. R., Mufson, L., Gallop, R. J., & Benas, J. S. (2012). Interpersonal psychotherapy-adolescent skills training: Anxiety outcomes and impact of comorbidity. *Journal of Clinical Child and Adolescent Psychology, 41,* 640-653.

Young, J. F., Mufson, L., & Davies, M. (2006). Impact of comorbid anxiety in an effectiveness study of interpersonal psychotherapy for depressed adolescents.

Journal of the American Academy of Child and Adolescent Psychiatry, 45, 904-912.

Zeman, J., Cassano, M., Suveg, C. M., & Shipman, K. (2008). *Initial validation of the Worry Management Scale for Children*.

Zeman, J., Shipman, K., & Penza-Clyve, S. (2001). Development and initial validation of the Children's Sadness Management Scale. *Journal of Nonverbal Behavior, 25*, 187-205.

APPENDIX A

EXPANDED LITERATURE REVIEW

Anxiety disorders are common in youth, affecting between 3% and 24% of the youth population (Cartwright-Hatton, McNicol, & Doubleday, 2006). The DSM-V (American Psychiatric Association, 2013) lists eight anxiety disorders: Generalized Anxiety Disorder (GAD), Social Anxiety Disorder (SAD), Specific Phobia (SP), Panic Disorder (PD), Agoraphobia (AG), Separation Anxiety Disorder (SepAD), Selective Mutism (SM), and Anxiety Not Elsewhere Classified (NEC). These disorders are often comorbid (Kendall et al., 2010), and are associated with a variety of adverse outcomes including impairment in school, family, and social situations (Ialongo, Edelsohn, Werthamer-Larsson, Crockett, & Kellam, 1994). Left untreated, these disorders rarely remit on their own (Compton, Burns, Egger, & Robertson, 2002) and put individuals at greater risk for anxiety, depression, substance use problems (Benjamin, Harrison, Settipani, Brodman, & Kendall, 2013), and educational underachievement later in life (Woodward & Fergusson, 2001).

Depression is also common among youth, particularly adolescents, with an estimated one year prevalence of 4-5% (Costello, Egger, & Angold, 2005; Costello, Erkanli, & Angold, 2006). Depression in adolescence puts individuals at greater risk of suicide, with greater than 50% of adolescent suicide victims reported to have a depressive disorder (Hawton & van Heeringen, 2009). Like anxiety disorders in youth, depression is prospectively associated with a variety of adverse outcomes, including increases in substance use and obesity (Hasler et al., 2005; Keenan-Miller, Hammen, & Brennan,

2007), as well as both social and educational impairment (Fletcher, 2008; Lewinsohn, Rohde, & Seeley, 1988).

Anxiety and depression often co-occur in children and adolescents (Axelson & Birmaher, 2001; Essau, 2008; Garber & Weersing, 2010). Multiple theoretical models have been proposed to explain the high rates of comorbidity between these two disorders (for review, see Cummings, Caporino, & Kendall, 2014); however, comparatively fewer studies have examined factors affecting their treatment (Kendall, Kortlander, Chansky, & Brady, 1992). Given that 15% to 75% of depressed youth present with comorbid anxiety (Angold, Costello, & Erkanli, 1999; Avenevoli, Stolar, Li, Dierker, & Merikangas, 2001; Yorbik, Birmaher, Axelson, Williamson, & Ryan, 2004), and that 10% to 15% of anxious youth present with comorbid depression (Angold et al., 1999; Axelson & Birmaher, 2001; Costello, Mustillo, Erkanli, Keeler, & Angold, 2003), understanding factors that influence their treatment is of particular public health importance (Kendall et al., 2014).

Cognitive behavioral therapy (CBT) has recently been defined as a "well-established" treatment for childhood anxiety (see, Hollon & Beck, 2013), using widely-accepted definitions (e.g., Chambless & Hollon, 1998). CBT typically achieves response rates of 60% in randomized clinical trials (RCTs; Reynolds, Wilson, Austin, & Hooper, 2012; Walkup et al., 2008); response rates in community settings are lower (Wei et al., 2014). Similarly, CBT has been shown to be an efficacious treatment for depression in adolescents (for reviews, see Klein, Jacobs, & Reinecke, 2007; Reinecke, Ryan, & DuBois, 1998; Weisz, McCarty, & Valeri, 2006). Despite support for the effectiveness of CBT for anxious and for depressed youth and numerous calls to evaluate mechanisms of

change in CBT (e.g., Kazdin, 2000; Kazdin & Nock, 2003; Weersing & Weisz, 2002), research is needed to elucidate how CBT achieves its beneficial effects.

From a historical context, there has been a great deal of research over the past sixty years designed to answer the question, "Does psychotherapy for child and adolescents work?" As Kazdin (2000) noted, there were over 1500 published empirical studies of psychotherapy for children as of his review, and we now know that child therapy can be effective. Since then, numerous other studies have supported the efficacy and effectiveness of therapy for anxiety and depression in children and adolescents. Despite support for the effectiveness of therapy for children and adolescents, we are not yet at a point where we can answer the question Kiesler (1966) posed and Paul (1967) re-asked, "What treatment, by whom, is most effective for this individual with that specific problem, under which set of circumstances?" Research focusing on how and why therapy works and why certain factors influence therapy outcomes has progressed, but much remains to be done to achieve empirically-based personalization of treatments to individual client presentations (Fisher, in press; Fisher & Bosley, in press; Kazdin, 2007).

The present review evaluates the current state of the literature regarding predictors, moderators, and mediators of outcomes from psychological treatment for youth internalizing disorders (i.e., anxiety and depression). We begin by discussing methodological issues related to the evaluation of predictors, moderators, and mediators of treatment response. We then review the literature on predictors, moderators, and mediators of youth outcomes from psychological treatment for anxiety and for unipolar depression. Given that cognitive behavioral therapy (CBT) has largely been the most

efficacious for these disorders, our review will primarily focus on predictors, moderators, and mediators of change in the context of CBT interventions. However, we also review interpersonal therapy (IPT) in the context of adolescent depression because it has been shown to be an effective treatment for depression in adolescents. Novel statistical approaches and data collection methods that are designed to address the mechanisms of therapeutic change are also described. Finally, we will offer specific suggestions for future research.

Methodological Issues in Evaluating Predictors, Moderators, and Mediators of Treatment Response

Despite the acceptance of RCTs as a preferred method to evaluate psychological interventions (Kendall & Comer, 2011), inconsistency in the definition of "treatment response" remains a concern for studies of anxiety and depression in youth. For example, some RCTs define treatment response in terms of statistically significant reductions in symptoms (i.e., reductions on self-report or clinician-administered measures of anxiety severity; e.g., Kendall & Treadwell, 2007) whereas others define treatment response as remission from the targeted disorder (i.e., no GAD at posttreatment; e.g., Halldorsdottir et al., in press) or remission from all disorders categorically related to the treatment (i.e., no anxiety disorders at posttreatment; e.g., Southam-Gerow, Kendall, & Weersing, 2001). These definitional differences (how treatment response is operationalized) make direct comparisons across studies difficult. Thus, as we review the literature on predictors, moderators, and mediators of treatment response, we encourage readers to consult Tables 1 (anxiety) and 2 (depression) which note how treatment response was defined.

Given the inconsistency in the operationalization of treatment response, and given the merits of each alternative, it seems reasonable to define treatment response in multiple ways, both at the diagnostic level (e.g., remission of a clinical disorder), the symptom level (e.g., significant reductions in symptom severity), and the functional level (e.g., significant increases in measures of global functioning or quality of life). With such an approach, consistency in findings across multiple operationalizations would be comprehensive evidence of an efficacious treatment (more so than significant changes on one outcome measure). However, there may be more to treatment response than is captured by these methods.

Consider the experience of treating a depressed teen who, after twenty sessions of CBT, no longer meets diagnostic criteria for depression, but reports that although he/she is no longer sad, he/she is not happy. Would you consider this client a treatment responder? Would that client consider himself/herself a treatment responder? For some clients, symptom reduction or remittance of a disorder is a welcomed improvement. For others, it is not the only metric by which they gauge treatment response. However, with few exceptions, researchers rarely use broad definitions of treatment response. As has been argued (Fisher, in press; Haynes, Mumma, & Pinson, 2009), a more idiographic assessment of treatment outcome that incorporates variables and functional relationships important to each individual client could serve as a meaningful metric for evaluating treatment response. Some research has begun to do this, creating idiographic assessment instruments such as the Top Problems Assessment (TPA; Weisz et al., 2011), which allows parents and youth to identify their most important concerns at the beginning of

treatment. An idiographic approach, as detailed later in this review, offers promise for future treatment outcome research.

Predictors of Treatment Outcome

Predictor variables identify the factors that are associated with treatment outcomes. More specifically, predictors of treatment response are variables that are associated with treatment outcome and have no interactive effect with treatment (Kraemer, Wilson, Fairburn, & Agras, 2002). Predictors may be assessed at baseline (i.e., prior to randomization) or posttreatment. However, if predictor variables are assessed at posttreatment they must not be correlated with treatment condition. Stated differently, predictor variables represent correlates and risk factors of the outcome (Kazdin, 2007). For example, if pretreatment levels of depression (severity) were significantly associated with outcomes from both psychological and pharmacological treatments for depression in youth, pretreatment levels of depression would be a predictor of treatment outcome. Similarly, adherence to diabetes self-care, which can only be assessed at posttreatment, can be considered a predictor of diabetes outcomes. It is important to note that predictor variables are considered nonspecific in that they are associated with outcome regardless of treatment assignment (i.e., no interactive effect). Although identifying predictors of treatment outcome is an important step, these efforts and findings do not explain how or why a given predictor variable is associated with outcome. Simply put, predictors of treatment response do not provide insight into which treatment for which individual is best or the mechanisms through which treatments work,

but they do provide important prognostic information that are not specific to a treatment modality.

Moderators of Treatment Outcome

Treatment moderator variables explain for whom and/or under what circumstances a treatment works (Baron & Kenny, 1986; Kraemer et al., 2002). Moderator variables *must* be assessed prior to treatment and must not be correlated with treatment. Thus, treatment moderators are baseline factors that interact with treatment to produce differential outcomes dependent on the value of the moderating variable. A common mistake in labeling moderators was noted by Kraemer and colleagues (2002) and occurs when a posttreatment variable is not correlated with treatment, but interacts with treatment to predict outcome. In this circumstance, the treatment is a moderator of the posttreatment variable, although authors may misreport the results as the posttreatment variable moderating outcome. Consider the following example of a hypothetic RCT examining the effect of CBT as compared to a support and attention control condition for youth anxiety. The effect of parental divorce during treatment (which must be assessed at posttreatment and is likely not to be correlated with treatment assignment) may affect treatment outcome to a lesser extent among youth in the CBT condition relative to the control condition (i.e., interacts with treatment). In this instance, the effect of parental divorce on treatment outcome is moderated by treatment condition because youth were better able to cope with parental divorce in the CBT condition compared to those in the support and attention control condition.

Statistically speaking, moderators of treatment outcome are typically evaluated through ANOVA or linear regression techniques by including the main effects of treatment (Tx) and the proposed moderator (Mod), as well as the Tx X Mod interaction to predict outcome. A statistically significant Tx X Mod term indicates that variable moderates the relationship between treatment and outcome. Moderator variables go a step further than predictor variables such that they describe specific subpopulations for which an intervention may be particularly beneficial. For example, if pretreatment levels of depression (severity) interacted with treatment (CBT versus pharmacotherapy) such that more severely depressed youth responded better to pharmacotherapy compared to CBT, pretreatment levels of depression would be a moderator of treatment outcome. That is, pretreatment levels of depression were positively associated with better treatment outcome for one treatment (pharmacotherapy), but not another (CBT). However, moderators do not describe how a particular treatment achieves its beneficial effects.

Mediators of Treatment Outcome

Mediating variables are variables that describe possible mechanisms through which a treatment may achieve its beneficial effects (Kraemer et al., 1997; Kraemer et al., 2002). As Kraemer and colleagues (2002) point out, "all mechanisms are mediators but not all mediators are mechanisms" (p. 878). Mediating variables *must* be assessed after randomizing participants to treatments to demonstrate that treatment condition has an effect on the mediating variable (i.e., that changes in the mediating variable are specific to a given treatment). Mediating variables should be assessed prior to the posttreatment assessment to demonstrate that change in the mediator occurs prior to change in the

outcome (termed "temporal precedence;" Gollob & Reichardt, 1991; Kazdin, 2007). As will be emphasized throughout this review (see Tables 1 and 2 for overview), few studies have established temporal precedence of the mediating variable despite the importance of this concept first being published in 1991 (Gollob & Reichardt, 1991).

Initially, mediation was evaluated through a three step process (Baron & Kenny, 1986; Judd & Kenny, 1981). This process is depicted visually in Figure 1. First, the mediator (M) must be regressed on the independent variable (path a) and the path coefficient must be statistically significant. Second, the dependent variable must be regressed on the independent variable (path c) and the path coefficient must be statistically significant. Third, the dependent variable must be regressed on both the independent variable (path c') and the mediating variable (path b). To say that a variable M mediates the relationship between X and Y, path b must be significant in the third regression equation and the parameter associated with path c' must reduce in magnitude from that associated with path c. Sobel (1982) developed a statistical test (aptly termed the Sobel Test) to determine whether the indirect effect (i.e., the effect of X on Y through M) is statistically significant. However, there are a variety of concerns with the Sobel Test due to the distributional assumptions it places on the indirect effect (MacKinnon, Lockwood, Hoffman, West, & Sheets, 2002; MacKinnon, Lockwood, & Williams, 2004). Alternative strategies have been developed to test the significance of the indirect effect that do not have these distributional assumptions (e.g., MacKinnon et al., 2004; Preacher & Hayes, 2008). As we review studies examining mediators of treatment outcome, readers are encouraged to consult Tables 1 (for anxiety) and 2 (for depression) to

determine whether the study being reviewed established temporal precedence of the mediating variable, as well as whether the statistical analyses used methods besides the Sobel Test for testing the indirect effect.

Predictors, Moderators, and Mediators of Youth Internalizing Outcomes

In the following section, we review the research findings regarding predictors, mediators, and moderators of youth therapeutic outcomes for internalizing disorders. Combinations of relevant search terms were entered into PsycINFO and MEDLINE to collect articles for the review. The search terms used included the following keywords: *youth, adolescents, children, treatment, CBT, cognitive behavior therapy, behavior therapy, outcome, predictor, mediator, moderator,* and *mechanism.*

Searches were limited to those published in peer-reviewed journals between 1980 and 2015. Articles not published in peer-reviewed journals (e.g., dissertations) were excluded so that only articles whose quality has been evaluated by external reviewers were included. Articles for inclusion were limited to those focusing on internalizing disorders (anxiety and unipolar depression).

Predictors of Treatment Outcome

Anxiety disorders. Several studies of youth with anxiety have examined predictors of outcomes from CBT interventions, but few consistent predictors have emerged. Kendall and Treadwell (2007) examined predictors of anxiety symptoms in 145 youth aged 9 to 13 (71 youth with an anxiety disorder and 84 youth scoring in the normal range on multiple measures of anxiety, fear, depression, and externalizing behavior). The authors found that anxious self-statements predicted anxiety symptoms in

children with and without anxiety disorders. However, anxious self-statements and anxiety symptoms were both assessed with child-report questionnaires so shared method variance may have been driving the significant association.

Berman and colleagues (2000) used data from two RCTs (e.g., Silverman, Kurtines, Ginsburg, Weems, Lumpkin, et al., 1999; Silverman, Kurtines, Ginsburg, Weems, Rabian, et al., 1999) to examine predictors of treatment outcome from CBT for child anxiety. The authors examined a variety of potential predictor variables, including sociodemographic characteristics, diagnostic characteristics (i.e., number of diagnoses), treatment format (individual vs. group), parent- and child-reported child anxiety symptoms, and marital adjustment. The authors found that children with a diagnosis of depression were less likely to be treatment responders compared to those without a diagnosis of depression. This finding also held when examining depressive symptoms dimensionally using the Children's Depression Inventory (CDI; Kovacs, 1981). Additionally, children with higher levels of child-reported trait anxiety were less likely to respond to treatment. Higher levels of parent symptoms of depression, fear, hostility, and paranoia also were significant predictors of treatment outcome such that children of parents with higher levels of these variables were less likely to respond to treatment.

A study by Southam-Gerow, Kendall, and Weersing (2001) examined predictors of treatment response in 135 youth with an anxiety disorder who received 16 sessions of CBT. The authors classified youth into one of two treatment response groups based on parent-reported diagnoses: poor treatment response and good treatment response. The authors used discriminant function analysis to examine predictors of treatment response

and found that higher levels of maternal- and teacher-reported internalizing symptoms at pretreatment, higher levels of maternal self-reported depressive symptoms, and older child age were associated with poor treatment response. Further, child ethnicity, child sex, family income, family composition, child-reported symptomology, and maternal-reported levels of child externalizing behavior problems did not predict treatment response.

More recently, Tiwari and colleagues (2013) examined characteristics of exposure sessions as predictors of treatment response among 61 anxious youth aged 7 to 14 receiving CBT (individual CBT or family CBT) as part of a RCT. The authors reported that preparation for exposure tasks was not significantly associated with clinician-rated diagnostic improvements. However, post-exposure processing of the exposure task (therapists guiding the youth in making sense of the exposure experience) was significantly associated with diagnostic improvements. Exploratory analyses also revealed that treatment responders were more likely to be assigned between-session exposure tasks and were more likely to be rewarded in session. These findings highlight the importance of discussing and rewarding youth for their participation in exposure tasks.

Anxiety severity, perhaps more than any other variable, has been thought to be a predictor of treatment outcome. However, the evidence is mixed, with some studies finding that youth who were more anxious at pretreatment were no less likely to respond to treatment than youth who were less anxious and others finding associations between pretreatment anxiety severity and posttreatment outcomes. Kley and colleagues (2012)

examined predictors of treatment response among 75 youth aged 8 to 13 with SAD who were receiving a 12-session CBT program. The authors found that higher child-reported levels of social anxiety at pretreatment predicted greater reductions in social anxiety symptoms at posttreatment. Additionally, reductions in self-consciousness and maladaptive anxiety regulation (i.e., poor coping) predicted reductions in social anxiety symptoms at posttreatment.

Contrary to the findings of Kley and colleagues (2012), a study using data from the Child/Adolescent Anxiety Multimodal Study (CAMS; Compton et al., 2010; Walkup et al., 2008), found that lower levels of anxiety severity at pretreatment (both independent-evaluator- and parent-rated) predicted better outcomes, regardless of treatment condition (Compton et al., 2014). Additionally, lower levels of caregiver strain predicted better outcomes regardless of treatment condition (Compton et al., 2014). Though a full review of CAMS methodology is beyond the scope of this paper (see Compton et al., 2010), we will highlight a few of the study's methodological strengths as they relate to the evaluation of predictors, moderators, and mediators of treatment response. First, the CAMS trial is the largest RCT for child anxiety to date, with 488 youth randomized to one of four treatment conditions: CBT only, Medication only (SRT), CBT + Medication (COMB), or a pill placebo (PBO). This large sample size allows for additional statistical power to detect small effects that other studies with smaller samples cannot. Additionally, clinicians rated improvement weekly, and independent-evaluators blind to treatment condition (IEs) rated anxiety severity and improvement every four

weeks. Thus, data from the CAMS trial is well suited for examining predictors, moderators, and mediators of treatment response.

Also examining data from the CAMS trial, Peris and colleagues (2015) examined trajectories of change during CBT to identify whether the introduction of relaxation, cognitive restructuring, and/or exposure tasks affected the rate of change in anxiety symptom severity and overall functioning. The authors reported that the introduction of cognitive restructuring and exposures accelerated the rate of progress on measures of symptom severity and global functioning for participants in the CBT or COMB (i.e., CBT+Sertraline) conditions, but not for those in the Sertraline or Placebo condition. Additionally, this accelerative effect was more pronounced for youth in the CBT condition compared to the COMB condition. There was no effect of the introduction of relaxation on the trajectory of anxiety symptom or global functioning measures for participants in any condition. This study benefitted from the use of excellent statistical procedures for evaluating changes in trajectories (i.e., longitudinal discontinuity analyses), the use of control and active treatment comparison conditions, and the previously noted benefits of the CAMS trial (e.g., large sample size, multiple raters of anxiety severity).

The therapeutic alliance has been evaluated as a predictor of treatment outcomes from CBT for anxiety disorders. Cummings and colleagues (2013) used data from the CAMS to examine the therapeutic relationship as a predictor of treatment outcomes. The authors used ratings of the therapeutic relationship (i.e., alliance) taken at session 6 to predict posttreatment PARS, CGI-I, and CGI-S scores. Results revealed that the

therapeutic alliance was associated with outcomes for youth in the CBT and COMB conditions, but was not associated with outcomes in the SRT or PBO conditions. These results are consistent with meta-analytic studies (e.g., Shirk, Karver, & Brown, 2011) demonstrating a small to medium effect size for the therapeutic alliance on treatment outcomes across multiple childhood and adolescent disorder categories and treatment modalities. Taken together, these findings suggest that developing a strong therapeutic alliance is important to achieving good outcomes from CBT treatments for youth anxiety.

A discussion of predictors of treatment response would be incomplete without consideration of comorbid diagnoses. It has been hypothesized (and borne out in some research studies) that anxious youth with comorbid mental health diagnoses do not respond to CBT as well as youth with anxiety but without comorbid diagnoses. Ollendick and colleagues (2008) reviewed the literature on comorbidity as a predictor and moderator of treatment response across four DSM-IV-TR (American Psychiatric Association, 2000) disorder categories: anxiety, depression, Attention Deficit Hyperactivity Disorder (ADHD), and Oppositional Defiant Disorder/Conduct Disorder (ODD/CD). With regards to anxiety, 13 of the 16 studies reviewed found no predictive or moderating effects of comorbidity. The authors concluded that the effect of comorbid mental health diagnoses on treatment outcome may not be as detrimental as was previously thought.

Kerns and colleagues (2013) examined the associations between pretreatment comorbidity and outcomes at long-term follow-up (i.e., average of 7.4 years after treatment). Using data (N = 91) from an RCT and a long-term follow-up study (i.e., an

average follow-up period of 7.4 years after treatment), the authors used Hierarchical Linear Modeling (HLM) to examine pretreatment SAD symptoms and diagnoses as a predictor of both short- (posttreatment) and long-term treatment outcomes. Youth with pretreatment SAD diagnoses and subclinical symptoms made similar gains from pre- to post-treatment. However, youth with SAD diagnoses and subclinical SAD symptoms were significantly less improved at the 7.4 year follow-up compared to youth without an SAD diagnosis or subclinical SAD symptoms (Kerns et al., 2013). As is suggested by this study, it is possible that the effect of comorbid diagnoses on treatment outcome may only present itself years after treatment. Replication is needed in samples that include long-term follow-up assessments, however, before firm conclusions can be drawn.

fMRI data were examined as predictors of treatment outcome for youth anxiety disorders. McClure and colleagues (2007) examined pretreatment amygdala activity as a predictor of treatment response among 12 youth receiving either CBT or Fluoxetine. To examine amygdala activation, the authors used a face-attention paradigm that required participants to view a series of randomly-ordered faces (the faces were afraid, happy, neutral, or angry) and then make a specified rating of how afraid they are. The authors examined amygdala activation in the contrast between fearful faces (afraid-fearful) and happy faces (afraid-happy) as a predictor of treatment response. Using Spearman correlations (for CGI-I) and regression analyses (for CGI-S), the authors reported that left amygdala activity during the afraid-fear vs afraid-happy contrast was associated with posttreatment CGI-I and CGI-S scores. The same pattern of results was not found for right amygdala activity during the afraid-fear vs afraid-happy contrast. These results

suggest that pretreatment levels of left amygdala activity during a face-attention paradigm are a nonspecific predictor of response to CBT and Fluoxetine.

Finally, only one study has examined therapist factors as potential predictors of treatment outcome for youth anxiety. Podell and colleagues (2013) examined the relationship between therapist factors (therapist style, treatment integrity, and therapist experience) and treatment outcomes among youth receiving CBT in the CAMS. Results revealed better outcomes from therapists who were more collaborative and empathetic, were more adherent to the treatment manual, and implemented the treatment in a developmentally appropriate manner. Additionally, higher levels of therapist experience were significantly associated with better outcomes. Interestingly, lower levels of therapist experience treating anxiety were also associated with better outcomes (Podell et al., 2013). The results of this study suggest that studying the associations between therapist factors and outcomes from CBT for youth anxiety are likely to yield informative findings. However, given the preliminary nature of this study, replication in additional samples is warranted.

Depressive disorders. A review of predictors of depression treatment outcomes concluded that there are several important predictors of outcome (Nilsen, Eisemann, & Kvernmo, 2013). Ethnic minority status predicted slower recovery rates in two of three depression treatment studies that were reviewed. However, no other consistently significant predictors of treatment outcome were found for demographic factors. With regard to clinical factors (i.e., symptom severity, psychosocial stress, family functioning), the majority of studies reviewed indicated that baseline symptom severity was predictive

of depression treatment response, such that youth with more severe depression at pretreatment were less likely to respond to treatment. Additionally, in two studies examining the impact of stress, participants reporting high levels of stress were less likely to have their depression remit at posttreatment compared to those with low levels of stress (Jayson, Wood, Kroll, Fraser, & Harrington, 1998). Higher levels of social dysfunction in the family was also predictive of slower recovery rates and higher rates of posttreatment depressive symptoms (Gunlicks-Stoessel, Mufson, Jekal, & Turner, 2010). Overall, the authors concluded that the lack of significant associations between demographic factors and treatment outcome is consistent with several other reviews of adolescent depression (Emslie, Kennard, & Mayes, 2011; Emslie, Mayes, Laptook, & Batt, 2003; Weisz et al., 2006), and suggest that baseline demographic do not play an important role in the prediction of outcomes from depression treatments.

Cognitive predictors of treatment outcome were examined among 44 depressed adolescents by Shirk and colleagues (2013). The authors examined the predictive relations of several cognitive variables, including client involvement and cognitive distortions. Cognitive distortions were assessed at pretreatment, posttreatment, and after completing session 5. Client involvement was coded from audio recordings of sessions 2 and 4. Depressive symptom severity was assessed at pretreatment, posttreatment, as well as after completing sessions 4, 8, and 12. Results revealed that changes in cognitive distortions from pretreatment to session 5 predicted changes in depressive symptoms from pre- to post-treatment, such that participants who evidence a greater change in cognitive distortions had lower levels of depressive symptoms at posttreatment.

Subsequent analyses indicated that changes in depressive symptoms did not predict subsequent changes in cognitive distortions, providing support for the temporal relationship between cognitive distortions and depressive symptoms. In their discussion, the authors suggested that their results "provide strong support for the view that cognitive distortions are a pivotal change mechanism in CBT for adolescent depression" (Shirk et al., 2013, p. 320). Additional work is needed (including a control condition; formal statistical mediation analyses) to establish change in cognitive distortions as a therapeutic mechanism of change (e.g., Kazdin, 2007; Kraemer et al., 2002).

Similar to the anxiety literature, the therapeutic alliance has been examined as a predictor of depression treatment outcome. Shirk and colleagues (2008) examined the alliance-outcome association among 54 depressed adolescents. Results revealed that a higher level of adolescent-reported alliance was positively associated with change in depressive symptoms. Therapist-rated alliance, on the other hand, was not significantly associated with change in depressive symptoms. These results are consistent with meta-analytic studies demonstrating moderate effect sizes for the alliance-outcome association across disorders (Shirk et al., 2011). Considered in the context of the alliance-outcome literature, the therapeutic alliance appears to consistently predict outcomes across disorders, with effect sizes consistently in the small to moderate range.

Regarding an association between comorbid diagnoses and response to depression treatment, there is mixed evidence. Young and colleagues (2012) examined the role of anxiety disorder comorbidity on outcomes from Interpersonal Psychotherapy-Adolescent Skills Training (IPT-AST), a depression prevention program. Results revealed that

participants in the IPT-AST condition demonstrated greater reductions in both anxiety and depressive symptoms relative to the control condition (school counseling). Additionally, baseline anxiety symptoms predicted changes in depressive symptoms early in treatment, such that participants with lower levels of baseline anxiety demonstrated more rapid declines in depressive symptoms (Young et al., 2012). However, the difference in depression severity between participants with and without anxiety symptoms was not significant by follow up. Other studies have found a deleterious effect of comorbid anxiety on depression outcomes, such that comorbid anxiety was associated with poorer depression outcomes (Emslie et al., 2010), particularly when adolescents had a probable diagnosis of social phobia (Young, Mufson, & Davies, 2006).

Other research has evaluated whether sudden gains made during therapy predict acute and long-term outcomes from depression treatments. A study by Dour and colleagues (2013) randomized 161 youth (7 to 13 years) who had elevated problems in anxiety, depression, or conduct-disruptive disorder to one of three treatments in community mental health centers. The authors operationalized sudden gains consistent with how they have been operationalized in the adult literature (e.g., Tang & DeRubeis, 1999). Specifically, between-session gains must have been (a) large in absolute terms, (b) 25% larger than they were at the previous session, and (c) significantly larger when averaged across the following three sessions than the previous three sessions. Results revealed that most sudden gains occurred early in treatment, and were associated with the therapist introducing relaxation techniques. Participants were more likely to have a sudden gain if they presented with comorbid diagnoses. In terms of predictors, sudden

gains predicted overall symptom levels, but not disorder-specific symptoms, at participants' last assessment following their posttreatment assessment (roughly 8 months after their posttreatment assessment). The authors concluded that capitalizing on sudden gains made during treatment could increase the efficiency of treatments and potentially allow the duration of treatment programs to be condensed (Dour et al., 2013)

Two studies evaluated predictors of treatment response in the Treatment for Adolescents with Depression Study (TADS; Curry et al., 2006; Feeny et al., 2009). Curry and colleagues (2006) evaluated predictors of acute outcome in TADS. The authors found that younger adolescents, with a shorter duration of depression, who were higher functioning, less hopeless and less suicidal, had fewer melancholic features or comorbid diagnoses, and greater expectations for treatment were more likely to benefit from treatment than their counterparts (Curry et al., 2006). Another study using data from the TADS examined the association between family functioning and depression outcomes (Feeny et al., 2009). The authors examined the associations of 20 candidate predictor variables that capture family functioning. Of the 20 variables examined, only mother-reported parent-child conflict was predictive of treatment response, such that participants whose mothers reported less conflict were more likely to respond to treatment than those whose mothers reported high levels of conflict (Feeny et al., 2009).

Reward-related brain functioning was evaluated as a predictor of treatment response in adolescents with MDD. Forbes and colleagues (2010) treated 13 adolescents aged 10 to 16 years with CBT or pharmacotherapy. One week before beginning treatment, participants completed an fMRI task that was an adaptation of a card guessing

paradigm designed to measure striatal response to feedback associated with a monetary reward. Using growth curve models that included assessments at pretreatment, week 2, week 4, week 6 and week 8, the authors found that greater pretreatment levels of reward-related striatal functioning was associated with higher overall clinical severity at the end of treatment and lower levels of anxiety symptoms at the end of treatment. Additionally, the rate at which anxiety symptoms improved was associated with greater striatal reactivity and lower medial prefrontal cortex reactivity (Forbes et al., 2010). Although limited by a small sample, the authors conclude that reward-related brain functioning is important not only in the pathophysiology of depression, but also in its treatment.

Moderators of Treatment Outcome

Though research examining predictors of treatment outcome provides important prognostic information, that information is general and not as informative or prescriptive as information about differential treatment response. As mentioned, research examining moderating variables can guide treatment choice by identifying factors that predict differential response based on what treatment is provided.

Anxiety disorders. Comorbidity has been a topic of much research on potential moderators of outcome. Research has examined the role of comorbid moderate autism spectrum disorder (Puleo & Kendall, 2011), comorbid ADHD (Halldorsdottir et al., in press), and SAD (Compton et al., 2014; Manassis et al., 2002). Parenting and family factors have also been examined, such as parental psychopathology (Bodden et al., 2008; Cobham, Dadds, & Spence, 1998), and caregiver strain (Compton et al., 2014). In

addition, demographic characteristics (e.g., child age, gender, ethnicity, socioeconomic status, etc.) have been studied.

In a recent review examining moderators of treatment outcome in child and adolescent anxiety, Nilsen, Eisemann, and Kvernmo (2013) conclude that the majority of findings suggest that there are no demographic or clinical (i.e., duration, diagnosis, pretreatment severity, comorbidity) characteristics that consistently moderate treatment outcome. In their discussion of the reviewed articles, the authors note that lack of statistical power, poor study design for testing moderating variables, and lack of variability in the moderator of interest, may be partially to blame for the lack of significant moderation effects (Nilsen et al., 2013). In contrast, the absence of significant moderators can be seen as evidence that the treatments are comparably effective for youth across the variables studied. Several studies have been published since the Nilsen et al. (2013) review.

Using data from CAMS, Compton and colleagues (2014) reported that participants' principal diagnosis at pretreatment moderated treatment outcomes on a continuous measure of symptom severity. When the authors probed the interaction, they found that participants with a pretreatment diagnosis of SepAD had the most favorable outcomes when treated with COMB compared to each of the other treatments. Participants with a primary diagnosis of SAD had the most favorable outcomes when treated with SRT or COMB compared to CBT or PBO. Participants with a primary diagnosis of GAD had the most favorable outcomes when treated with CBT or COMB compared to SRT or PBO. Given the use of both active treatment comparisons and a

placebo control, these results provide good support for treatment choice to depend on individuals' diagnosis at pretreatment.

Another study using data from the CAMS found that the effect of starting exposures on the rate of clinical improvement, as measured by the CGI-I (Guy, 1976), was more pronounced for younger children compared to adolescents (Peris et al., 2015). Additionally, the effects of beginning cognitive restructuring and beginning exposures were more pronounced for participants in the CBT condition compared to the COMB condition. These results suggest that both cognitive restructuring and exposures make significant contributions to clinical improvement in CBT, and these contributions are more powerful among youth receiving CBT compared to CBT and medication. Additionally, these results suggest that exposures are particularly important when working with younger children. It is important to note, however, that these findings are not true moderators of treatment outcome because they were not assessed prior to randomization. These findings do provide information regarding treatment choice so are included in this section nonetheless.

A third study using data from the CAMS examined the associations of comorbid ADHD and ODD on acute treatment response (Halldorsdottir et al., in press). The authors found that a comorbid diagnosis of ADHD predicted poorer treatment response and remission rates for participants receiving CBT. Comorbid ADHD did not predict treatment response or remission rates for youth receiving COMB, SRT, or PBO. Additionally, the authors found that participants with comorbid ODD were no less likely to respond to treatment than participants without comorbid ODD. In the discussion of

their results, Halldorsdottir and colleagues (in press) note that relatively low sample sizes for the comorbid ADHD and ODD groups may have prevented the detection of smaller moderating effects of these variables. Despite this limitation, these results highlight the importance of considering comorbid ADHD when treating anxious youth with CBT.

Depressive disorders. Nilsen and colleagues (2013) recently reviewed moderators of depression treatment outcome. Thirteen studies examining depression treatment outcomes were examined. Five studies evaluated age as a predictor or moderator. In one study age moderated outcome such that older youth responded better to IPT than treatment as usual (TAU) while outcomes for younger youth did not differ between IPT and TAU (Mufson et al., 2004). In the same study, baseline severity (both depression symptom severity and impairment) moderated outcome such that participants with high baseline severity (i.e., ≥ 22 on the HAMD or median split of CGAS ratings) who received IPT had significantly lower severity at posttreatment compared to youth who received TAU; this difference was not significant for the low severity group (Mufson et al., 2004). Another study reviewed also found significant differences between CBT and waitlist participants for severely depressed youth (Rohde, Lewinsohn, & Seeley, 1994). Five studies examined internalizing comorbidity as a predictor or moderator. Of these five studies, one found that CBT was more effective than nondirective supportive therapy, and that this difference was even more pronounced when youth had a comorbid anxiety disorder (Brent et al., 1998). Another study reviewed found that IPT was more effective than TAU when youth had comorbid Panic Disorder (Young et al., 2006).

The two previously mentioned TADS reports (Curry et al., 2006; Feeny et al., 2009) also evaluated potential moderators of treatment response. In the study by Feeny and colleagues (2009) family functioning was found to be a significant moderator of outcome such that adolescents who endorsed more negative environments (defined as 1 SD above the mean) were more likely to benefit from fluoxetine treatment compared to CBT, CBT+Fluoxetine, and a pill placebo. Curry and colleagues (2006) found three variables (out of 21 that were examined) that moderated outcome: annual family income, severity of depression, and the severity of cognitive distortions. With regard to annual family income, among participants with an annual family income less than $75,000 per year, CBT+Fluoxetine and Fluoxetine were equally effective, and both more effective than CBT or placebo. With regard to depression severity, among participants with lower levels of baseline severity, CBT+Fluoxetine led to better results than Fluoxetine or CBT. However, only Fluoxetine and CBT+Fluoxetine led to better outcomes than placebo among participants with lower levels of depression. Comparatively, among participants with higher levels of baseline severity, there was no difference between Fluoxetine and CBT+Fluoxetine, and both of these conditions led to better outcomes than CBT and placebo. Finally, with regard to baseline cognitive distortions, participants with lower scores on the Children's Negative Cognitive Errors Questionnaire (CNCEQ; a measure of cognitive distortions) responded equally well to CBT+Fluoxetine and Fluoxetine, and both of these conditions were associated with better outcomes than CBT and placebo. Among participants with higher scores on the CNCEQ (moderator effects were examined using a median split), CBT+Fluoxetine led to the best outcomes, followed by Fluoxetine,

and then by CBT. In this subgroup of participants, only CBT+Fluoxetine and Fluoxetine demonstrated superior outcomes compared to placebo. These moderator results suggest that family income, baseline severity, and baseline levels of cognitive distortions can inform the treatment of choice among these populations (Curry et al., 2006).

Mediators of Treatment Outcome

Moderating variables help guide treatment choice, but do not explain the mechanisms through which a treatment exerts its effect. The evaluation of potential mediators of treatment outcome provides information about the "active ingredients" of psychological treatment, which in turn can help treatment developers refine treatments to be more effective. We now review mediators of treatment outcome for youth internalizing disorders.

Anxiety disorders. Two major reviews focused on reviewing mechanisms of change for CBT for child anxiety (Prins & Ollendick, 2003; Weersing & Weisz, 2002). Weersing and Weisz (2002) reviewed the outcome literature for a variety of mental health conditions in youth, including anxiety disorders. With respect to anxiety disorders, the authors found that over half of the CBT treatment outcome studies reviewed measured possible mediating variables. In all of these studies, CBT did change both the mediating variable and symptom outcome. However, only one study (Treadwell & Kendall, 1996) conducted formal tests for mediation and found that changes in self-talk mediated treatment outcomes from youth receiving CBT as compared to a waitlist condition. Weersing and Weisz (2002) note that mediational findings were diminished because in all studies reviewed, the mediating variable was assessed at posttreatment (i.e.,

concurrent with outcome), which does not allow for examination of the temporal relationship between mediator and outcome.

In another review, Prins and Ollendick (2003) reviewed 25 studies to examine cognitive change and changes in coping as potential mechanisms of change in CBT for childhood anxiety. The authors concluded that domain-specific measures of processes hypothesized to be the mechanism of change in CBT are not routinely administered. Consistent with Weersing and Weisz's (2002) review, only 1 of the 25 (4%) studies reviewed examined mediation. Prins and Ollendick (2003) concluded that CBT research to date has not been designed to test mediational issues.

A meta-analysis examining potential mediating variables conducted by Chu and Harrison (2007) coded studies of CBT for anxiety and/or depression that assessed process variables and compared them to a waitlist or an active treatment. The authors divided process variables into four categories: cognitive, behavioral, physiological, and coping. Using meta-analytical techniques, the authors found that CBT produced large effects on behavioral variables, and moderate effects on physiological, cognitive, and coping variables (Chu & Harrison, 2007). Since these reviews, additional work has examined potential mediators of outcomes in CBT for youth anxiety (Alfano et al., 2009; Hogendoorn et al., 2014; Kendall et al., under review; Kendall & Treadwell, 2007; Lau, Chan, Li, & Au, 2010).

A study by Kendall and Treadwell (2007) examined self-talk as a mediating variable among 71 youth with an anxiety disorder and 84 control participants who did not meet diagnostic criteria for an anxiety disorder. As discussed in the section on predictors

of treatment response, anxious self-statements were found to predict anxiety symptoms in children with and without anxiety disorders. For anxiety-disordered youth, changes in anxious self-statements mediated treatment gains, which replicated their earlier finding (i.e., Treadwell & Kendall, 1996). Additionally, the ratio of negative to positive thoughts mediated one outcome measure. Positive and depressive self-talk did not mediate any outcomes. Taken together, these findings suggest that one way that CBT achieves positive outcomes may be by changing anxious self-talk. However, given that self-talk and anxiety symptoms were only measured pre- and post-treatment, it is not possible to determine the temporal relationship between changes in self-talk and reductions in anxiety symptoms, and it is equally possible that changes in anxiety led to subsequent changes in coping. Further research is needed to clarify the temporal relationship between these two variables.

In another study evaluating the effectiveness of group CBT for childhood anxiety in community clinic settings, children's anxiety-related cognitions and child-reported ability to cope in anxiety-provoking situations fully mediated treatment gains (Lau et al., 2010). However, similar to Kendall and Treadwell (2007), the authors did not establish temporal precedence of the mediator so additional research is needed to determine whether changes in anxiety-related cognitions and child-reported coping abilities preceded decreases in anxiety severity or are simply covariates of change (for a further discussion of this distinction, see Laurenceau, Hayes, & Feldman, 2007).

Alfano and colleagues (2009) used data from two of their RCTs examining the efficacy of Social Effectiveness Therapy for Children to examine potential mediators of

outcome among youth with SAD. Using a sample of 88 youth aged 7 to 17 years, the authors examined the potential mediating effects of observer-rated social skills and child-reported loneliness. Analyses revealed that loneliness scores and social effectiveness predicted changes in social anxiety and overall functioning at posttreatment. Further, using a mediation model that allowed for the concurrent examination of multiple mediating variables, the authors found that changes in child-reported social anxiety symptoms were partially mediated by child-reported loneliness scores. However, the authors did not establish temporal precedence of the mediator so future work is needed to determine whether changes in child-reported loneliness scores preceded changes in child-reported social anxiety symptoms. Furthermore, results are confounded by shared method variance between child-reported loneliness and child-reported social anxiety symptoms. Despite these limitations, results of this study suggest that loneliness may be an important treatment target for children and adolescents suffering from SAD (Alfano et al., 2009).

Hogendoorn and colleagues (2014) examined mediators of CBT for anxiety among 145 anxious youth aged 8 to 18 years. The authors used Latent Difference Score modeling (McArdle, 2009; McArdle & Hamagami, 2001) to examine the temporal relationship between three putative mediators (negative and positive thoughts, coping strategies, and perceived control over anxious situations) and both parent- and child-reported anxiety symptoms. The authors found that an increase in positive thoughts preceded a decrease in child-reported anxiety during treatment. Additionally, an increase in three coping strategies (direct problem solving, positive cognitive restructuring, and

seeking distraction) preceded a decrease in parent-reported anxiety symptoms. Finally, a decrease in parent-reported anxiety symptoms both preceded and followed an increase in perceived control (i.e., a reciprocal effect). Though the authors did not examine mediation directly, these results suggest that changes in positive thoughts and several coping strategies precede changes in anxiety symptoms; in doing so, the authors establish temporal precedence of these putative mediators. Future research directly testing the mediating role of these variables as compared to a control condition is needed before they can be established as true mechanisms of change in CBT for child anxiety (Kraemer et al., 2002).

The CAMS trial provided data to examine changes in coping efficacy and anxious self-talk as mediators of treatment outcomes at 3-month follow up (Kendall et al., under review). Strengths of this study include that the authors used a latent variable approach in the context of a structural equation modeling (SEM) framework to model mediation, inclusion of both parent- and child-reported measures of mediators, use of independent-evaluator-rated symptom severity as an outcome, multiple treatment conditions (CBT, COMB, SRT, and PBO), and established temporal precedence of the mediator. Results revealed that coping efficacy mediated gains in the CBT, SRT, and COMB conditions, but not the PBO condition. Contrary to the Treadwell and Kendall (1996) and Kendall and Treadwell (2007) findings, treatment assignment was not associated with a reduction in anxious self-talk and anxious self-talk did not predict changes in anxiety symptoms.

Depressive disorders. In a review examining mechanisms of change for psychological treatments for youth, Weersing and Weisz (2002) found that although the

majority of studies reviewed did include measures of cognitive and behavioral processes hypothesized to be mediating variables, only one study conducted formal tests of mediation. In that study, the authors found that changes in cognitive distortions were specific to CBT relative to alternative treatments, but that these changes did not mediate the effects of CBT on treatment outcome (Kolko, Brent, Baugher, Bridge, & Birmaher, 2000). Weersing and Weisz conclude that studies of mechanisms of change in depression treatments for youth are lacking and that the extant studies suffer from a variety of methodological limitations, including shared method variance between mediating variables and outcomes, as well as conceptual overlap between measures of depression symptoms and cognitive measures of depressogenic cognitions. The authors suggest that future studies examining mechanisms of change in youth depression treatments should consider using more specific measures of cognitive processes (Weersing & Weisz, 2002).

In a meta-analytic review of candidate mediators of change for depression treatments in youth, Chu and Harrison (2007) examined the effect of CBT on cognitive processes, behavioral variables, and coping variables. The authors concluded the CBT for depression produced small effects for cognitive processes and nonsignificant effects for behavioral and coping variables. Another more recent review of change processes in CBT for adolescent depression, Webb, Auerbach, and DeRubeis (2012) examined the effects of four process variables: the therapeutic alliance, patient cognitive change, therapist adherence to therapeutic techniques, and therapist competence in therapeutic techniques. Despite reviewing several studies assessing mechanisms of change, the authors discuss several methodological shortcomings in the extant literature that limit the

conclusions that can be drawn. Most problematic is that the vast majority of studies to date do not demonstrate temporal precedence of the mediator, which does not allow researchers to distinguish significant effects as being mediational or simply covariates of change. Additionally, Webb and colleagues (2012) discuss how nomothetic approaches to analysis (i.e., evaluating mediation effects based on means derived from pooling across subjects) may mask significant mechanisms of change from being uncovered. In their discussion of the literature, the authors conclude that the evaluation of mechanisms of change for depression treatments in adolescents is in its infancy and much work remains to be done before we have an understanding of how CBT achieves its beneficial effects (Webb et al., 2012).

Since these reviews, an additional study has been published (Shirk et al., 2013). Despite not including a comparison condition, which precludes the authors from determining whether their findings were specific to CBT, Shirk and colleagues (2013) found that changes in cognitive distortions predicted subsequent changes in depressive symptoms. These results provide some additional support for the notion that CBT achieves its beneficial effects by influencing cognitive distortions, which in turn influence depressive symptoms. However, without a comparison condition, it is not possible to determine whether changes in cognitive distortions mediated the effects of treatment and are a mechanism of change in CBT for adolescent depression.

New Approaches to the Study of Therapeutic Change

Research aimed at the study of therapeutic change in CBT for youth anxiety and depression has taken a nomothetic approach to analysis, aggregating samples to strive to

identify what predicts, moderates, and mediates outcomes for the "average" youth (Kazdin, 2003; Nock, Janis, & Wedig, 2008). Deviations from the "average" youth, or *intra*-individual variability, have typically been viewed as error in common analytic techniques such as linear regression and other ANOVA/ANCOVA-based approaches (Collins & Sayer, 2000; Molenaar, 2004). However, it can be argued that only a small number of youth present for treatment similarly to the "average" youth, which limits the transportability of strategies from research to clinical settings.

The notion that most participants are not "typical" was demonstrated in a study by Borkenau and Ostendorf (1998) where they sought to determine whether what holds true on the group level can generalize to the individual level. Consider the Big Five personality traits, which have been shown to be stable over time, and factor analytic studies examining measures of the Big Five traits have consistently demonstrated a five factor structure mapping onto the Big Five traits. In their study, Borkenau and Ostendorf (1998) had participants (N = 22) complete a measure of the Big Five traits each night for 90 days. When the authors used standard factor analytic approaches that examine *inter*-individual variation, the five factor model was supported. However, when the authors used factor analytic approaches that examined *intra*-individual variation (i.e., one person's variation across the 90 administrations of the measure), the factor structure was not consistent across participants and did not map onto the five factor model (Borkenau & Ostendorf, 1998). These intra-individual models differed between subjects in both the number of factors extracted and in how the factors related to the individual items. In reviewing this study, Molenaar and Campbell (2009) conclude, "the nominal inter-

individual (Big Five) structure cannot be generalized to the level of variation within each subject" (p. 115). Relating this back to the study of change in youth receiving psychological treatments, this study demonstrates that results from analyses that aggregate individuals and analyze their *inter*-individual variability likely cannot be generalized to individual participants. All the studies reviewed in this manuscript, except a few notable exceptions (e.g., Compton et al., 2014; Forbes et al., 2010; Hogendoorn et al., 2014; Kendall et al., under review), used analytic techniques that aggregate information across individuals and treat intra-individual variability as error variance. How can we use information from these studies when working with individual clients when the analytic techniques used cannot generalize back to individual clients? Clearly we are in need of more idiographic approaches to research—a call that has been echoed by leaders in the field in recent years (Barlow & Nock, 2009; Kazdin, 2000; Kazdin & Kendall, 1998; Kazdin & Nock, 2003; Molenaar, 2004; Nesselroade, Gerstorf, Hardy, & Ram, 2007).

Another problem in the study of mechanisms of change is that many analytical approaches used in treatment outcome research assume that change is linear or quadratic, which is rarely the case in practice (Hayes & Feldman, 2007; Hayes, Laurenceau, Feldman, Strauss, & Cardaciotto, 2007; Laurenceau et al., 2007). To successfully model nonlinear change, multiple assessments from the same individual must be collected prior to, during, and after treatment. Simply put, novel approaches to data collection and analysis will improve the ability to identify predictors of differential gain, moderators of treatment response, and mechanisms of therapeutic change.

Dynamical Systems Approaches

Overview of dynamical systems approaches. One novel approach to the study of therapeutic change over time in an idiographic manner is dynamical systems. Dynamical systems approaches have been used in a variety of scientific disciplines to model the nonlinear behavior of a variety of systems. Recently, dynamical systems approaches have been increasingly used in mental health more generally (Vallacher, Coleman, Nowak, & Bui-Wrzosinska, 2010; Vallacher & Nowak, 1997), as well as to study mechanisms of change in CBT (Fisher, Newman, & Molenaar, 2011; Hayes & Feldman, 2007; Hayes et al., 2007; Hayes & Strauss, 1998; Hayes, Yasinski, Ready, Laurenceau, & Chen, under review) and other forms of psychological treatments (Pascual-Leone, 2009). A dynamical system is one that changes over time in response to input from the environment and from itself at an earlier point in time. Further, dynamical systems are often studied through the use of differential equations to model individual trajectories (Boker, 2001; Boker & Laurenceau, 2006; Salvatore & Tschacher, 2012; Thelen & Smith, 2006) or other techniques that use individual time-series data to analyze change on a person-by-person basis and allow for variation in the shape of intra-individual change.

The dynamical systems approach is concerned with how variables relate to each other and change over time. Further, this approach emphasizes the study of stable patterns, termed "attractors," and how these patterns destabilize and change over time to be replaced by new attractors, termed "phase changes." Patterns serve as a better unit of analysis than individual variables because they emphasize the relationships both within

and between variables (Kelso, 1995; Thelen & Smith, 2006). Given that many therapies, including those for anxious youth such as the Coping Cat (Kendall & Hedtke, 2006), are designed to dislodge stable and maladaptive patterns of cognition and behavior that maintain a disorder and replace these patterns with more adaptive ways of functioning, dynamical systems approaches provide a useful framework for quantifying the phenomenological processes active prior to, during, and after receiving psychological treatment. Hayes and Yasinski (2015) echo this point in saying, "[successful therapy] involves the activation of these pathological patterns, together with exposure to corrective information and new experiences that induce dissonance…that challenges patients to develop new cognitive-affective-behavioral-somatic patterns" (p. 2). Moreover, the use of a dynamical systems approach to study mechanisms of change in CBT allows for the integration of information from a range of disciplines to inform novel experimental paradigms designed to provide information about how CBT achieves its beneficial effects. Through a better understanding of how CBT achieves its beneficial effects and what factors differentiate treatment responders from nonresponders, interventions can be personalized to target treatment-refractory youth.

Dynamical systems and mechanisms of change. In the following section we review several studies that have used dynamical systems analyses to examine mechanisms of therapeutic change. Given the relative lack of studies using dynamical systems approaches in the child internalizing disorder literature compared to the adult internalizing disorder literature, we primarily review studies among adult populations.

However, these techniques can, and should, be extended to child internalizing disorder populations.

Spectral analyses and dynamic factor models. Although novel, dynamical systems approaches are already being implemented in the adult literature. Fisher and colleagues (2011) applied a dynamical systems analysis to model data from 33 adult participants who each completed multiple diary entries daily while receiving either CBT or applied relaxation for GAD. Using spectral analyses and the residual variance from dynamic factor models (i.e., autoregressive models with a one day lag), the authors demonstrated that spectral power interacted with time to predict treatment response over a 1-year follow-up period, such that lesser spectral power (less intense and frequent variability in anxiety symptoms) predicted increases in reliable change over one-year follow-up period and greater spectral power (more intense and frequent variability in anxiety symptoms) predicted decreases in reliable change over the follow-up period. Additionally, the residual variance from the dynamic factor models significantly moderated the slope of reliable change over the follow-up period, such that greater order in dynamical systems (i.e., less residual variance from the dynamic factor models) predicted increases in reliable change over the follow-up period and less order (i.e., greater residual variance from the dynamic factor models) predicted decreases in reliable change over the follow-up period (Fisher et al., 2011).

In a follow-up study, Newman and Fisher (2013) examined whether the duration of GAD moderated response to CBT versus its components (cognitive therapy [CT] and self-control desensitization [SCD]), and whether increases in dynamic flexibility of

anxious systems during therapy was a mediator of the moderated effect of duration of GAD on outcome (i.e., mediated moderation). Consistent with their prior study (i.e., Fisher et al., 2011), the authors quantified dynamic flexibility as the inverse of spectral power from daily to intradaily oscillations in daily diary data. Results revealed that duration of GAD moderated outcome such that those with longer duration showed greater reliable change from component treatments compared to CBT alone. Increases in flexibility over the course of therapy fully mediated the moderating effect of GAD duration on condition. The authors concluded that individuals who have had GAD for a longer duration may respond better to more focused treatment, and that the mechanism by which this moderation occurs is through the establishment of flexible responding during treatment (Newman & Fisher, 2013).

State space grids and the Gridware program. The computer program GridWare (Lamey, Hollenstein, Lewis, & Granic, 2004) allows for the construction of state space grids, which are two-dimensional planes formed by the intersection of two axes (Hollenstein, 2013). The two axes represent two distinct variables, such as positive affect and negative affect, and users can plot the activation (i.e., score) of each variable that each individual endorses over time. In this manner, GridWare is able to capture activation of one variable (i.e., a single attractor), activation of multiple variables (i.e., multiple attractors), and the movement from the activation of one variable to the activation of another (i.e., phase changes). The program uses multiple methods to quantify attractors, phase changes, and other variables relevant to dynamical systems approaches (see, DiDonato, England, Martin, & Amazeen, 2013; Granic, Hollenstein,

Dishion, & Patterson, 2003; Granic & Lamey, 2002; Hayes et al., under review). A sample state space grid from the GridWare program is presented in Figure 2.

Hayes and Yasinski (2015) used the GridWare program to re-analyze data from 27 participants in an open trial of Cognitive Therapy Personality Disorders (CT-PD). The authors coded treatment sessions for positive network activation and negative network activation. These variables were then entered into GridWare for analyses. The authors used the GridWare program to calculate dispersion scores for each participant. Dispersion operationalizes the level of instability or spread in the relationship between two variables for each participant. Higher dispersion scores represent less stability in the relationship between the two variables over time. These dispersion scores were entered into a new dataset for further analysis. Using hierarchical regression techniques, the authors found that more dispersion in the second phase of therapy predicted more improvement in personality disorder symptoms and positive network strength at posttreatment. The authors conclude that the GridWare program represents a relatively easy to use quantitative method for studying the process of change among patients receiving psychological treatment (Hayes & Yasinski, 2015).

Carper and Kendall (2014) used the GridWare program to examine the process of change in CBT for youth anxiety. Using data (N = 138) from an RCT evaluating the efficacy of individual CBT (ICBT) and family CBT (FCBT) compared to a family-based educational support and attention control (FESA), the authors examined whether the stability of the relationship between the therapeutic alliance and anxiety symptoms predicted anxiety symptom and functional outcomes. Consistent with Hayes and

Yasinksi (2015), the authors found that greater dispersion predicted improved functioning at posttreatment while lower dispersion predicted worse functioning. These results were limited to functional outcomes, as dispersion was not a significant predictor of changes in anxiety symptoms (Carper & Kendall, 2014).

Latent Difference Scores. Latent difference scores and bivariate latent difference scores (LDS and BLDS, respectively; McArdle, 2009; McArdle & Hamagami, 2001; McArdle et al., 2004; McArdle & Nesselroade, 1994) are another approach that is becoming more widely used to study mechanisms of change. The BLDS approach allows researchers to concurrently examine three types of change over time: additive change over time (α), multiplicative change over time (β), and the effect that changes in one variable have on later changes in another variable over time (γ). The use of these three change components allows for a variety of nonlinear patterns to emerge. Additionally, the use of the structural equation modeling (SEM) framework to examine these models allows for the inclusion of participants with incomplete data.

Figure 3 presents a BLDS model for data collected at four time points. As can be seen in the model, the α parameter represents a coefficient similar to a latent growth curve model, where change over time is consistent. The β parameter represents a coefficient explaining change from one session to the next. Finally, when examining the temporal relationship between two variables over time, the γ parameter represents the effect of one variable at time T on another variable at time $T + 1$. The use of BLDS models is becoming increasingly popular and allows researchers to model both uni-directional and bidirectional (i.e., reciprocal) effects to determine the temporal

relationships between two variables. Given that one of the primary methodological and statistical issues with current research examining mechanisms of change in child and adolescent psychology is establishing temporal precedence of a mediating variable (Kazdin, 2007; Kazdin & Nock, 2003; Maric, Wiers, & Prins, 2012), BLDS represent a timely addition to the statistical repertoire of treatment outcome researchers.

The BLDS approach was used in a study examining the relationship between the therapeutic alliance and symptom improvement over the course of CBT for child anxiety. Using data from the same RCT as the Carper and Kendall (2014) study reviewed earlier, Marker and colleagues (2013) found that the relationship between the therapeutic alliance and symptom change varied depending on who was reporting the alliance and symptoms. Changes in mother- and therapist-reported therapeutic alliance significantly predicted later changes in child anxiety symptoms. Changes in child-reported anxiety also predicted later change in father- and therapist-rated alliance. Finally, the authors found that the relationship between child-reported anxiety and child-reported alliance was not significant. The authors conclude that mothers develop an alliance early and this is predictive of symptom change. Fathers, on the other hand, need to see symptom change before developing an alliance. Finally, the relationship between therapist-reported therapeutic alliance and symptom change is bidirectional, with changes in alliance predicting later changes in anxiety, and changes in anxiety predicting later changes in alliance (Marker et al., 2013).

Improving Assessment in Process-Outcome Research

It has already been argued that to understand how therapy works and what factors differentiate treatment responders from nonresponders we need to use analytic techniques that treat the unit of analysis as the individual rather than the group. Dynamical systems approaches were proposed to fill this need and several analytical techniques were discussed that use principles of dynamical systems to understand mechanisms of change. However, research taking a dynamical systems perspective requires intensive longitudinal data, and the use of multiple assessment points throughout treatment has been advocated for by multiple leaders in the field (Collins & Sayer, 2000, 2001; Kraemer et al., 2002).

Ecological momentary assessment (EMA) collect real-time data in participants' natural environments, assessing changes over time and across situations (Shiffman, Stone, & Hufford, 2008). These rich longitudinal data emphasize the uniqueness of the individual, how the individual responds to its environment, and the interaction of these factors with the passage of time. Additionally, EMA methods reduce retrospective recall bias associated with self-report questionnaires (Piasecki, Hufford, Solhan, & Trull, 2007; Solhan, Trull, & Wood, 2009). Thus, studies using EMA methods invite inquiry into previously unanswerable research questions with a high degree of measurement precision.

The benefits that EMA methods offer to researchers are numerous and the approach is being used to a greater extent within the field. EMA methods allow for the modeling of both *inter*- and *intra*-individual change by gathering repeated assessments of the same individual over time, and provides data for numerous secondary analyses. Whereas EMA began with beepers, daily diaries, and automated phone calls, the rapid

rate at which technology is improving has changed the face of EMA data collection. Smartphones and tablets are extremely common, with 61% of youth aged 13-18 owning a smartphone, and 37% of youth aged 8-18 owning a tablet (Harris Interactive, 2013). Given the penetration smartphones have in our society, scientists have teamed with application ("app") developers to develop smartphone apps capable of improving the scientific process, including the collection of EMA data (Estrin & Sim, 2010; Kendall, Carper, Khanna, & Harris, 2015; Luxton, McCann, Bush, Mishkind, & Reger, 2011). For example, the software company Illumivu (www.illumivu.com) developed a smartphone app and wearable biosensors that scientists can use to collect a variety of psychological, physiological, and environmental data. Some researchers have even developed ecological momentary intervention (EMI) apps that provide targeted and individualized interventions in real time (Pramana, Parmanto, Kendall, & Silk, 2014).

Conclusions

Much quality research has been accomplished in the efforts to determine whether therapy for internalizing disorders is effective. Thanks to these efforts, those treatments that have been evaluated can be said to be efficacious in treating anxiety (Reynolds et al., 2012) and depression (Weisz et al., 2006). However, more work is needed to determine how therapy achieves its beneficial effects. The present review suggests that much more work has been done in search of nonspecific predictors of treatment response than to identify moderators and/or mediators of treatment outcomes. In addition to less focus, there are potential limitations that may contribute to the findings of relatively few

significant moderational and mediational factors. These limitations include poor timing of assessments and analytical techniques that aggregate heterogeneous participants.

One striking conclusion that can be drawn from the present review is that researchers seem to have trouble using consistent terminology regarding moderation and mediation. For example, when describing significant mediational findings, authors may conclude (incorrectly) that a variable mediates treatment outcome when there was an absence of an alternative treatment or comparison condition (in this case, the variable mediates the relationship between the independent and dependent variable, but does not mediate treatment outcome), or when the measure of the putative mediating variable did not have temporal precedence (in this case mediational findings are diminished because it is not possible to conclude that the mediating variable changed as a result of treatment condition, which in turn affected the outcome, or as a result of the treatment condition affecting the outcome, which in turn affected the putative mediating variable). Authors typically discuss the lack of temporal precedence as a study limitation, but some abstracts nevertheless present the findings as providing support for mediation. Consistent with earlier comments by Holmbeck (1997), we encourage authors and reviewers to revisit the recommended best practices (e.g., Holmbeck, 1997; Kraemer et al., 2002; Maric et al., 2012) for the description and reporting of moderation and mediation. Consistency in the use of these terms will facilitate progress towards understanding how and why psychological treatments work.

Another reason that we have not yet found many moderators and mediators of treatment response may be due to our use of nomothetic analytical techniques. By

aggregating participants into groups and performing analyses based on group means, we lose the ability to generalize back down to the individual participant (Molenaar, 2004; Molenaar & Campbell, 2009). Providing psychological treatment is an inherently idiographic endeavor insofar as clients are unique individuals coming from various environments and presenting to treatment with their own unique sets of problems, psychosocial stressors, and biological/genetic vulnerabilities. Thus, we need to use analytical techniques that can capture these inter- and intra-individual differences and can generalize back to the individual. Further, by treating the level of analysis as the group mean, we may lose important moderational or mediational findings as a result of averaging data from different participants. That is, what is a mediator for one individual may not be a mediator for another individual. Additionally, given that psychological treatments typically include multiple active components, it is possible that each component has a different mechanism by which it affects outcome. Thus, there is a need for dismantling studies that examine various combinations of therapeutic components. Once potential mediators are found, multiple mediation models (i.e., models that concurrently examine multiple mediating variables) can be used to determine the unique effects of each putative mediator.

This review also suggested that using dynamical systems approaches to data analysis may lead to a better understanding of the mechanisms through which psychological treatments achieve their beneficial effects. We reviewed four dynamical systems analytic techniques that have the potential to greatly advance our understanding of mechanisms of change in the child and adolescent psychology literature: spectral

analyses, dynamic factor models, state space grids and the GridWare program, and latent difference score models. These techniques each treat the level of analysis as the individual, which allows for a more idiographic understanding of therapeutic mechanisms. These techniques have been applied in the adult literature, but only latent difference score models (Hogendoorn et al., 2014; Marker et al., 2013) and the GridWare program (Carper & Kendall, 2014) have been applied to the child and adolescent internalizing literature. Thus, it is our hope that this review encourages other researchers in the child and adolescent internalizing disorder field to incorporate these, or other, idiographic techniques in their research.

Future research taking a dynamical systems approach could examine person-specific patterns of variability and stability that predict, moderate, or mediate treatment outcome. Many of these analytical techniques are already available in traditional statistical packages like R, SPSS, Stata, SAS, and MPlus. Additionally, R and the GridWare program are freely available and relatively easy to use. However, training programs do not typically teach these strategies, which may be one reason why they are underutilized in the child and adolescent clinical psychology arena. Once research identifies factors that distinguish between those for whom treatment worked and those for whom it was less effective in one study, these factors can be directly tested in a follow-up study to see if they make a significant contribution to outcomes. It is only through a better understanding of how therapy achieves its beneficial effects that we can hope to personalize treatments to maximize clinical gains and reduce costs for treatment-seeking patients.

Table A1. *Characteristics of studies examining predictors, moderators, and mediators of treatment outcome for youth with anxiety disorders.*

Citation	Age Range	N	Study Design	Conditions	Treatment Response Definition	Assessment Points used in Predictor / Moderator/ Mediator Analyses	Moderator Assessed at Baseline	Temporal Precedence of Mediator	Bootstrapped SEs or Tested Indirect Effect Without Sobel Test	Consistent Effects Across Outcomes
Alfano et al, 2009	7-17	145	RCT data	CBT only	(1) ADIS-C/P CSR (2) CGAS (3) SPAI-C	Pre-tx; Post-tx	N/A	No	Yes	No
Berman et al., 2000	6-17	106	RCT data	Exposure-based txs	Treatment success: elimination of primary diagnosis; Posttreatment CSR	Pre-tx; Post-tx	N/A	N/A	N/A	Yes
Compton et al., 2014	7-17	488	RCT	CBT; SRT; COMB; PBO	PARS	Pre-tx; Post-tx	Yes	N/A	N/A	N/A
Cummings et al., 2013	7-17	488	RCT	CBT; SRT; COMB; PBO	PARS; CGI-S; CGI-I	Pre-tx; Session 6; Post-tx	N/A	N/A	N/A	Yes
Halldorsdottir et al., in	7-17	488	RCT	CBT; SRT;	Remission: Absence of	Pre-tx; Post-tx;	Yes	N/A	N/A	Yes

press				COMB; PBO	targeted anxiety disorder; Response: Score of 1 or 2 on CGI-I	24-week follow-up				
Hogendoorn et al., 2014	7-17	488	RCT	CBT; SRT; COMB; PBO	RCADS-C/P	Pre-tx; Session 8; Post-tx; 12-week follow-up	N/A	Yes	No	N/A
Kendall & Treadwell, 2007	9-13	145	Open trial for AD youth; Cross-sectional for controls	AD youth received CBT; Non-AD youth	Change in RCMAS, A-Trait, and FSSC-R from pre- to post-tx	Pre-tx; Post-tx	N/A	No	No	Yes
Kendall et al., under review	7-17	488	RCT	CBT; SRT; COMB; PBO	PARS	Pre-tx; Post-tx; 12-week follow-up	N/A	Yes	Yes	N/A
Kerns et al., 2013	8-14	91	RCT	CBT only	ADIS-C/P CSR	Pre-tx; Post-tx; 7.4 year Follow-up	Yes	N/A	N/A	N/A
Kley et al., 2012	8-13	75	Open trial	CBT	SPAI-C; CBCL-A	Pre-tx; Post-tx	N/A	N/A	N/A	No
Lau et al., 2010	6-11	45	RCT	CBT; Waitlist	SCAS-C/P	Pre-tx; Post-tx	N/A	No	Yes	Yes

McClure et al., 2007	10-16	12	Open trial	CBT or Fluoxetine (choice)	CGI-S; CGI-I	Pre-tx; Post-tx	N/A	N/A	N/A	Yes
Peris et al., 2015	7-17	488	RCT	CBT; SRT; COMB; PBO	PARS; CGAS	Pre-tx; Weekly; Post-tx	Yes	N/A	N/A	Yes
Podell et al., 2013	7-17	279	RCT	CBT; COMB	CGI-I; CGI-S; CGAS; PARS; CBCL; MASC	Pre-tx; coded treatment sessions; Post-tx	N/A	N/A	N/A	No
Southam-Gerow et al., 2001	7-15	135	Open trial	CBT	Good tx response: Youth did not meet criteria for any targeted ADs)	Pre-tx; Post-tx; 1-Year Follow-Up	N/A	N/A	N/A	N/A
Tiwari et al., 2013	7-14	61	Open trial	CBT	CSR, CGAS, MASC, CBCL, TRF	Pre-tx; Exposure sessions; Post-tx	N/A	N/A	N/A	No
Treadwell & Kendall, 1996	8-13	151	Open trial for AD; cross-sectional for control	CBT	Change scores on RCMAS, A-Trait, A-State, FSSC-R, CDI	Pre-tx; Post-tx	N/A	No	No	No

s

Table A2. *Characteristics of studies examining predictors, moderators, and mediators of treatment outcome for youth with unipolar depressive disorders.*

Citation	Age Range	N	Study Design	Conditions	Treatment Response Definition	Assessment Points used in Predictor/ Moderator/ Mediator Analyses	Moderator Assessed at Baseline	Temporal Precedence of Mediator	Bootstrapped SEs or Tested Indirect Effect Without Sobel Test	Consistent Effects Across Outcomes
Brent et al., 1998	13-18	107	RCT	CBT; Systemic-behavioral family therapy, nondirective supportive therapy	No MDD at post and BDI < 9 at 3 consecutive sessions and sustained till end of tx; CGAS	Pre-tx; Post-tx	N/A	N/A	N/A	No
Curry et al., 2006	12-17	439	RCT	COMB, Fluoxetine, CBT, PBO	CDRS-R	Pre-tx; Post-tx	Yes	N/A	N/A	N/A
Dour et al., 2013	7-13	161	RCT	Modular tx; Standard manual tx; TAU	Change in total, internalizing, and externalizing scores on idiographic measure	Pre-tx; Weekly; Post-tx	N/A	N/A	N/A	No
Emslie	12-18	33	RCT	SSRI;	Remission:	Pre-tx;	N/A	N/A	N/A	N/A

et al., 2010		4		SSRI+CBT	< 1 on Adolescent Longitudinal Interval Follow-Up Evaluation for 3 consecutive weeks	Post-tx; Every 12 weeks after tx				
Feeny et al., 2009	12-17	439	RCT	COMB; Fluoxetine; CBT; PBO	CDRS-R; CGAS; RADS	Pre-tx; Post-tx	Yes	N/A	N/A	No
Forbes et al., 2010	10-16	13	Open trial	CBT or CBT+SSRI (choice)	CGI-S; CGI-I; MFQ; SCARED	Pre-tx; Session 2; Session 4; Session 6; Session 8 (Post-tx)	N/A	N/A	N/A	No
Gunlicks-Stoessel et al., 2010	14-18	63	RCT	IPT-A; CBT	HRSD	Pre-tx; Week 4; Week 8; Week 12 (Post-tx)	N/A	N/A	N/A	N/A
Jayson et al., 1998	10-17	50	Two RCTs	ICBT; CBT; Relaxation	K-SADS scores on depressed mood and anhedonia as “slight” or less lasting for 3-weeks	Pre-tx; Post-tx	N/A	N/A	N/A	N/A

Kolko et al., 2000	13-18	103	RCT	CBT; Systemic-behavioral family therapy; nondirective supportive therapy	BDI; DEP-13	Pre-tx; Session 6; Post-tx; 24-month Follow-Up	N/A	Yes	No	Yes
Rohde et al., 1994	14-18	115	RCT	Group CBT; Group CBT with Family; Waitlist	BDI; CES-D; HDRS	Pre-tx; Post-tx	Yes	N/A	N/A	No
Shirk et al., 2008	14-18	54	Open trial	CBT	BDI; C-DISC	Pre-tx; Session 3; Post-tx	N/A	N/A	N/A	Yes
Shirk et al., 2013	14-18	44	Open trial	CBT	BDI	Pre-tx; Session 5; Post-tx	N/A	Yes	No	N/A
Young et al., 2006	12-18	63	RCT	IPT-A; TAU	HRSD; CGAS	Pre-tx; Post-tx; Yes	N/A	N/A	N/A	Yes
Young et al., 2012	11-17	98	RCT	IPT-A; TAU	SCARED; CES-D	Pre-tx; Post-tx; 12-Month Follow-Up	N/A	N/A	N/A	Yes

Figure A1. *Simple mediation diagram*

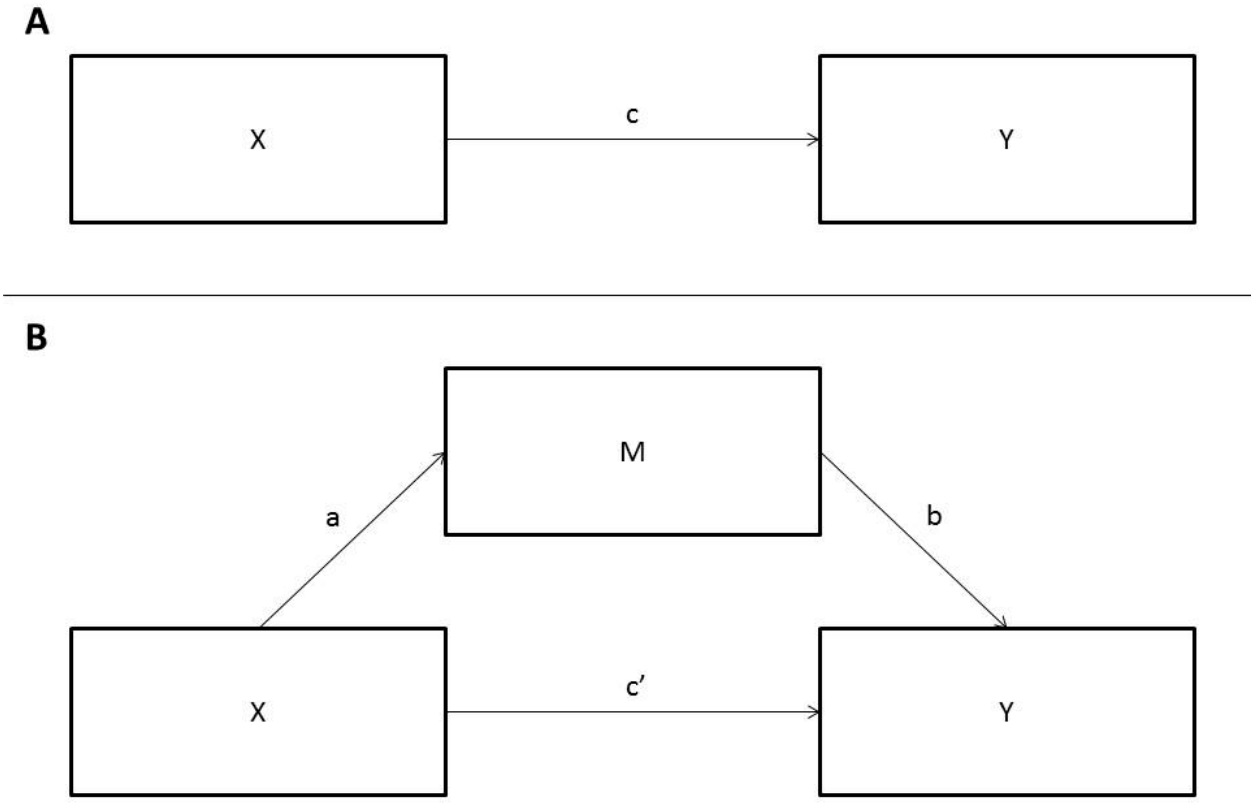
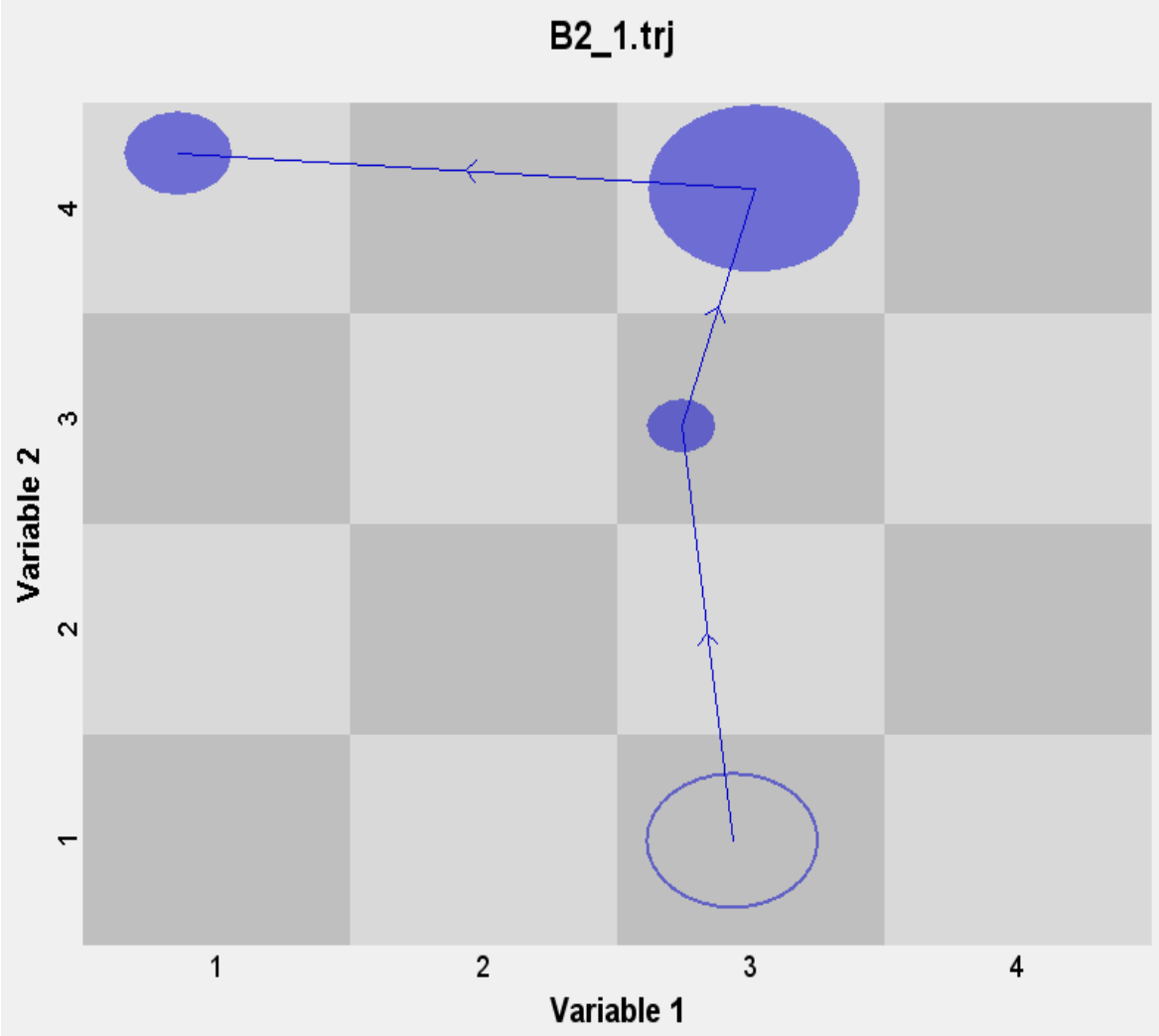
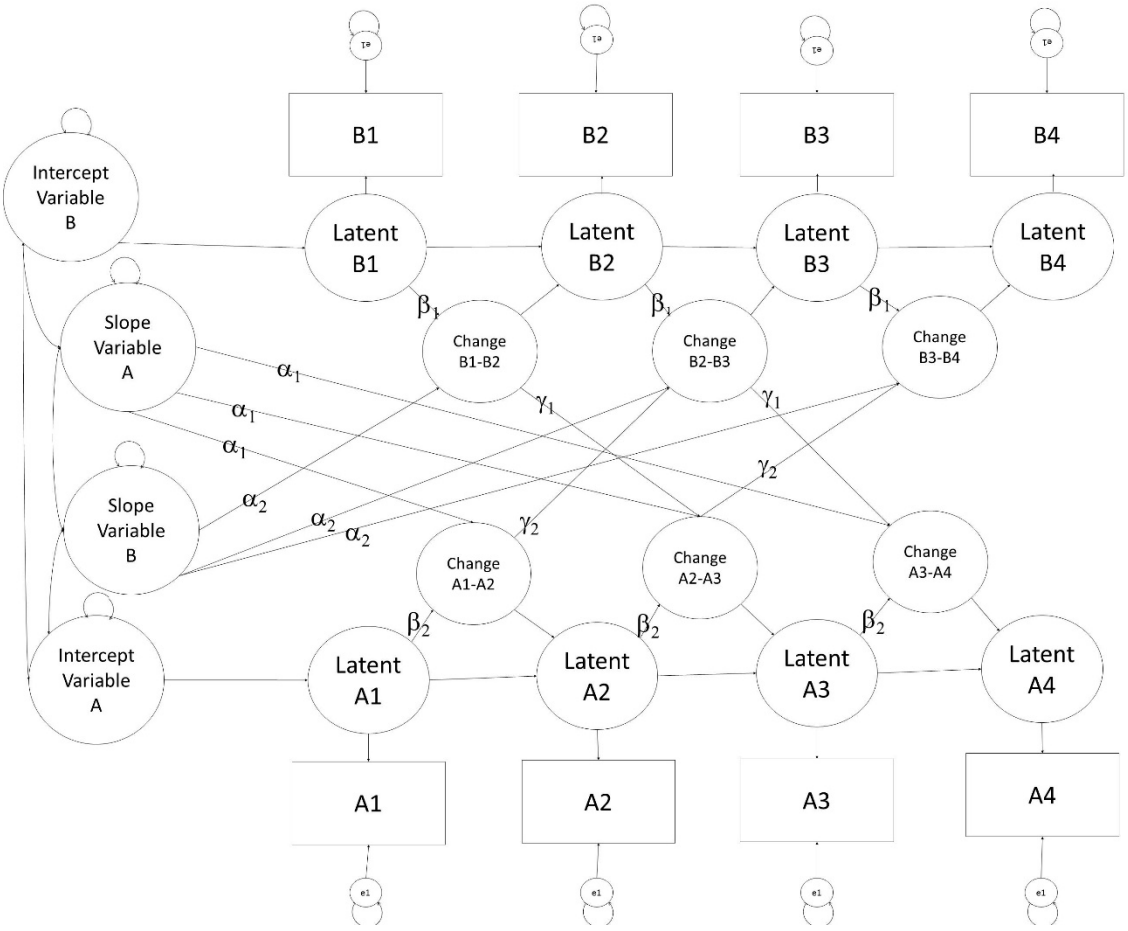


Figure A2. *Sample state space grid from GridWare program.*



Note: Values on variable 1 and variable 2 are plotted on the X- and Y-axis, respectively. Empty circles represent the starting point. Lines with arrows represent movement over time. Larger circles indicate that a participant stayed in that area of the grid for a longer period of time.

Figure A3. *Prototypical Bivariate Latent Difference Score model with four time points*



Note: Traditionally, labeled parameters are constrained to be equal. Unlabeled parameters are fixed to 1.

APPENDIX B

COPY OF EMA SCRIPT ADMINISTERED TO PARTICIPANTS AT EACH EMA BLOCK

ID Number:	Running Call Number: Call Number Per Day:	Caller: Start Time:	Tape #
Total Call Number:		End Time:	Tape Counter Start:
Week Number:	Contact Date:	Total Time:	
Call Completion (circle one):	yes=1 blackout=2 technical problem=3 technician error=4 no answer=5 call ended early=6 subject refused=7		

Current feelings

Ask on every call

I am going to ask you some questions about how you were feeling when the phone rang. Use the 1-5 scale on the back of your phone to tell me how you were feeling.

1=very slightly or not at all
2=a little
3=moderately
4=quite a bit
5=extremely

1. How would you rate how **happy** (good, satisfied) you were?

2. How would you rate how **sad** (blue, unhappy) you were?

3. How would you rate how **cheerful** (full of good spirits) you were?

4. How would you rate how **nervous** (worried, uneasy) you were?

5. How would you rate how **upset** (disturbed or agitated, emotional or mental distress) you were?

6. How would you rate how **interested** (really paying attention to something, being involved in what you were doing) you were?

7. How would you rate how **angry** (feeling or showing anger) you were?

8. How would you rate how **excited** (waiting for something good) you were?

12. How would you rate how **bored** (wearingly dull, repetitive, tedious) you were?

50A. Do you have concerns about the validity of the responses for this section? **Yes** **No**

Media

15. At the moment the phone rang, what types of media were you using:

A1. Music **Yes** **No**

1=
Ra
dio
2=MP3
Player/Ipo
d
3=
CD
4=Comput
er
5=Other (fill in)
_____
_____

A2. Artist
_____
_____

A3. Song
_____
_____

B1. TV **Yes** **No**

B2. Program name
_____
_____

C1. Movie **Yes** **No**

C2. Movie name
_____
_____

D1. Computer **Yes**

No

D2. URL/Primary Computer Activity
_____
D3. Primary Computer Activity
1 = Social networking (email, AIM, myspace, facebook, etc.)
2 = Other general surfing (www.alishakeys.com, www.yahoo.com, www.monroevillemall.com, www.snowboarding.com, etc.)
3 = Computer Game
4 = School work (Microsoft word, homework help website etc.)
5 = Watching a movie on DVD
6=Other
_____
___

E1. Video Games **Yes No**

E2. 1 = Console based (Nintendo, PlayStation, Xbox) Specific Console: _____
2 = Computer based

E3. Interactivity
1 = Playing alone
2 = Playing with other people in the room
3 = Playing with someone online

E4. Game name
_____
_____

F1. Reading **Yes No**

F2. Magazine Title
_____
_____
F3. Newspaper name, Page (sports, arts, business, etc.) _____
F4. Book Title, Author
_____

G. Other Media

_____

H. What is the main type of media you were using? (If using only one type of media ask the questions about that one)
(circle one)

1=Music 2=TV 3=Movie 4=Primary Computer Activity 5=Video Game 6=Reading 7=Other Media

I. Did someone else choose that or did you? me =1 someone else=2 both=3

[use panas scale]

J. How into it were you? ____
K. How funny was it? ____
L. How violent was it? ____
M. How sad was it? ____
N. How scary was it?

1=very slightly or not at all
2=a littl e
3=moder ately
4=quite a bit
5=extre mely

50B. Do you have concerns about the validity of the responses for this section? **Yes No**

Food Consumption

Ask on every call

20A. At the moment the phone rang, were you eating, drinking, or chewing gum? **Yes No**

B. What were you eating or drinking? If chewing gum, was your gum sugarless?

C. How long were you eating, drinking, or chewing gum (report in minutes)? _____

Eating Code A	
Eating Code B	
Eating Code C	
Eating Code D	
Eating Code E	

50D. Do you have concerns about the validity of the responses for this section? **Yes No**

Current Activity

21. At the moment the phone rang, what were you doing?

Current Act Code A	
Current Act Code B	
Current Act Code C	
Current Act Code D	
Current Act Code E	

22. Where were you doing (current activity)?

Where Code	

23A. Who were you interacting with (in person, on telephone, on computer) when the phone rang?

Interacting Code A	
Interacting Code B	
Interacting Code C	

B. If they were interacting with someone on #23…

Were you doing (current activity) together (with person A) when the phone rang? **Yes No**	
Were you doing (current activity) together (with person B) when the phone rang? **Yes No**	
Were you doing (current activity) together (with person C) when the phone rang? **Yes No**	

1. How close or connected did you feel to (restate person they were interacting with) right now? [panas scale]

Interacting Code A _____
Interacting Code B _____
Interacting Code C _____

1=very slightly or not at all
2=a littl e
3=moderately
4=quite a bit
5=extremely

50E. Do you have concerns about the validity of the responses for this section? **Yes No**

Most Negative - Past Hour

Ask on every call

Most Neg Code	

24. Try to remember your feelings and thoughts over the past hour.
Think about the time when you felt the worst, or the most negative

(e.g. mad, upset, nervous, disappointed, sad, worried).
What happened?
If subject says nothing say:

Prompt 1: Sometimes it helps to think about what happened over the past hour. What were you doing an hour ago? What have you been doing since then? During that time, was there anything that made you feel bad?

Prompt 2: Sometimes little things can get under your skin. Was there anything minor that happened that bugged you, like you hurt yourself, you lost something, you didn't get something you wanted, or somebody annoyed you?

Prompt 3: Was there anything that you were thinking about that may have upset you, such as feeling unhappy about something?

25. When was it?	____right before I was called=1 ____about 15 minutes ago=2 ____about 30 minutes ago=3 ____about 45 minutes ago=4 ____about 1 hour ago=5

26. ***(ONLY ask if they said nothing for question 24)*** Alright, then please think about the last time you can remember
when you felt badly or were mad, upset, nervous, disappointed, sad, or worried. What happened?

27. When was that (report in minutes)?
_____

28A. At the worst point, how angry did you feel?	**1=very slightly or not at all**
B. At the worst point, how nervous did you feel?	**2=a littl e**
C. At the worst point, how sad did you feel?	**3=moder ately**
D. At the worst point, how upset did you feel?	**4=quite a bit**
E. At the worst point, how bored did you feel?	**5=extre mely**

29. How much control did you feel you had over the situation?

1 = no control
2 = a little control
3 = medium control
4 = a lot of control
5 = complete control

30. When you started feeling the worst, did you react in any of the following ways?

_____C. Did you realize that you just have to live with things the way they are?

_____D. Did you do something to fix the problem or think of a way to make things better?

_____G. Were you unable to stop thinking about how you were feeling - thoughts about [Most Negative] kept popping up in your mind?

30M Mind Off What Code_A

_____M. Did you keep your mind off of the problem by doing something else?

What did you do? _____

30M Mind Off What Code_B

_____H. Did you tell yourself that it wasn't a big deal or try to think of the problem in a different way so it didn't seem as bad?

_____I. Did you try not to think about it or try to forget all about it?

_____L. Did you get a headache, stomachache, tight muscles, fast breathing, or become hot and sweaty?

30P Strategy_ Code_A

_____P. Did you do anything else?

30P Strategy_

Code_B

Describe
_____
_____

neg with you code A

neg with you code B

neg with you code C

31A. Was anyone else with you when you did these things? **Yes** **No**

31B. If yes, who was with you?
_____
____

31C. Did this person (neg with you code A) talk with you about (restate negative event)? **Yes** **No**

31C. Did this person (neg with you code B) talk with you about (restate negative event)? **Yes** **No**

31C. Did this person (neg with you code C) talk with you about (restate negative event)? **Yes** **No**

50F. Do you have concerns about the validity of the responses for this section? **Yes** **No**

Most Positive - Past Hour

Most Positive Code

33. Think about the most enjoyable or happy time in the past hour. What happened? (e.g. happy, relaxed)

pos with you code A

pos with you code B

pos with you code C

34A. Was anyone with you? **Yes** **No**

34B. If yes, who was with you?
_____

35. When was it?

____right before I was called=1
____about 15 minutes ago=2
____about 30 minutes ago=3
____about 45 minutes ago=4
____about 1 hour ago=5

36A. At the best point, how happy did you feel?

1=very slightly or not at all
2=a littl e
3=moder ately
4=quite a bit
5=extre mely

37A. Did you do anything to make the good feeling last longer? **Yes No**

50G. Do you have concerns about the validity of the responses for this section? **Yes No**

Caffeine Use

Caffeine Type Code A	
Caffeine Type Code B	
Caffeine Type Code C	

Ask on every call

38A. Did you have any caffeine since the last time we talked? **Ye s No**

B. How many servings of caffeine (report in milligrams)? _____

C. What type(s) of caffeine did you have (e.g., Pepsi, coffee, tea, etc.)?

50H. Do you have concerns about the validity of the responses for this section? **Yes No**

Planned activity

Ask only on the first completed call of

the day

39P1A. Do you have anything planned for later today? **Yes** **No**

40P1. What are you planning to do?

P1 What Plan Code A

P1 What Plan Code B

P1 What Plan Code C

39P2A. Do you have anything planned for later today? **Yes** **No**

40P2. What are you planning to do?

P2 What Plan Code A

P2 What Plan Code B

P2 What Plan Code C

Physical Activity After Last Call Last Night

[Do not ask on Thursday; ask only on first completed call of the day]

53A. Did you engage in any physical activity last night? **Yes** **No**

53B .How long were you physically active (report in minutes)? _____

53C. What Activities did you do?_____

Activity Code A

Was (Activity Code A) organized (structured class, team, or intramurals) or recreational (unstructured without a coach, instructor, or organizer)?
1=Organized
2=Recreational

Activity Code B

Was (Activity Code B) organized (structured class, team, or intramurals) or recreational (unstructured without a coach, instructor, or organizer)?
1=Organized
2=Recreational

Activity Code C

53D. Were you physically active by yourself or with someone?

Active with Code A

1=by yourself **2=with someone else**	Active with Code B	

E. If so, who?_____

50I. Do you have concerns about the validity of the responses for this section? **Yes** **No**

Worry

Ask on every call

41A. Tell me what you were worrying about before the phone rang. *If nothing, see question 42.*

W1	W1 Worry1 Code	
	W2 Worry2 Code	
	W3 Worry3 Code	

Is there anything else that you were worrying about?
W2

Is there anything else that you were worrying about?
W3

41B.How worried were you about (worry)? [use panas scale]	**W1** **W2** **W3**	**1=very slightly or not at all** **2= a littl e** **3=moder ately** **4=quite a bit** **5=extre mely**

42A. (*Ask only if nothing for question 41*) What have you been thinking about?

42B. Is there anything else you have been thinking about?

50J. Do you have concerns about the validity of the responses for this section? **Yes** **No**

Tobacco Use, Naps, Exercise, and School

Ask only last call of the day

44A. Did you have any tobacco products today? **Yes** **No**

Tobacco Type Code

B. How many servings of tobacco?
_____

C. What type of tobacco products did you have (cigarettes or chewing tobacco)?
_____

45A. Did you nap at all today? **Yes** **No**

B. How long did you spend napping today (report in minutes)? _____

46A. Were you physically active today? **Yes** **No**

B. How long were you physically active today (report in minutes)? _____

C. What activities did you do?
_____

Activity Code A

Activity Code B

Activity Code C

Was (Activity Code A) organized (structured class, team, or intramurals) or recreational (unstructured without a coach, instructor, or organizer)?
1=Organized
2=Recreational

Was (Activity Code B) organized (structured class, team, or intramurals) or recreational (unstructured without a coach, instructor, or organizer)?
1=Organized
2=Recreational

Was (Activity Code C) organized (structured class, team, or intramurals) or recreational (unstructured without a coach, instructor, or organizer)?
1=Organized
2=Recreational

D. Were you physically active by yourself or with someone?

1=by yourself
2=with someone else

Active With Code A	
Active With Code B	
Active With Code C	

E. If so, who?

_____

47. Did you go to school today?

yes=1 weekend=2 school holiday=3 doctor/dentist appointment=4 sick=5 just not going=6 home schooled=7 summer vacation=8

48. Will you go to school tomorrow?

yes=1 weekend=2 school holiday=3 doctor/dentist appointment=4 sick=5 just not going=6 home schooled=7 summer vacation=8

49. Did you have any after school or extracurricular activities today?

sporting activity=1 academic=2 social (football game, dance, etc.)=3 detention=4 other extracurricular activity=5 none=6

50L. Do you have concerns about the validity of the responses for this section? **Yes No**

On the last EMA call of the day please remind subjects to:

1. Wear their actigraph and press the button when they go to sleep and wake up!!!
2. Fill out their forms.
3. Recharge phones, and have them on at the next call time.

COMMENTS:

A. Affect (Observed): Interviewers impression of subject's current affective state.

1=Depressed (loss of emotional expersion, flat affect, persistent sad, anxious or empty mood)

2=Dysphoric (down more than expected situation; could be low end of normal if circumstances are very negative)

3=Euthymic (normal range)

4=Elevated (very happy, likely more than one would expect for circumstances but could be the high end of normal if good things are happening)

5=Elated (very happy or proud; jubilant; in high spirits)

6=Anxious (uneasy and apprehensive about an uncertain event or matter; worried)

7=Irritable (easily irritated or annoyed; readily excited to impatience or anger)

8=Enraged (to make extremely angry; put into a rage; infuriate)

9=Labile (emotionally unstable)