Pepperdine University

Graduate School of Education and Psychology

# NEUROPSYCHOLOGICAL REHABILITATION SPECIFIC TO ANOREXIA NERVOSA: A CRITICAL REVIEW OF THE LITERATURE ON EXECUTIVE FUNCTIONING SYMPTOMATOLOGY AND COGNITIVE REMEDIATION TREATMENT APPLICATIONS TAILORED TO THIS PATIENT POPULATION

A clinical dissertation submitted in partial satisfaction

of the requirements for the degree of

Doctor of Psychology

by

Kayleigh Elizabeth Hale

June, 2015

Judy Ho, Ph.D., ABPP – Dissertation Chairperson





ProQuest LLC.
789 East Eisenhower Parkway
P.O. Box 1346
Ann Arbor, MI 48106 - 1346

This clinical dissertation, written by

Kayleigh Elizabeth Hale

under the guidance of a Faculty Committee and approved by its members, has been submitted to and accepted by the Graduate Faculty in partial fulfillment of the requirements for the degree of

DOCTOR OF PSYCHOLOGY

Doctoral Committee:

Judy Ho, Ph.D., ABPP, Chairperson

Anat Cohen, Ph.D.

Sepida Sazgar, Psy.D.

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# VITA

## EDUCATION

Pepperdine University, Graduate School of Education & Psychology - Los Angeles, CA
**Doctor of Psychology in Clinical Psychology, APA Accredited Program** May 2015
**Chair:** Judy Ho, Ph.D., ABPP
**Dissertation Title:** Neuropsychological rehabilitation specific to anorexia nervosa: A critical review of the literature on executive functioning symptomatology and cognitive remediation treatment applications tailored to this patient population

Pepperdine University, Graduate School of Education & Psychology - Malibu, CA
**Master of Arts in Clinical Psychology** May 2011
**Emphasis in Marriage and Family Therapy**

University of Southern California, Leonard Davis School of Gerontology - Los Angeles, CA
**Bachelor of Science in Human Development and Aging** May 2009

## HONORS & AWARDS

Graduated with honors from Pepperdine University May 2011
Graduated with honors from the University of Southern California May 2009
Student of the Year award from the University of Southern California April 2009

## CLINICAL NEUROPSYCHOLOGY ASSESSMENT EXPERIENCE

**VA Long Beach Healthcare System - Long Beach, CA**
**Neuropsychology and Rehabilitation Medicine**
Intern, APA Accredited Program August 2014 – February 2015

- Intern under supervision of Duke Han, Ph.D., ABPP-CN, and Tiffany Barr, Ph.D.
- Evaluated adults within inpatient and outpatient contexts, presenting with acquired brain injuries, vascular disease, dementias, meningioma, metabolic disturbances, psychiatric conditions and other neurological disorders.
- Conducted neurorehabilitation group and individual cognitive retraining for TBI/Polytrauma patients.

**University of California Los Angeles, Semel Institute for Neuroscience and Human Behavior - Los Angeles, CA**
**Medical Psychology Assessment Center**
Pre-Intern June 2013 – July 2014

- Pre-intern under supervision of Delany Thrasher, Ph.D., ABPP-CN, and Christopher Benjamin, Ph.D.
- Evaluated adult and geriatric patients presenting with epilepsy, brain tumor, traumatic brain injury, cerebrovascular accident, multiple sclerosis, Parkinson's disease, organ transplant, psychiatric and other neurological disorders.
- Attended intraoperative cortical electrical stimulation mapping, epilepsy grid mapping, intracarotid sodium amobarbital procedures (WADA Testing), and fMRI examinations.

**Los Angeles County + University of Southern California Medical Center - Los Angeles, CA**
**Department of Neurology**
Pre-Intern September 2012 – August 2013

- Pre-intern under supervision of Nora Jimenez, Ph.D.
- Evaluated adult, geriatric, and incarcerated patients presenting with epilepsy, traumatic brain injury, brain tumor, mild cognitive impairment, cerebrovascular accident, psychiatric and other neurological disorders.
- Attended multidisciplinary epilepsy meetings and intracarotid sodium amobarbital procedures (WADA Testing).

## OTHER CLINICAL EXPERIENCE

**VA Long Beach Healthcare System - Long Beach, CA**
**Spinal Cord Injury/Dysfunction (SCI)**
Intern, APA Accredited Program February 2015 – Present

- Intern under supervision of Linda Mona, Ph.D.
- Provide psychotherapeutic treatment to patients with spinal cord, chronic pain, and related disorders.
- Provide consultation-liaison services within an interdisciplinary medical team and conduct staff in-service trainings.

**VA Long Beach Healthcare System - Long Beach, CA**
**Substance Abuse Treatment Clinic (SATC)**
Intern, APA Accredited Program February 2015 – Present

- Intern under supervision of Henry C. Benedict, Ph.D.
- Provide individual and group psychotherapy to veterans with dual diagnosis, dual addiction, and alcohol use disorders.
- Provide consultation-liaison services within a multidisciplinary team framework.

**VA Long Beach Healthcare System - Long Beach, CA**
**Support and Family Education Group (S.A.F.E.)**
Intern, APA Accredited Program August 2014 – Present

- Intern under supervision of Lisa Finlay, Ph.D.
- Provide group psychotherapy for family members and significant others of patients with psychiatric/medical illnesses.

**VA Long Beach Healthcare System - Long Beach, CA**
**Infectious Disease Clinic, Oncology, Hospice, & Nephrology Consultation**
Intern, APA Accredited Program August 2014 – February 2015

- Intern under supervision of Adrienne House, Ph.D.
- Provided individual and group psychotherapeutic treatment to veterans within both inpatient and outpatient contexts, presenting with a wide variety of psychological symptoms associated with chronic and terminal illnesses.
- Generated organ transplant and psychodiagnostic evaluations.
- Provided consultation services within a primary care clinic and as a member of interdisciplinary treatment teams.

**Pepperdine Community Counseling Center - Encino, CA**
Pre-Intern September 2011 – July 2014

- Pre-intern under supervision of Anat Cohen, Ph.D., and Sepida Sazgar, Psy.D.
- Provided individual, couples, family, and school-based psychotherapeutic treatment for diverse populations, including:
  - Community-based individuals, graduate, and undergraduate students, presenting with a broad range of symptoms, including disorders of mood, anxiety, adjustment, eating, sleep, substance-use, and personality.
  - **Children of the Night in association with Pepperdine Community Counseling Center** - children and adolescents ages 11-17 who have experienced childhood prostitution, sexual/physical abuse, substance use, and self-injurious behaviors.
  - **Canoga Park High School in association with Pepperdine Community Counseling Center** - "at-risk" adolescents ages 14-17 presenting with self-injurious behaviors, substance use, gang involvement, PTSD, depression, anxiety, and learning disabilities.
  - **Lanai Road Elementary School in association with Pepperdine Community Counseling Center** - children ages 5-12 referred for interpersonal and behavioral difficulties in the home and school environment.

**Monte Nido Vista Treatment Center - Agoura Hills, CA**
Practicum Student October 2009 – January 2012

- Primary therapist under supervision of Carolyn Costin, MFT, and Jeff Radant, MFT.
- Provided individual, couples, family, and group therapy in a residential eating disorder treatment center.

## RESEARCH EXPERIENCE

**VA Long Beach Healthcare System**
**Neuropsychology and Rehabilitation Medicine**
Intern, APA Accredited Program August 2014 – Present

- Conduct neuropsychology research under supervision of Duke Han, Ph.D., ABPP-CN, focused on creating database specific to patients with TBI/Polytrauma.

**University of California Los Angeles, Semel Institute for Neuroscience and Human Behavior**
**Medical Psychology Assessment Center** January 2014 – July 2015
Research Assistant for study on utility of right-sided IAP for surgical planning

- Research assistant under supervision of Christopher Benjamin, Ph.D., in collaboration with Leigh Sepeta, Ph.D. of Children's National Hospital.
- Collated, coded, and maintained data related to WADA analyses, to examine the frequency by which IAP failure precluded standard mesial temporal lobectomy.

**University of California Los Angeles, Semel Institute for Neuroscience and Human Behavior**
**Medical Psychology Assessment Center** June 2013 – July 2015
Research Assistant for Pre-Surgical Localization of Language Cortex Using fMRI study

- Research assistant under supervision of Susan Bookheimer Ph.D., Patricia Walshaw, Ph.D., and Christopher Benjamin, Ph.D.
- Collated, coded, and maintained data related to fMRI/MRI/WADA analyses, to validate fMRI with WADA data.

**University of California Los Angeles, Semel Institute for Neuroscience and Human Behavior**
**Medical Psychology Assessment Center** June 2013 – July 2014
Research Assistant for CogEx study

- Research assistant under supervision of Delany Thrasher, Ph.D., ABPP-CN.
- Managed a research project examining the effects of exercise on cognition in multiple sclerosis, by coordinating communication between clinicians, collating data, and scheduling participants.

**University of California Los Angeles, Semel Institute for Neuroscience and Human Behavior**
**Medical Psychology Assessment Center** June 2013 – July 2014
Research Assistant for Metabolic Cerebral Imaging in Incipient Dementia study

- Research assistant under supervision of Delany Thrasher, Ph.D., ABPP-CN.
- Administered and scored neuropsychological and emotional assessment measures for a research project examining metabolic cerebral imaging in incipient dementia.

## SCIENTIFIC CONFERENCE PRESENTATIONS

A clinical model of language for presurgical language localization using fMRI, September 2014, Poster presented at Societas Linguistica Europaea, Poland

A clinical model of language for presurgical language localization using fMRI, April 2014, Poster presented at Cognitive Neuroscience Society Annual Meeting

Evidence-Based Group Therapy Model for Disordered Eating Symptomatology, October 2013, Poster presented at Los Angeles County Psychological Association (LACPA) Conference

## TEACHING EXPERIENCE

**Pepperdine University Graduate School of Education & Psychology - Los Angeles, CA**
**Assessment of Intelligence Graduate Course**
Guest Lecturer and Teaching Assistant for Sepida Sazgar, Psy.D. September 2012 – August 2013

- Guest Lectures: Foundations of Neuropsychological Assessment, April 2013 and WAIS-IV Analysis, March 2013.
- Tutored students on the administration, scoring, and interpretation of neuropsychological assessment measures.
- Reviewed students' integrated assessment reports, provided detailed feedback, and graded protocols.

**Pepperdine University Graduate School of Education & Psychology - Los Angeles, CA**
**Personality Assessment Graduate Course**
Teaching Assistant for Sepida Sazgar, Psy.D. January 2013 – August 2013

- Tutored students on the administration, scoring, and interpretation of emotional/personality assessment measures.
- Reviewed student's integrated assessment reports, provided detailed feedback, and graded protocols.

**Pepperdine University Graduate School of Education & Psychology - Malibu, CA**
**Marriage and Family Therapy Graduate Course**
Guest Lecturer and Teaching Assistant for Dennis Lowe, Ph.D. December 2010 – April 2011

- Guest Lecture: Family of Origin Psychotherapy, February 2011.
- Developed assignments, assisted professor during instructional activities, and tutored students.

## COMMUNITY-BASED PRESENTATIONS

Clinical Assessment and Management of Childhood Anxiety, March 2013, Lemay Road Elementary School

Identifying and Responding to Bullying for Elementary School Students Grades One Through Three, February 2013, Lanai Road Elementary School

Identifying and Responding to Bullying for Elementary School Students Grades Four Through Five, February 2013, Lanai Road Elementary School

Identifying and Responding to Bullying for Elementary School Students in Kindergarten, February 2013, Lanai Road Elementary School

Clinical Assessment and Management of Childhood Anxiety, January 2013, Lanai Road Elementary School

Clinical Assessment and Management of Childhood Anxiety, February 2012, Liggett Street Elementary School

## CLINICAL SUPERVISION EXPERIENCE

**Pepperdine Community Counseling Center - Encino, CA**
Doctoral Peer Supervisor September 2013 – July 2014

- Conducted weekly individual supervision of graduate externs, including providing detailed feedback on intake evaluations and case notes, reviewing videotaped sessions, and assisting supervisees with articulating clear training goals based on a competency benchmarks model.
- Participated in weekly supervision for supervisors group, facilitated by clinic director, Anat Cohen, Ph.D.

**VA Long Beach Healthcare System - Long Beach, CA**
**Neuropsychology and Rehabilitation Medicine** August 2014 – February 2015
Intern, APA Accredited Program

- Intern under supervision of Duke Han, Ph.D., ABPP-CN.
- Supervised practicum students in neuropsychology.

## LEADERSHIP EXPERIENCE

**VA Long Beach Healthcare System - Long Beach, CA**
Elected Chief Intern — August 2014 – Present

**Los Angeles County Psychological Association (LACPA) - Los Angeles, CA**
Ethics Committee Liaison and Research Subcommittee Representative September 2012 – Present

**Pepperdine Community Counseling Center - Encino, CA**
School-Based Therapy Program Coordinator and Liaison — September 2012 – July 2014

**Pepperdine GSEP Student Government Association - Los Angeles, CA**
Doctoral Class Representative — April 2013 – April 2014
Doctoral Steering Committee Representative — November 2012 – April 2013

**University of Southern California Student Gerontology Association - Los Angeles, CA**
President — April 2008 - May 2009

## CERTIFICATIONS

Marriage and Family Therapist Intern, License Number 67629 — August 2011 – August 2012

## PROFESSIONAL ASSOCIATIONS

American Psychological Association (APA) — January 2012 - Present
Sigma Phi Omega, Honor and Professional Society in Gerontology — January 2009 - January 2010
Psi Chi, International Honor Society in Psychology — May 2011 - Present
American Association of Marriage & Family Therapists — September 2009 - May 2011
Los Angeles County Psychology Association (LACPA) — April 2013 - Present

# ABSTRACT

Engaging, maintaining, and treating patients with anorexia nervosa (AN) remains a significant challenge for clinicians, hypothesized explanations for which are thought to involve specific executive functioning impairments. The neuropsychological treatment paradigm Cognitive Remediation Therapy (CRT) represents the translation of neurocognitive research into practice, and is thought to remediate neuropsychological symptoms and associated maladaptive cognitive processes. Additionally, the etiological model of AN related to executive functioning provides a conceptual framework for this novel approach to treatment. This study identifies and examines such a model, in addition to CRT protocols. Methodology involved a comprehensive synthesis and critical analysis of the literature pertaining to these domains. A variety of promising findings attributed to CRT are discussed, including an increase in participant BMI, improved neuropsychological performance, reduced perseveration, increased capacity for global processing, decreased eating disorder and depressive symptomatology, increased motivation, and confidence in patients' ability to change and begin subsequent therapies. Numerous important methodological limitations are also elucidated, as many studies utilized small sample sizes resulting in low statistical power and poor generalizability, neglected to identify or consider demographic and cultural variables, failed to assess general intelligence or reference the normative data used, did not identify or discuss potential cohort or practice effects, provided limited details influencing studies' reproducibility, and introduced a variety of biases. Nevertheless, this groundwork illuminated promising results in the treatment of a diagnostically complex and challenging disorder. Accordingly, a number of suggested future directions and clinical applications are elaborated upon.

# Chapter I: Review of the Literature on Anorexia Nervosa

## Clinical Description of Anorexia Nervosa

Eating disorders and other manifestations of disordered eating are reaching epidemic proportions in many Western countries and are considered among the most prevailing public health problems (Stein, Latzer, & Merrick, 2009). The *Diagnostic and Statistical Manual of Mental Disorders* (DSM-IV-TR) specifies three domains of eating disorder psychopathology: Anorexia Nervosa (AN), Bulimia Nervosa (BN), and Eating Disorder Not Otherwise Specified (EDNOS). Of these three disorders, AN will henceforth be the focus of attention.

AN is a major source of physical and psychological morbidity (Watkins, 2011), the central disturbance of which involves pathological eating habits and subsequent physical, psychological and social consequences (American Psychiatric Association, 2000). AN is primarily characterized by a refusal to maintain a minimally normal body weight, significant body image disturbance, intense fear of weight gain, and amenorrhea in postmenarcheal females (American Psychiatric Association, 2000). An accurate diagnosis of AN is therefore comprised of physiological, psychological, and behavioral components, which may be considered mutually influential.

**Physiological components of anorexia nervosa.** Two physiologically based criteria are required for formal AN diagnosis. The first, and considerably most universally noted symptom of AN psychopathology, involves the maintenance of a body weight that is below what is considered minimally normal for age and height (DSM-IV-TR Criterion A; American Psychiatric Association, 2000). What is often deemed severe weight loss may be accomplished through a variety of behavioral methods, discussed later in *Behavioral Components of Anorexia Nervosa*. Criterion A provides a specific standard for determining when the individual meets a

defined threshold for being considered underweight; 'weight loss leading to maintenance of body weight less that 85% of that expected' (American Psychiatric Association, 2000). The diagnosing clinician is prompted to view these cutoffs as guidelines as they gather information related to the patient's body build and weight history, as it is unreasonable to specify a single standard for minimally normal weight. This criterion can also be met by having a body mass index (BMI) equal or below 17.5 $kg/m^2$, as specified by the International Classification of Mental and Behavioural Disorders (World Health Organization, 1993). The second physiologically based criterion (DSM-IV-TR Criterion D) is amenorrhea, the absence of at lease three consecutive menstrual cycles in postmenarcheal females. However, recent studies have produced results indicating a lack of any clinically significant difference between individuals with AN who do and do not menstruate, thereby questioning the relevance of this criterion (Gendall et al., 2006; Watson & Anderson, 2003).

**Psychological components of anorexia nervosa.** Psychologically grounded criteria of the DSM-IV-TR AN diagnosis are characterized by fear, preoccupation, dissatisfaction, distorted perception, variable self-esteem, and ego-syntonic characteristics. An intense fear of gaining weight or becoming fat encompasses DSM-IV-TR Criterion B (American Psychiatric Association, 2000), and the individual's distress regarding these stimuli is not relieved by the weight loss. In fact, apprehension related to weight gain tends to increase as actual weight decreases. The intense fear defined by Criterion B is typically accompanied by both a preoccupation and dissatisfaction with shape and weight, in addition to overvalued ideas about their importance (Watkins, 2011). Distorted body image related to both weight and shape represents DSM-IV-TR Criterion C of AN, which can be exhibited in a global (e.g., entire body) or localized (e.g., abdomen, buttocks, and thighs) fashion (American Psychiatric Association,

2000). Variable self-esteem is also considered a prominent component of AN psychopathology, which is highly dependent on the individual's body shape and weight. Weight loss is revered, whereas weight gain is considered an unacceptable failure of self-control. One of the factors contributing to the difficulty in treating AN, is the ego-syntonic nature of the disorder, in which individuals refuse to maintain minimal body weight and the medical implications of malnourishment are frequently denied (American Psychiatric Association, 2000). The ego-syntonic nature of AN symptomatology is also observed as individuals with AN rarely seek help on their own and are more often brought to professional attention by a concerned other after the individual has lost a considerable amount of weight. It is more likely for an individual with AN to seek professional treatment once they have experienced considerable subjective distress over the somatic and psychological sequelae of starvation.

**Behavioral components of anorexia nervosa.** Various behavioral methods aimed at weight loss and the maintenance of low weight, specific to DSM-IV-TR diagnosis, include caloric restriction, purging, excessive exercise, and body checking. Weight loss is typically accomplished via a reduction or restriction in total food intake, which often begins by excluding highly caloric foods, and commonly develops into a markedly restrictive diet (American Psychiatric Association, 2000). Individuals with AN may also restrict calories by means of purging through self-induced vomiting and excessive exercise, in addition to misuse of laxatives and/or diuretic medications. Standards of *excessive exercise* vary across the literature, yet most often are based on a frequency criterion specified by the original version of the Eating Disorder Examination (EDE), *intense exercise* to control shape or weight on average at least five days a week (Fairburn & Cooper, 1993; Mond & Calogero, 2009). Young adult females with AN may also engage in behavioral methods to estimate their body size and weight, termed

*body checking*, examples of which include excessive and compulsive weighing, obsessive measuring of body parts, and using reflections (e.g., mirrors, windows, and other reflective surfaces) to assess for perceived areas of *fat* (American Psychiatric Association, 2000).

**Subtypes and Diagnostic Criteria of Anorexia Nervosa**

The manifestation of specific physiological, psychological, and behavioral symptomatology is noted to occur in two distinctive presentations of AN psychopathology. These distinguishable AN subtypes have therefore been clinically defined in the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-IV-TR; DSM-V), as Restricting and Binge-Eating/Purging Types. These subtypes, in addition to their DSM-IV-TR and DSM-V diagnostic criteria, are briefly described.

**Anorexia nervosa subtypes.** Two subtypes of AN have been specified by the DSM-IV-TR and DSM-V; Restricting and Binge-Eating/Purging Types (American Psychiatric Association, 2000; American Psychiatric Association, 2013a). The restricting subtype characterizes a clinical presentation in which weight loss is accomplished primarily through dieting, fasting, or excessive exercise, and regular engagement in binge eating or purging does not occur. Conversely, binge-eating/purging subtype includes regular engagement in binge eating, purging, or both.

During DSM-V development, a major consideration pertaining to accurate AN diagnosis involved the disproportionate number of patients who met criteria for EDNOS, rather than AN or BN (American Psychiatric Association, 2013b). Certain modifications were therefore made to the diagnostic criteria of AN in order to better account for the presenting symptoms and behaviors (American Psychiatric Association, 2013a). For example, the term *refusal* was removed from Criterion A, because it suggests that patients' dietary restrictions are volitional,

which is also challenging to determine (American Psychiatric Association, 2013b). The criterion related to amenorrhea (Criterion D) was also removed, as this symptom cannot be applied to a number of patient populations, including pre/post-menarchal females, those following an oral contraception regimen, and males (American Psychiatric Association, 2013b). In addition to these changes, the DSM-V permits the diagnosing clinician to specify the severity the illness based on BMI, and whether the individual is in partial or full remission. All other descriptions of this disorder remained unchanged, aside from the aforementioned revisions to the diagnostic criteria.

Table 1

*Diagnostic Criteria of Anorexia Nervosa*

| Criterion | DSM-IV-TR | DSM-5 |
|---|---|---|
| A | Refusal to maintain body weight at or above a minimally normal weight for age and height (e.g., weight loss leading to maintenance of body weight less than 85% of that expected; or failure to make expected weight gain during period of growth, leading to body weight less than 85% of that expected). | Restriction of energy intake relative to requirements, leading to a significantly low body weight in the context of age, sex, developmental trajectory, and physical health. *Significantly low weight* is defined as a weight that is less than minimally normal or, for children and adolescents, less than that minimally expected. |
| B | Intense fear of gaining weight or becoming fat, even though underweight. | Intense fear of gaining weight or of becoming fat, or persistent behavior that interferes with weight gain, even though at a significantly low weight. |

(continued)

| Criterion | DSM-IV-TR | DSM-5 |
|---|---|---|
| C | Disturbance in the way in which one's body weight or shape is experienced, undue influence of body weight or shape on self-evaluation, or denial of the seriousness of the current low body weight. | Disturbance in the way in which one's body weight or shape is experienced, undue influence of body weight or shape on self-evaluation, or persistent lack of recognition of the seriousness of the current low body weight. |
| D | In postmenarcheal females, amenorrhea, i.e., the absence of at least three consecutive menstrual cycles. (A woman is considered to have amenorrhea if her periods occur only following hormone, e.g., estrogen, administration). | Criterion D eliminated |
| Specify Type | | |
| Restricting Type | During the current episode of Anorexia Nervosa, the person has not regularly engaged in binge-eating or purging behavior (i.e., self-induced vomiting or the misuse of laxatives, diuretics, or enemas). | During the last 3 months, the individual has not engaged in recurrent episodes of binge eating or purging behavior (i.e., self-induced vomiting or the misuse of laxatives, diuretics, or enemas). This subtype describes presentations in which weight loss is accomplished primarily through dieting, fasting, and/or excessive exercise. |
| Binge-Eating/Purging Type | During the current episode of Anorexia Nervosa, the person has regularly engaged in binge-eating or purging behavior (i.e., self-induced vomiting or the misuse of laxatives, diuretics, or enemas). | During the last 3 months, the individual has engaged in recurrent episodes of binge eating or purging behavior (i.e., self-induced vomiting or the misuse of laxatives, diuretics, or enemas). |

(continued)

| Specify State of Remission | | |
|---|---|---|
| In Partial Remission | No specification | After full criteria for anorexia nervosa were previously met, Criterion A (low body weight) has not been met for a sustained period, but either Criterion B (intense fear of gaining weight or becoming fat or behavior that interferes with weight gain) or Criterion C (disturbances in self-perception of weight and shape) is still met. |
| In Full Remission | No specification | After full criteria for anorexia nervosa were previously met, none of the criteria have been met for a sustained period of time. |
| Specify Current Severity | | |
| Mild | No specification | BMI ≥ 17 kg/m$^2$ |
| Moderate | No specification | BMI 16–16.99 kg/m$^2$ |
| Severe | No specification | BMI 15–15.99 kg/m$^2$ |
| Extreme | No specification | BMI < 15 kg/m$^2$ |

**Course, Prevalence, and Comorbidities Associated with Anorexia Nervosa**

The prognosis of a psychiatric disorder such as AN can be considered in terms of its course. According to the American Psychiatric Association, the course of AN is highly variable (American Psychiatric Association, 2000). The onset of AN classically begins during mid-to-late adolescence (14 to 18 years of age), may be associated with a stressful life event, and is deemed rare in females over age 40. The variability of the course is evident as some individuals

recover fully after one episode, others exhibit a fluctuating period of weight gain followed by relapse, and some experience a chronically deteriorating course of the illness over many years (American Psychiatric Association, 2000). Studies have shown that a clinically significant number of individuals with the restrictive subtype will develop binge eating behaviors within five years of AN onset, warranting a change of diagnosis to binge-eating/purging subtype (American Psychiatric Association, 2000).

Current prevalence rates of AN in females range from 0.3 to 0.4%, with an incidence of eight per 100,000 individuals each year (American Psychiatric Association, 2013; Hoek, 2006). In terms of gender-based discrepancies, population samples may demonstrate a 10:1 female-to-male ratio (American Psychiatric Association, 2013a). AN has the highest mortality rate of any psychiatric illness, the most recent statistics indicating mortality at over 10%, typically from starvation, suicide, or electrolyte imbalance (American Psychiatric Association, 2000; Vitiello & Lederhendler, 2000). Mortality rates as reported in the literature range between 0% to 21%, with 0.5% to 1% per year of observation (Herzog, Rathner, & Vandereycken, 1992). A more recent longitudinal study of mortality in eating disorders identified a mortality rate of 4.0% in individuals with AN (Crow et al., 2009). Death may occur as a result of suicide (indicated in ½ to ⅓ of patients), extreme emaciation, inappropriate use of medications (e.g., laxatives and/or diuretics), and/or pathologic eating habits (e.g., electrolyte changes following vomiting; Herzog et al., 1992).

There is evidence in the literature of numerous comorbidities with AN psychopathology, including disorders of mood, anxiety, substance use, and personality. The most commonly reported comorbidity is associated with elevated rates of depressive disorders. Prevalence rates reported in the literature pertaining to Major Depressive Disorder (MDD) are quite inconsistent,

with lifetime prevalence rates ranging from 9.5% to 64.7% in individuals with AN Restricting Type, and from 50% to 71.3% in patients with AN Binge-Eating/Purging Type (Godart et al., 2007). This variance may be related to the particular studies' sample size, and whether DSM-III, DSM-III-R, or DSM-IV diagnostic criteria were employed. According to the American Psychiatric Association (2000), mood symptomatology characterized by depressed mood, social withdrawal, irritability, insomnia, and/or sexual disinterest is indicated in significantly underweight individuals with AN. In light of these findings, clinicians are urged to complete thorough assessments and consider various differential diagnoses as many of the presented depressive features may be secondary to the physiological sequelae of starvation.

Prominent rates of anxiety disorders have also been indicated in young adult females diagnosed with AN. A review of the literature has identified lifetime prevalence rates of anxiety disorders in individuals with AN ranging from 23% to 54% (Godart, Flament, Perdereau, & Jeammet, 2002), the most common of which is reported as being Social Phobia (Fornari et al., 1992; Jordan et al., 2008; Laessle, Wittchen, Fichter, & Pirke, 1989). Obsessive-Compulsive Disorder (OCD) is also frequently diagnosed in patients with AN (Kaye, Bulik, Thornton, Barbarich, & Masters, 2004; Thornton & Russell, 1997). As previously mentioned, careful delineation of differential diagnosis is warranted in order for the clinician to assess the quality of the obsessions and compulsions, which may or may not be related to food. Individuals with AN may present with obsessive tendencies manifested in a preoccupation with thoughts about food, collecting recipes, and hoarding food, which may be caused or exacerbated by undernutrition (American Psychiatric Association, 2000), a type of malnutrition related to inadequate food intake or inability to efficiently process certain nutrients. The American Psychiatric Association (2000) also suggests that individuals with AN demonstrate concerns about public eating, general

ineffectiveness, need for environmental control, rigid thinking, restricted social spontaneity, perfectionism, and overly restrained initiative and emotional expression.

Finally, elevated rates of substance use and personality disorders are indicated in individuals with AN. Individuals with the bing-eating/purging subtype of AN may have a greater likelihood of presenting with impulse control problems, alcohol and/or substance abuse, mood lability, increased sexual activity, and greater frequency of suicide attempts. In addition, personality disturbance such as Borderline Personality Disorder has also been associated with this clinical population (American Psychiatric Association, 2000). In consideration of the negative outcomes and trajectories identified in the literature on the prevalence, course, and comorbidities of AN, a focus on effective treatments is deemed paramount.

**Clinical Outcomes of Anorexia Nervosa**

Prognostic indicators may also be related to clinical outcomes, which are quite variable in this patient population (American Psychiatric Association, 2000). A review of the literature suggests that the evidence base for psychological treatments of AN is strikingly scarce. Considerably few randomized controlled trials (RTCs; considered the optimal method for assessing intervention effectiveness) have been conducted related to AN, and those that have present with mixed results (Watkins, 2011). Despite the limited collection of evidence-based treatments for AN, a number of interventions are presented in the literature. During the acute illness phase of AN, specialist supportive clinical management is more effective than both Cognitive Behavioral Therapy (CBT) and Interpersonal Psychotherapy (IPT; McIntosh et al., 2005). Cognitive Analytic Therapy (CAT), Focal Psychodynamic Therapy (FPT), and family therapy demonstrate greater efficacy in producing weight gain, restoring menstruation, and reducing bulimic symptoms of AN binge-eating/purging type when compared to control

treatments (Dare, Eisler, Russell, Treasure, & Dodge, 2001). Additionally, patients who are not acutely underweight demonstrate better outcomes and extended time to relapse after receiving CBT compared to nutritional counseling (Pike, Walsh, Vitousek, Wilson, & Bauer, 2003).

## Chapter II: Review of the Literature on Anorexia Nervosa and Executive Functioning

The origin of AN psychopathology is multifactorial and associated with various biopsychosocial risk factors. A variety of conceptual models of AN development and maintenance have been proposed, including those grounded in sociocultural theories (Groesz, Levine, & Murnen, 2002; Nasser, Katzman, & Gordon, 2001; Rieger, Touyz, Swain, & Beaumont, 2000; Stice, 2002), genetic factors (Bulik, Sullivan, Wade, & Kendler, 2000; Strober, Freeman, Lampert, Diamond, & Kaye, 2000), perinatal influences (Cnattingius, Hultman, Dahl, & Sparen, 1999; Favaro, Tenconi, & Santonastaso, 2006), puberty (Connan, Campbell, Katzman, Lightman, & Treasure, 2003; Watkins, 2011), psychodynamic theories (Bruch, 1973, 1974; Goodsitt, 1985; Minuchin, Rosman, & Baker, 1978; Palazzoli, 1974; Watkins, 2011), family/systemic theories (Eisler, 1995; Minuchen et al., 1975), cognitive behavioral theories (Fairburn, 1997; Fairburn, Shafran, & Cooper, 1999; Fairburn et al., 1995; Garner & Bemis, 1982; Shafran, Cooper, & Fairburn, 2002; Slade, 1982; Sullivan, Bulik, Fear, & Pickering, 1998; Vitousek & Hollon, 1990; Watkins, 2011; Williamson, 1996), and aspects of personality (Anderluh, Tchanturia, Rabe-Hesketh, & Treasure, 2003; Cassin & von Ranson, 2005; Claes, Vandereycken, & Vertommen, 2002; Fahy & Eisler, 1993; Grilo et al., 2003; Halmi et al., 2000; Narduzzi & Jackson, 2000; Newton, Freeman, & Munro, 1993; Rossier, Bolognini, Plancherel, & Halfon, 2000; Srinivasagam et al., 1995; Steiger, Jabalpurwala, Champagne, & Stotland, 1997; Tyrka, Waldron, Graber, & Brooks-Gunn, 2002; Watkins, 2011), each of which consider specific predisposing, precipitating, and perpetuating factors.

Eating disorders are complex in nature, consisting of biological, psychological, and sociocultural components. Researchers exploring the biological domain have conceptualized AN in the literature as a neuropsychiatric disorder. Refined neuroscientific approaches have revealed

neural circuit abnormalities and dysfunction in this clinical population, which have implications for the understanding of AN development, and perhaps more importantly, its treatment. Impairments in cognitive performance, including executive and visuospatial functioning deficits, have been indicated in individuals with AN, ultimately impacting their ability to engage in traditional therapeutic interventions. This finding may subsequently be associated with poor prognosis and clinical outcomes, in addition to the previously described lack of evidence-based treatments. In consideration of these significant factors, a neuroscience-based conceptual model of AN (that implicates executive functioning), neuroimaging, neurochemical, and neuropsychological studies will be reviewed, followed by a summary of the main findings.

**Review of a Neuroscience-Based Conceptual Model of Anorexia Nervosa that Implicates Executive Functioning**

Nunn, Lask, and Frampton (2011) have developed and proposed a neuroscience-based conceptual model of AN, which includes frontal/executive functioning components. These researchers note that while malnutrition contributes to certain AN symptomatology, including concentration and memory deficits, it fails to account for much of the clinical phenomena. Impaired neuroplasticity represents a prominent component of their etiological model, which suggests that AN be explained in terms of neural circuit abnormality, and more specifically, dysfunction located to the insula. Premorbid dysregulation in various brain systems, including those involving noradrenergic, anticholinergic, serotonergic, and glutamate, may result in neuroplasticity impairments within the insula. These researchers also posit that individuals with AN may have a reduced capacity to respond to the neuroplastic demands of puberty. Neuroplasticity impairment contributes to insula dysfunction, and as a result, AN may be conceptualized as a physiological, psychological, and behavioral manifestation of insula neural

circuit abnormality. Insula dysfunction is thus reported to play a prominent role in AN, implicating numerous neurological systems including the frontal lobe, subsequently contributing to executive functioning deficits. Based on their model, various neuropsychological interventions are recommended to alleviate respective frontal deficits. Specifically, cognitive remediation therapy (CRT) is cited as a treatment that may assist in improving the executive impairments, viosuopatial memory, and weak central coherence indicated in the AN population (which is later reviewed).

**Review of Frontal Lobe Neuroimaging Studies of Anorexia Nervosa**

The behavioral symptomatology of AN (see *Behavioral Components of Anorexia Nervosa* for detailed information), including caloric restriction and purging by means of induced vomiting, laxatives, diuretics, and enemas, can result in physiological disturbances in numerous organ systems, further evidenced in abnormal laboratory findings (Fuglset & Frampton, 2011). One such organ system impacted by these behaviors is the central nervous system, and in particular, the brain. Fuglset and Frampton (2011) suggest that structural and functional imaging techniques can provide valuable information on the impact of AN on the brain, and test theories associated with the etiology and consequences of disordered eating. Moreover, they note that imaging techniques may eventually be utilized as an outcome measure of specific AN treatments.

**Structural imaging.** Starving the body will inevitably starve the brain, the effects of which can be examined by means of structural imaging methods, including computerized tomography (CT) and magnetic resonance imaging (MRI) techniques. The clinical features of AN may be attributed to brain structure changes, secondary to severe malnourishment (Fuglset & Frampton, 2011). Studies employing imaging methods seek to examine relationships between brain structure and the psychological and behavioral symptomatology characteristic of AN (i.e.,

elucidation of brain-behavior relationships). Structural neuroimaging has been utilized to evaluate regions of the brain containing myelin-rich bundles of axons (white matter) and areas comprising dense connections between neuronal cell bodies (grey matter). In particular, these imaging techniques have provided information regarding the extent to which white matter is reduced as a result of starvation and then recovered following weight restoration, in addition to the impact of malnourishment on grey matter (Fuglset & Frampton, 2011).

CT imaging techniques have been utilized to examine overall brain structure and volume in individuals presenting with AN symptomatology. Numerous studies have produced results indicating an overall reduction in brain volume in individuals with AN. Specifically, enlarged ventricles and expanded sulci have been identified in comparison to healthy controls (Artmann, Grau, Adelmann, & Schleiffer, 1985; Dolan, Mitchell, & Wakeling, 1988; Kohlmeyer, Lehmkuhl, & Poutska, 1983; Kornreich et al., 1991; Krieg, Pirke, Lauer, & Backmund, 1988), in addition to significant enlargement of the inter-hemispheric fissure (Artmann et al., 1985; Kohlmeyer et al., 1983). In addition to the increased size of these regions, various reductions in brain matter have also been documented in individuals with AN. Specifically, cerebral atrophy and loss of neuronal cell bodies (grey matter) have been reported in patients with AN in comparison to healthy control groups (Fuglset & Frampton, 2011). A reduction in the density of synaptic connections between soma (white matter) has also been reported in structural imaging studies (Fuglset & Frampton, 2011).

The extent to which the aforementioned brain changes reverse with nutritional restoration represents an interesting question posed in AN CT imaging studies. Fuglset and Frampton (2011) suggest that in a majority of cases, expansion of ventricles, sulci, and interhemispheric fissure seem to improve with weight restoration. Additionally, the reversal of concurrent

cerebral atrophy in white and grey matter has been associated with weight gain in a significant number of cases. However, no correlation has been reported in the literature between the level of ventricular enlargement and duration of illness on an individual with AN's cognitive assessment performance (Fuglset & Frampton, 2011).

Research utilizing MRI techniques have corroborated results from previous CT studies. One such confirmed finding involves the presence of significantly larger ventricles and sulci on cortical surfaces in patients with low-weight AN in comparison to controls (Golden et al., 1996; Katzman et al., 1996; Kingston, Szmukler, Andrewes, Tress, & Desmond, 1996; Swayze et al., 1996). The reversibility of acute demyelination due to severe malnourishment has also been confirmed in MRI research (Katzman, Zipursky, Lambe, & Mikulis, 1997). Lambe, Katzman, Mikulis, Kennedy, and Zipursky (1997) reported that grey-matter volume deficits persist in weight-recovered AN patients, concluding that an irreversible component to certain structural brain changes is associated with this diagnosis. McCormick et al. (2008) noted that structural neuroimaging has identified a relationship between reduced right dorsal anterior cingulate cortex volume and deficits in perceptual organization and conceptual reasoning in patients with AN. Additionally, a number of participants in their study demonstrated normalization of this brain region following weight restoration, and higher rates of relapse were indicated in those that did not.

In addition to providing valuable information related to AN psychopathology, numerous clinical implications can be elicited from research utilizing structural imaging techniques. As previously identified, malnourishment may directly contribute to quantifiable changes in brain structure in patients with AN. Though some structural improvement in ventricular and sulcal volumes have been identified post treatment, it is not found in many cases, and while

conceivable improvements in white matter mass is encouraging, the failure of gray matter to return to pre-illness levels is of significant concern (Fuglset & Frampton, 2011). Moreover, an individual's absolute lowest weight, as opposed to duration of AN, has been identified as the primary factor in determining structural brain outcome post weight-restoration treatment, which may have implications for AN treatment and refeeding regimens (Fuglset & Frampton, 2011).

**Functional imaging.** In contrast to structural imaging methods, which utilize x-ray-based techniques to reveal brain formations, functional imaging depicts brain changes associated with the metabolism of glucose and oxygen in specific brain regions (Sternberg & Sternberg, 2012). Examining the functionality of the brain, by means of positron emission tomography (PET), functional magnetic resonance imaging (fMRI), and single-photon emission computed tomography (SPECT), has significant implications.

Positron emission tomography (PET) involves injecting glucose labeled with a radioactive tracer into the bloodstream, the metabolism of which is then monitored with a scintillator (Lezak, Howieson, Bigler, & Tranel, 2012). In comparison to controls, AN patients demonstrate both global and regional glucose hypometabolism (decreased glucose metabolism) (Delvenne et al., 1996). It is suggested in the literature that this may occur as a result of neuroendocrinological or morphological aspects of AN, secondary to altered neurotransmitter activity associated with a deficient nutritional state (Fuglset & Frampton, 2011). Delvenne et al. (1995) identified that patients with AN evidence frontal cortex hypometabolism, and thus suggest that a primary corticocerebral dysfunction is associated with this diagnosis. The different AN subtypes previously discussed, including the Restricting and Binge-Eating/Purging Types, may also experience distinctive patterns of altered neurotransmitter activity (Bailer et al., 2005). PET studies have confirmed that altered serotonin and dopamine functioning is a central

component of AN. Results from research utilizing these techniques have suggested that dysfunction in dopamine circuits might contribute to altered executive control, reward-processing, and decision-making (Kaye, Fudge, & Paulus, 2009).

Single photon emission computed tomography (SPECT) images brain metabolism in a manner similar to PET, but is considerably less expensive and utilizes a more convenient contrast agent (Lezak et al., 2012). Research utilizing this technique has identified diffuse bilateral hypoperfusion (decreased blood flow through an organ) in frontal regions in AN patients pre-treatment (Karuoglu et al., 1998). These findings were no longer evident in either left or right hemisphere three months post-treatment, which has implications for predicting patient response to therapy and treatment follow-up assessment. In a comparison between AN Restricting Type, Binge-Eating/Purging Type, and controls, Naruo et al. (2000) identified that the Binge-Eating/Purging Type presented with considerably greater changes in prefrontal brain areas.

Dysfunction in neuronal circuitry related to AN has also been identified in a number of studies utilizing functional imaging methods, including the presence of discernable hypoperfusion in the orbital frontal brain region (Key, O'Brian, Gordon, Christie, & Lask, 2006; Rastam et al., 2001). A number of functional imaging studies have also noted significantly reduced blood flow in the frontal brain region, particularly the bilateral anterior cingulate gyrus (Beato-Fernandez et al., 2009; Nozoe et al., 1995; Yonezawa, Otagaki, Miyake, Okamoto, & Yamawaki, 2008) and medial prefrontal cortex (Takano et al., 2001).

Functional magnetic resonance imaging (fMRI) is a technique that identifies activated brain regions related to specific neuropsychological functions, by means of measuring BOLD signal differences (variances in oxyhemoglobin versus deoxyhemoglobin following oxygen

metabolism; Lezak et al., 2012). fMRI research conducted by Ellison et al. (1998) identified a neural response in individuals with AN demonstrating "calorie fear" analogous to that of those with simple phobias when confronted with the phobic stimuli (activation of the anterior cingulate and left insula brain areas). Their research also identified a relationship between caloric fear and increased activation in the left Hippocampal-Amygdala Formation (HAF) in the AN population, which they suggest may mediate a conditioned fear to high-calorie foods (Ellison et al., 1998). Functional imaging studies utilizing fMRI methods to compare food-image associated neural activity in women recovered from AN, currently ill patients, and healthy controls, have concluded that brain activity in recovered women represents a combination of responses present in both of the other groups (Uher et al., 2003). Based on this finding, researchers concluded that an underlying trait vulnerability remains post weight-restoration, possibly related to an alternative neural substrate for the acute low-weight phase in AN.

Literature on fMRI studies has sought to examine the abnormal medial prefrontal circuit activation identified in disorders of eating, addiction, and obsessive-compulsiveness, with the potential to account for the common compulsive behaviors characteristic of these clinical presentations. Uher et al. (2004) suggested that the common neural response is potentially due to a common underlying "transdiagnostic" factor. Caloric restriction behaviors in AN may be facilitated by decreased food-related somatosensory processing when satiated, and attentional processing biasing when hungry (Santel, Baving, Krauel, Munte, & Rotte, 2006). fMRI may also assist researchers and clinicians in developing a more accurate understanding of body image disturbances, as studies have found that patients with AN utilize a different visuospatial system when processing their physical self-image (Wagner, Ruf, Braus, & Schmidt, 2003). The self-image distortion characteristic of AN psychopathology may also relate to discrepant emotional

and perceptual processing (Sachdev, Mondraty, Wen, & Gulliford, 2008). Difficulties in identifying the emotional significance of a particular stimulus (impairment in positive and negative feedback discrimination), even after having recovered from AN, impacts the reward system and may represent a predisposing factor to AN development (Wagner et al., 2007). The unique neural activation patterns identified in recovered AN patients suggests that they may process taste stimuli in a manner different than controls (Wagner et al., 2008). A study conducted by Marsh, Maia, and Peterson (2009) utilizing functional imaging methods, identified that impaired set-shifting related to AN prefrontal circuits, seems to relate to reduced activation in the ventral anterior cingulate-straito-thalamic loop. Research utilizing functional imaging has also provided valuable information regarding the neurochemistry of AN, elucidating clinically significant findings unique to this psychiatric diagnosis. Dopamine, serotonin, acetylcholine, nitric oxide, and noradrenalin have been cited as specific neurochemicals with unique characteristics in this population. According to Nunn (2011), the dopaminergic functions especially pertinent to AN involve movement and motivation, with excessive and reduced neurotransmitter activity relating to agitation/motor restlessness and anergia/Parkinsonian symptoms, respectively. The quantity of serotonin, a derivative of carbohydrate, decreases as a result of carbohydrate restriction (Nunn, 2011). Moreover, PET research examining underweight patients with AN has identified reduced concentrations of serotonin in their cerebrospinal fluid (Kaye et al., 2005). The fact that there is no serotonin available for an SSRI to effect, aids in the understanding of SSRI ineffectiveness while malnourished. Starvation also leads to instability of the brain's calming system, which in turn may become over or underactive. Acetylcholine overactivity in AN results in slowing of heart and respiration rates, which leads to decreases in temperature and blood pressure. Impaired visual memory retrieval often identified in AN, may

also relate to changes in acetylcholine (Nunn, 2011). The effects of nitric oxide may also be relevant in the understanding of AN psychopathology, specifically in regard to the clinical presentation of preoccupation with the body as a whole or specific areas. Nunn (2011) points out that the process of thinking about a specific region of the body leads to vasodilation in that area and at the location of its cortical representation. Finally, excessive noradrenalin, a neurotransmitter critical to the fight or flight system (Bremner, Krystal, Southwick, & Charney, 1996), may represent an essential factor in the pathogenesis of AN (Urwin & Nunn, 2005).

Functional imaging studies have clearly contributed to the understanding of AN psychopathology and brain functioning, and as a result, numerous clinical implications have been derived. Persistent cognitive deficits identified in this population, indicated by functional imaging studies, may contribute to the development of specific treatment approaches for deficits in set-shifting, emotional-awareness, and food-related risk/reward decisions, potentially utilizing cognitive remediation therapy (CRT; Fuglset & Frampton, 2011).

**Review of Executive Functioning Neuropsychological Studies of Anorexia Nervosa**

The study of clinical neuropsychology involves assessing the relationship between brain pathology and behavior utilizing standardized assessment measures (Lezak, Howieson, & Loring, 2004). According to Steinglass and Glasofer (2011), the use of neuropsychological testing to study eating disorders, such as AN, is a relatively new field beginning in the late twentieth century. Various studies have identified cognitive deficits in AN sufferers, however, results have been somewhat inconsistent in terms of which specific variables are implicated in the development and/or maintenance of AN (Lena, Fiocco, & Leyanaar, 2004). Certain deficits in cognitive functioning identified while an individual with AN is significantly underweight may improve following weight normalization, whereas others seem to persist (Lauer, Gorzewski,

Gerlinghoff, Backmund, & Zihl, 1999; Mikos et al., 2008). For example, though attention tends to improve, deficits in visuospatial processing and executive functioning abilities endure (Kingston, Szmukler, Andrewes, Tress, & Desmond, 1996; Tchanturia et al., 2004). The neuropsychological literature on AN executive functioning is henceforth discussed.

**Executive functioning.** Neuropsychological studies of AN have provided valuable information regarding the relationship between brain functioning and observable behaviors unique to this diagnosis. Individuals meeting diagnostic criteria for AN present with rigid and maladaptive behaviors which they seem incapable of altering, despite external pressure (Steinglass & Glasofer, 2011). When viewed in the context of brain functioning, these symptoms bring executive processes into consideration. Several abilities within this domain have been found to be impaired in AN patients, including cognitive flexibility/rigidity and divided attention, which lead to symptoms of impaired set shifting (i.e., perseveration). Cognitive flexibility involves the ability to cognitively or behaviorally shift between mental sets (Steinglass & Glasofer, 2011), and impairment within this domain is considered a pertinent clinical feature of AN. Studies of this construct, utilizing the Trail Making Test, a measure of ability to divide attention involving timing of shifting mental sets, have identified that individuals with AN make significantly more perseveration errors on Trails B (Roberts, Tchanturia, & Treasure, 2010; Steinglass, Walsh, & Stern, 2006). Trails B is a subtest which requires the examinee to draw a line alternating between categories, such as numbers and letters, as quickly as possible (Arbuthnott & Frank, 2000). AN patients also demonstrate rigidity on the Wisconsin Card Sorting Test (WCST; Fassino et al., 2002; Nakazato et al., 2009; Roberts et al., 2010; Steinglass et al., 2006), an untimed measure of cognitive flexibility, which involves matching cards from a deck to one of four key cards according to the examiner's feedback (Lezak et al., 2012). There is

evidence in the literature that AN patients correctly match fewer cards, thereby achieving what is termed "fewer categories of classification" (Fassino et al., 2002). Based on these findings, researchers have suggested an association between AN psychopathology and difficulties in identifying and switching to new matching rules. A meta-analysis conducted by Roberts, Tchanturia, Stahl, Southgate, and Treasure (2007) integrated data from all existing studies consisting of a set-shifting task, ultimately corroborating the presence of such deficits in AN. Moreover, clinically observed inflexibility in AN patients is consistent with these neuropsychological findings (Roberts et al., 2007).

Impulsivity and decision-making processes have also been found to be impaired in the AN population. Engagement in behaviors with maladaptive outcomes is considered a standard feature of behavioral disorders (Steinglass & Glasofer, 2011). Studies have reported that individuals with AN typically exhibit less impulsive behavior, and that members of this population demonstrate implicit learning difficulties that lead to disadvantageous responding (Cavedini et al., 2004; Tchanturia et al., 2004), which may be related to the previously discussed deficits in set-shifting.

**Visuospatial processing.** Visuospatial processing involves the ability to perceive and organize visual images, and deficits within this cognitive domain have been identified in the AN population (Murphy, Nutzinger, Paul, & Leplow, 2004; Szmukler et al., 1992), which persist following weight-gain (Braun & Chouinard, 1992; Mathias & Kent, 1998). Evidence in the literature suggests that individuals with AN demonstrate impairments in "central coherence" as they often emphasize details above overarching context (Steinglass & Glasofer, 2011). A tendency to process information in this manner is evidenced clinically as these patients present as

excessively focused on calories, body image/weight, and excessive exercise (Lopez et al., 2008).

Steinglass and Glasofer (2011) deny the presence of a perceptual deficit in this clinical population, instead suggesting that they employ problem solving strategies that overly emphasize details, which may relate to complex visual memory or visuospatial manipulation abnormalities. They suggest that these findings are consistent with clinical observations of AN patients as being detail-oriented, evidenced by their excessive focus on counting calories, exercise schedules, and body shape (Lopez et al., 2008), which is also consistent with diagnostic criteria (American Psychiatric Association, 2000; American Psychiatric Association, 2013a). Moreover, the weak central coherence identified in AN patients implies that they experience poor global processing (Lopez et al., 2008), which involves accurately perceiving the gestalt, or larger picture (Lezak et al., 2012). These deficits in visuospatial processing remain following normalization of weight, and have been noted as an area of interest in AN research and treatment.

**Summary of Main Findings**

AN has been conceptualized in the literature as a neuropsychiatric disorder, which is supported by neuroscientific research identifying neural circuit abnormalities unique to this clinical population. Insula dysfunction attributed to neuroplasticity impairment is deemed a central contributor to AN symptomatology, which implicates the frontal lobe and contributes to executive functioning deficits. Structural imaging methods utilizing computerized tomography (CT) and magnetic resonance imaging (MRI) techniques have produced results indicating an overall reduction in brain volume in individuals with AN, which may relate to the diagnosis' clinical features. Functional imaging techniques including positron emission tomography (PET),

functional magnetic resonance imaging (fMRI), and single-photon emission computed tomography (SPECT), have identified frontal cortex hypometabolism (decreased glucose metabolism) and hypoperfusion (decreased blood flow) in patients with AN, in addition to discrepant emotional and perceptual processing, and utilization of a different visuospatial system when processing their physical self-image. Frontal lobe neurochemical studies of AN have reported that dopamine, serotonin, acetylcholine, nitric oxide, and noradrenalin have unique characteristics in this clinical population. Neuropsychological studies of individuals presenting with AN have identified deficits in executive functioning (primarily involving set-shifting) and visuospatial processing abilities (characterized by an excessive focus on details), both of which endure following weight-gain treatment. These symptoms are clinically evidenced by rigid and maladaptive behaviors, and an excessive focus on calories, body image/weight, and/or excessive exercise. Moreover, impairments in cognitive performance, including executive functioning deficits and maladaptive thinking styles, may significantly impact AN patients' ability to engage in traditional therapeutic interventions, suggesting a need for novel approaches. Considering that these findings are associated with the development and maintenance of AN, clinical outcomes may improve if treatments focus on remediating these specific cognitive issues.

## Chapter III: Review of the Literature on Cognitive Remediation Therapy, an Evidence-Based Treatment that Addresses Executive Functioning Deficits in Anorexia Nervosa

Effective treatment of AN can be challenging, which is reflected in research documenting poor prognosis for AN sufferers. According to Lindvall & Lask (2011), this challenge may be partially explained by a failure to address the underlying neurobiological contribution to AN's etiology and maintenance in most existing treatment techniques (i.e., insula dysfunction). As previously reviewed, evidence in the literature has identified that AN patients demonstrate dysfunction in various cognitive domains (Brewerton, Frampton, & Lask, 2009; Frampton & Hutchinson, 2007). Executive functioning deficits are noted as those most commonly reported, and are least likely to resolve following nutritional stabilization (Lindvall & Lask, 2011). Specific executive functioning difficulties relate to set-shifting (difficulty with flexibility and considering alternatives; Roberts et al., 2007; Tchanturia, Davies, & Campbell, 2007), weak central coherence (difficulty perceiving the bigger picture; Lopez, Tchanturia, Stahl, & Treasure, 2008), and visuospatial impairments (distorted perception of body shape; Lask et al., 2005; Lena, Fiocco, & Leyenaar, 2004). Impaired set-shifting contributes to concrete and rigid approaches to problem solving (poor cognitive flexibility) in addition to persistent maladaptive cognitions and behaviors (Lindvall & Lask, 2011). Central coherence relates to the tendency of AN patients to focus on fine details while neglecting general context, and may be related to a preoccupation with detail, order, and symmetry (Gillberg, Gillberg, Rastam, & Johansson, 1996; Lopez, Tchanturia, Stahl, & Treasure, 2008). As previously described, this cognitive process manifests clinically in disproportionate attention to body weight/shape and calories. Additionally, studies have identified persistently impaired visual memory and spatial processing

in AN patients, (Brewerton, Frampton, & Lask, 2009), which researchers suggest may contribute to symptomatology associated with distorted body image.

Cognitive Remediation Therapy (CRT), a neuropsychological treatment paradigm, has evidenced potential to strengthen, refine, and create neural connections, ultimately improving cognitive performance. CRT can be tailored to remediate the maladaptive cognitive processes and neuropsychological deficits commonly associated with the disorder (Lindvall & Lask, 2011). Principles underlying and delivery of CRT, treatment goals related to executive functioning rehabilitation, CRT applications specific to executive functioning, and outcome literature will be reviewed.

**Principles of Cognitive Remediation Therapy**

CRT is designed as an interactive treatment focused on addressing cognitive processes as opposed to specific thought content (Lindvall & Lask, 2011). The clinician does not discuss or explore themes such as body weight and diet, and if patients wish to describe such issues, they are explored within the framework of cognitive appraisals. This emphasis assists AN patients in developing a metacognitive awareness of their thinking style. The aim of CRT is to identify and target the patient's unique cognitive difficulties while supporting their engagement in metacognitive processes. The patient begins to evaluate their cognitive style and explore alternative thinking strategies, which may ultimately lead to behavioral change. New strategies may develop as the patient becomes increasingly cognizant of problematic thinking styles that affect their functioning, and ultimately, overall wellbeing. These novel techniques are then practiced during treatment and related to the patient's daily functioning, in order to increase ecological validity. Additionally, CRT is conceptualized as an adjunctive, as opposed to a primary, treatment modality of AN. While amending cognitive processes represents the focus of

CRT, the specific content of patients' thoughts, including affectively laden material (e.g., body shape, calories, etc.) is processed in adjunctive or subsequent therapies (Tchanturia et al., 2008).

**Delivery of Cognitive Remediation Therapy**

The delivery of CRT to patients presenting with AN symptomatology may be accomplished through three modes of delivery; individual, group, and/or family therapy sessions (Lindvall & Lask, 2011). The treating clinician may decide to incorporate CRT via individual format when treatment indicates an in-depth exploration of the patient's cognitive styles and difficulties. Alternatively, group-based interventions are recommended when the clinician needs to maximize time and resources, foster peer-group support, and enrich moral in a treatment milieu. Finally, CRT delivered via family therapy serves to increase family members' understanding of the patient's unique difficulties (Lindvall & Lask, 2011).

The CRT manual for AN treatment developed by Tchanturia, Davis, Reeder, and Wykes (2010), proposes that individual CRT be delivered through 10 weekly or biweekly 30 to 40 minute sessions. They report that the clinician will choose between two treatment approaches when deciding upon which specific domain(s) to focus. The first approach is for the AN patient to initially complete neuropsychological testing (utilizing the Ravello Profile, a neuropsychological test battery for AN; Stedal, Frampton, Landro, & Lask, 2012), the results of which guide task and puzzle selection. Treatment begins with easier exercises, gradually increasing the level of difficulty. The researchers note that by selecting this method, the CRT program will be individually tailored, evidence-based, and address the core features of the patient's cognitive process. An alternative approach is to assess neurocognitive abilities clinically throughout the course of CRT. This approach is recommended if the patient evidences

extreme rigidity despite scoring in the normal range on tests assessing executive functioning (particularly while completing tasks involving cognitive flexibility and set-shifting).

Lindvall and Lask (2011) suggest that the concept of neuroplasticity provides a theoretical rationale for emphasizing a metacognitive perspective as a core component of CRT for AN. Specifically, the patient's existing neural circuits may be strengthened and novel ones generated as they reflect upon their cognitive approaches, identifying ineffective strategies and developing alternative skills. These researchers further suggest that if a patient presenting with AN develops an understanding of their processing style and its subsequent influence on their daily functioning, they might become better able to change maladaptive symptoms associated with their diagnosis. Questions designed to encourage metacognitive reflections, identified by Lindvall & Lask (2011), include:

1) What did you think of this task?
    a. Was it easy or difficult?
    b. In what way was it easy/difficult?
    c. Did you like it/dislike it?
2) How did you go about trying to solve it?
    a. Did you use any particular strategy/technique/trick?
    b. How did that particular strategy/technique/trick work for you?
    c. Could you have completed it in a different way?
    d. What would have been different if you had chosen a different strategy/technique/trick?
    e. If you had been given the same task again, how would you have tackled it?

3) Did you learn anything about your own thinking style while tackling this task/puzzle/game?
    a. If yes, what did you learn?
4) Would you say that this particular thinking style is one that you use in other areas of your life as well (outside therapy sessions)?
    a. Can you give me an example of an event or a situation where you might use the same 'thinking style' or the same strategy/technique/trick in your daily life?
    b. What usually happens when you use that strategy/technique/trick in your daily life?
    c. What do you think would happen if you did?
    d. What do you think are the pros and cons of each strategy/technique/trick? (p. 203)

An integral component of CRT is to explore how knowledge that the patient develops during sessions may be translated to their daily functioning, in order to increase its practical application. This may be accomplished by means of assigning between session homework, in the form of behavioral experiments designed to assist the patient in exploring and implementing adaptive alternative strategies. Examples of homework, identified by Lindvall & Lask (2011), include:

1) When you get dressed, put on your clothes in a different order than usual.
2) Try describing the route from home to school/work/the store/your favorite café to someone else.
3) Create a new music playlist and listen to this instead of your old one.
4) Choose a different route when visiting a friend or going to school or work.

5) Brush your teeth with your nondominant hand.
6) Read a newspaper or magazine starting from the back instead of the front.
7) Wear your watch on the other wrist for a day.
8) Watch a movie and describe the plot to a family member of friend using no more that five sentences.
9) Describe yourself by first writing a short story about yourself, then shorten it down to a few sentences, and finally, summarize the text in a few words. (p. 204)

**Treatment Goals Related to Executive Functioning Rehabilitation**

Specific treatment goals identified in CRT sessions include: (a) identify the patient's cognitive style(s) and acknowledge the strengths and weaknesses of these during information processing; (b) challenge ineffective thinking patterns and explore new ways of thinking; (c) promote thinking about thinking (metacognition), and; (d) implement small behavioral changes as a result (Tchanturia et al., 2010). Increasing and enhancing cognitive flexibility, global information processing, visuospatial abilities, and metacognitive processes represent treatment goals specifically related to executive functioning rehabilitation. A detailed description of various CRT techniques specific to accomplishing these goals follows.

**Cognitive Remediation Treatment Applications Specific to Executive Functioning**

**Cognitive flexibility.** Difficulties related to cognitive flexibility may be characteristic of AN presentation. Thus, at the onset of CRT, the clinician should collate quantitative and qualitative data that best accounts for the patient's ability to shift between mental categories, rules, and behaviors. The acquisition of quantitative data may be accomplished through conducting baseline neuropsychological testing, for example, administering measures of set-shifting ability such as Trails B, WCST, and/or Stroop. Utilizing standardized self-report

questionnaires that measure executive dysfunction in day-to-day life may also be of value, such as the Barkley Deficits in Executive Functioning Scale (BDEFS; Barkley, 2011) or the Behavior Rating Inventory of Executive Function (BRIEF; Gioia & Isquith, 2011). Integrating qualitative information through inquiring about patients' capacity to multitask may also enhance clinicians' understanding of their specific difficulties. If concerns related to cognitive flexibility are identified (e.g., if evident on testing, or if the patient endorses difficulties with multitasking or adapting behaviors to new rules), their everyday impact should be discussed (Lindvall & Lask, 2011). CRT interventions designed to address cognitive flexibility begin by the clinician instructing the patient to solve various tasks or play various games that require flexibility in thinking. If the patient evidences difficulties in completing these tasks, he/she and the clinician work collaboratively to consider what it is about the task that makes it difficult to solve and how it might be solved in an alternative or more efficient way. Pros and cons of the varying strategies are then identified and related to both the task itself and to the patient's daily functioning.

Two CRT interventions developed to assess and enhance cognitive flexibility include "Token Tower" and "Up & Down" (Lindvall & Lask, 2011). The aim of the Token Tower is for the patient to construct a tower consisting of building 'blocks' representing tokens of various shapes, sizes and colors, with the purpose of practicing set-shifting while building the tower. The clinician initiates this activity by laying down the first token using an unspoken rule based on the token's color, size, and/or shape. The patient then identifies what rule is being used, following the rule until the therapist changes the pattern by which the tower has been constructed. As described earlier, the clinician focuses on the process of completing the task, not on obtaining immaculate task performance. The Token Tower is considered a relatively simple activity where turn-taking, set-shifting, and multitasking abilities are established, practiced, and

reflected upon, with an eventual goal of identifying and evaluating the effectiveness of the cognitive processes employed by the patient. Moreover, the clinician supports the client's development of metacognition by discussing what made that exercise particularly challenging, how it might have been solved in an alternative or more efficient manner, and the effects of varying cognitive styles on daily functioning.

The purpose of Up & Down, a second CRT application tailored to executive functioning remediation, is for the patient to practice set-shifting following two different arrow directions (e.g., up or down). During this activity, the clinician presents the patient with a picture and provides the following instructions:

> The picture shows a monkey climbing up and down a palm tree. I want you to tell me how he climbs (up or down) by starting counting in the upper-left corner. Start with 1, and keep counting upwards until you encounter an arrow. When you encounter an arrow, instead of keeping counting, state the directing in which the arrow points (up or down). When you have done this, the direction of the arrow will inform you whether you should continue counting upwards (arrow pointing up), or if you should shift, starting to count downwards (arrow pointing down). The arrows at the right and left of the ladders indicate whether to continue at the end of a row. (Lindvall & Lask, 2011, p. 198)

The clinician then utilizes a similar method to process this task with the patient, discussing and reflecting upon cognitive processes applied, identifying alternatives, and relating to daily functioning.

**Global information processing.** Neurocognitive studies investigating central coherence in AN patient populations have produced results suggesting an inability to perceive stimuli in a gestalt manner, with a disproportionate focus on details (Lindvall & Lask, 2011).

These perceptual impairments influence the processing of both internal and external stimuli, also guiding cognitions, emotions, and behaviors. CRT interventions developed to increase the patient's global information processing include "Geometric Figures," "Optical Illusions," and "Summarizing" (Tchanturia et al., 2010). During Geometric Figures the clinician presents the patient with an assortment of symbols, who is instructed to select one, unseen by the clinician. The patient is then asked to describe the figure, with the clinician drawing a picture guided by the patient's depiction. During this task, the patient cannot see what the clinician is drawing and the clinician may not ask any questions. Once the patient has provided the description, the images are compared, and the clinician and patient process the strategies used to describe the symbol. Lindvall and Lask (2011) note that AN patients often focus on distinct aspects of the figures during this task, as opposed to relating the separate components and depicting whole objects. During the session, the cognitive process utilized is identified and discussed, alternative approaches to task completion are explored, and the pros and cons of each strategy are related to daily functioning. The model's authors also identify that the roles of drawer and speaker in this task may be reversed (Tchanturia et al., 2010).

A second CRT intervention designed to enhance global information processing and obtain clinical data related to the patient's thinking style, utilizes optical illusions to assess detailed versus holistic information processing. CRT Optical Illusion tasks begin by the clinician asking the patient to describe what they perceive upon immediate presentation of a stimulus. Their approach to processing the visual material is subsequently discussed and reflected upon based on their response. If the patient identifies a single aspect of the image, the clinician requests that they review the picture, considering if other objects, figures, or details may also be perceived. This process of identifying alternative strategies is discussed, which in itself

increases problem solving and cognitive flexibility capacities, and eventually related to the patient's coping skills.

An additional CRT technique related to global information processing, Summarizing, involves the clinician requesting that the patient read and paraphrase a text. As this cognitive ability develops, the clinician increases the task's level of difficulty, by requesting the patient to further condense a summary (e.g., to five sentences, five bullet points, or a phrase consisting of only a few words). Consistent with a CRT approach, the patient's strategies are then identified, examined, and related to daily functioning.

**Visuospatial abilities.** Increasing and enhancing visuospatial abilities represents treatment goals related to executive functioning rehabilitation for patients presenting with AN symptomatology. The objectives of these CRT interventions are to enhance the patient's abilities in the domains of object recognition, visual memory, and spatial location. Difficulties related to these processes are common to patients with AN and may influence body image perception, which suggests that improving visuospatial abilities during CRT sessions represents an integral treatment goal (Lindvall & Lask, 2011). CRT activities specifically developed for this purpose include "The Grid" and "Finding Your Way." During administration of The Grid, the clinician requests that the patient memorize an assortment of figures presented in a grid format, during a time frame that corresponds with the activity's difficulty level. The patient is then provided with an empty grid and requested to fill in the recalled figures. If impairment is evident, the patient and clinician identify and discuss the strategy employed, explore alternative approaches, and consider the benefits and consequences of each strategy in relation to the patient's day-to-day functioning.

"Finding Your Way," an additional CRT application tailored to visual processing development, is an activity in which the clinician requests the patient to find their way from one end of a 'maze' to the other, and while doing so, to keep count of the left and right turns. During this task, the clinician presents the patient with a picture of a maze and provides the following instructions:

> The girl in the picture is waiting to receive her birthday present. Can you see the girl and the gift? All right, imagine you're the girl, and to receive the present, you have to find your way through this maze. On your way to the gift, please try to remember how many left and right turns you make. Do you understand the task? Ok, let's begin! (Lindvall & Lask, 2011, p. 202)

Once the patient has completed this activity, they and the clinician discuss and reflect upon the cognitive processes utilized, evaluate benefits and consequences, and relate to everyday functioning.

**Review of the Effect of Cognitive Remediation Therapy**

Various studies examining the effects of CRT applied to the AN patient population have produced results evidencing improved cognitive performance, namely, in set-shifting, holistic processing (as opposed to an excessive focus on details), object recognition, visual memory, and spatial location, in addition to reducing eating disorder symptomatology (Pretorius & Tchanturia, 2007; Tchanturia, Davies, & Campbell, 2007). Researchers from such studies have concluded that the data supports the use of CRT as an additional treatment component for AN psychopathology. Additionally, a qualitative study conducted by Whitney, Easter, and Tchanturia (2008) reported that AN patients receiving CRT identified that they valued the intervention, found that the techniques improved their metacognitive abilities, and also that they

were successful in implementing behavioral changes in their daily functioning attributed to the newly acquired skill set.

**Rationale for Proposed Study**

Eating disorders, including AN, may be among the most notably misunderstood diagnoses (Lindvall & Lask, 2011), and are associated with significant mortality rates (Arcelus, Mitchell, Wales, & Nielsen, 2011; Sullivan, 1995). Thus, the availability of information pertaining to etiological models and respective treatments tailored to this clinical population are paramount. Evidence in the literature suggests that while previously deemed enigmatic, convoluted, and even irrelevant to treatment (Lindvall & Lask, 2011), current neuroscience-based approaches to AN conceptualization may have relevant clinical applications and promising outcomes. The intent of this critical analysis is to assist readers in developing an understanding of neurocognitive implications of AN symptomatology, particularly executive system dysfunction, in addition to increasing their knowledge of applied cognitive remediation treatment. This review seeks to demystify clinical applications related to the neuroscience of eating disorders, namely cognitive remediation therapy, and outline practical ways that clinicians providing treatment to AN patients may incorporate evidence-based methods such as these into their treatment plans.

# Chapter IV: Methodology

The proposed study aims to identify and examine an etiological model of AN related to executive functioning, and to review an evidence-based treatment that addresses respective symptomatology. The review will provide systematic information pertaining to two separate albeit related domains, the first of which encompasses an etiological model of AN related to executive functioning, including (a) model, (b) authors, (c) overview, (d) evidence base and testability, (e) clinical applications, and (f) critical appraisal. A second facet of the analysis will comprise methodical information on cognitive remediation therapy (CRT), an evidence-based treatment that addresses executive functioning. A comprehensive review of the literature utilizing CRT techniques to treat AN symptomatology will be synthesized and subsequently analyzed based on the following, (a) authors, (b) method, (c) results, (d) discussion/conclusions and clinical implications, and (e) critical appraisal and suggested future directions. Additionally, the critical appraisal component will include a specific emphasis on population demographics and generalizability of findings.

## Identify Literature on an Etiological Model of AN Related to Executive Functioning for Review

Literature to be reviewed pertaining to an etiological model of AN and executive functioning, will be identified through comprehensive searches of the following electronic EBSCOhost databases: PsycArticles, PsychINFO, PubMed, ProQuest, PsychiatryOnline, and WorldCat, in addition to public databases such as Google Scholar. The terms used to search each database will include anorexia nervosa, neuropsychological (and derivatives, e.g. neuropsychology), executive function/ing, frontal systems, cognition, and brain function. An additional literature review strategy will involve searching Pepperdine University, University of

California Los Angeles (UCLA), and Los Angeles Public Library systems, again applying the previously noted search terminology. Key articles and chapters identified during the comprehensive literature review will be synthesized, categorized, analyzed, and critiqued.

**Identify Literature on Cognitive Remediation Therapy for Review**

The literature to be reviewed pertaining to the application of CRT techniques to AN symptomatology, will be identified through comprehensive searches of the following electronic EBSCOhost databases: PsycArticles, PsychINFO, PubMed, ProQuest, PsychiatryOnline, and WorldCat, in addition to public databases such as Google Scholar. The terms used to search each database will include anorexia nervosa, cognitive remediation [therapy], neurocognitive treatment, evidence-based neuropsychological treatment, executive function/ing, and frontal systems. An additional literature review strategy will involve searching Pepperdine University, University of California Los Angeles (UCLA), and Los Angeles Public Library systems, again applying the previously noted search terminology. Key articles and chapters identified during the comprehensive literature review will be synthesized, categorized, analyzed, and critiqued.

**Presentation of Findings**

A comprehensive review of the literature relevant to a focused clinical problem (e.g., neuropsychological etiology and treatment of AN) will be systematically presented in two separate chapters, each written in prose format. The first chapter will comprise information synthesized on an etiological model of AN related to executive functioning, including a discussion of (a) model, (b) authors, (c) overview, (d) evidence base and testability, (e) clinical applications, and (f) critical appraisal. The second chapter will comprise information synthesized on cognitive remediation treatment applications that address executive functioning in AN, including a discussion of (a) authors, (b) method, (c) results, (d) discussion/conclusions and clinical implications, and (e) critical appraisal and suggested future directions.

As previously mentioned, the critical appraisal components within each chapter will place particular emphasis on population demographics and subsequent generalizability of findings.

## Chapter V: Critical Review of an Etiological Model of AN Related to Executive Functioning

AN is conceptualized as a neuropsychiatric disorder (Herpertz-Dahlmann, Seitz, & Konrad, 2011). Associated etiological models are based on neuroscientific studies of individuals with AN that have identified neural circuit abnormalities and dysfunction (Herpertz-Dahlmann et al., 2011; Nunn, Frampton, Gordon, & Lask, 2008; Nunn, Frampton, Fuglset, Törzsök-Sonnevend, & Lask, 2011; Nunn, Lask, & Frampton, 2011). These areas of dysfunction (described in detail in *Chapter II*) lead to impairments in cognitive performance, including executive and visuospatial functioning deficits (Braun & Chouinard, 1992; Fassino et al., 2002; Mathias & Kent, 1998; Murphy et al., 2004; Nakazato et al., 2009; Roberts et al., 2007; Roberts et al., 2010; Steinglass et al., 2006; Steinglass & Glasofer, 2011; Szmukler et al., 1992). As a result, these patients are less able to engage in traditional therapeutic interventions, experiencing poor prognosis and clinical outcomes. In other words, patients with AN evidence brain abnormalities that lead to cognitive deficits, which in turn impact treatment outcomes.

More specifically, AN is a neuropsychiatric disorder potentially attributed to abnormality within a brain structure known as the insular cortex, or insula. The insula serves an integrative function for all the structures relevant to the features of AN, and is connected with many of the most important structures for emotionality, bodily experience and communication. Additionally, the insula regulates communication between neurons in the different structures to which it is connected, including the frontal lobe which is central to executive functioning. As such, this brain structure may represent a core component of AN psychopathology, manifested in part by executive symptomatology.

Research on insula dysfunction conducted by Nunn and colleagues (Nunn et al., 2008; Nunn, Frampton et al., 2011; Nunn, Lask et al., 2011) led to the development of a neuroscience-based conceptual model of AN that implicates executive functioning. Overall, their model posited that premorbid dysregulation in various brain systems involving neurochemicals (e.g., noradrenergic, anticholinergic, serotonergic, and glutamate systems) lead to neuroplasticity impairments within the insula. Subsequent insula dysfunction implicates the frontal lobe and contributes to the executive functioning deficits seen in AN (Nunn, Lask et al., 2011). A detailed discussion of this particular etiological model of AN related to executive functioning will henceforth be the focus of this chapter.

**Model, Authors, and Overview**

It is now widely recognized that specific psychopathological symptoms can be correlated with certain neural dysfunction, including the various neuroanatomical abnormalities present in individuals with AN (see *Chapter II*). There is evidence in the literature that the clinical manifestation of AN may relate to abnormal fronto-striatal circuitry (Steinglass & Walsh, 2006). Nunn et al. (2008) and Nunn, Frampton et al. (2011) sought to examine the potential relationship between these neural regions and the various clinical features of AN. They eventually proposed an empirically-based model, that hypothesizes that rather than having dysfunction allocated to each of these domains, there exists a functional disconnection between these areas that ultimately leads to AN symptomatology. The unit responsible for this disconnection is the insula. This parsimonious model, the *Insula Hypothesis*, thus posited that insula dysfunction is responsible for wide-spreading disconnection.

The insula, often termed the *Central Station* of the brain, is a principle networking unit that connects and regulates many cortical and subcortal areas (Nunn, Frampton et al., 2011).

This structure serves a homeostatic function, facilitating balance between brain areas responding to external or internal environments. Medially positioned within the lateral (Sylvian) fissure, the insula is an area of highly complex connectivity and functionality. Generally speaking, the insula connects anterior and posterior structures, dominant and nondominant hemispheres, and cortical and sub-cortical structures. This includes the plethora of neural regions involved in AN, including the frontal lobes, cingulate gyrus, temporal lobes, amygdala, hippocampus, parietal lobes, somatosensory cortex, basal ganglia, thalamus, hypothalamus, periaqueductal matter, pons, medulla, and the nucleus of the solitary tract (Damasio, 1996; Nagai, Kishi, & Kato, 2007).

As an aspect of their etiological model, Nunn and colleagues described various functions of the insula (many of which involve frontal lobe connectivity) and corresponding AN symptoms related to its impairment. One of the insula's tasks is to regulate sympathetic (SNS) and parasympathetic nervous system (PNS) functioning, by monitoring information between the amygdala within the SNS and the nucleau accumbens within the PNS (Shelley & Trimble, 2004). The researchers suggested that insula impairment in AN may thus contribute to an overly aroused SNS, leading to heightened anxiety and more specifically, to fear of certain stimuli (i.e., food). A second function of the insula involves modulating appetite via connections between the frontal lobe and hypothalamus. Associated dysfunction may contribute to distorted hunger cues evident in AN patients. Also related to dietary functions, connectivity between the insula and nucleus tractus solitarious (NTS) contributes to taste reception, perception, and integration. Accordingly, lower insula activity may contribute to the reduced taste sensation identified in AN patients (Aschenbrenner, Scholze, Joraschky & Hummel, 2008; Kaye, Fudge, Paulus, 2009; Wockel, Hummel, Zepf, Jacob, & Poustka, 2007). Connections between the insula, somatosensory cortex, and frontal cortex allows for one to accurately perceive their

physiological state (Craig, 2002; Kaye, Fudge, Paulus, 2009; Shelly & Trimble, 2004). Insula dysfunction may therefore disrupt accurate body perception, interoceptive, and emotional awareness, which manifests clinically in AN as distorted body image.

The insula also plays a major role in ones' ability to consider the relationship between thoughts and feeling (Phan, Wager, Taylor, & Liberzon, 2002). Associated impairment would potentially lead to the significant difficulty that patients with AN have with this linking ability, often presenting with symptoms of alexithymia. Pain processing is modulated via connections between the insula, thalamus, somatosensory and frontal cortices (Ostrowsky et al., 2002; Peyron, Laurent, & Garcia-Larrea, 2000; Starr et al., 2009), with insula dysfunction potentially contributing to the pain insensitivity experienced by AN patients. Interestingly, the insula is responsible for the experience of disgust (Phillips et al., 1997), an experience familiar to AN patients. Finally, insula activity has been associated with empathy (Bird et al., 2010). As a result, Nunn and colleagues posited that reduced insula function contributes to reduced empathic responses observed in acute AN patients.

**The Insula Hypothesis**

Malnutrition and environmental conditions have failed to adequately explain AN phenomena. Considering this, in addition to the previously described neurological findings, Nunn and colleagues suggested that the cognitive, emotional, and behavioral symptoms of AN may be explained by insula dysfunction, a brain structure which underlies neural regions possibly associated with AN psychopathology (Frampton, Fuglset, & Jensen, 2010; Nunn et al., 2008). Thus insula impairment, potentially attributed to early developmental damage or neurochemical abnormalities, represents a predisposing risk factor to the development of AN. Such an individual experiences an inability to effectively integrate body perception (impaired

interoceptive awareness), emotional responses (including anxiety and disgust), and executive abilities related to modulating behaviors (set-shifting, cognitive flexibility, impulse regulation). Precipitating factors such as genetic loading, socio-cultural ideals regarding body size and shape, pubertal endocrine changes, and dietary behaviors may lead to increased anxiety. The amygdala then relays this information to the insula, however because the insula is impaired, it cannot effectively mediate this emotional material (amygdala) with an accurate perception of bodily state (temporal somatosensory) or hunger (basal ganglia). As a result, eating is restricted. In addition, insula dysfunction disrupts certain cognitive processes (e.g., executive functioning) which when operating effectively, would inhibit cognitions regarding the irrational importance of body weight and shape. According to Nunn and colleagues, this ultimately leads to the development of AN.

**Evidence Base and Testability**

The model presented by Nunn and colleagues is empirically derived, based on neuroimaging, neuropsychology, and neuropathology research identifying insula dysfunction. Functional neuroimaging methods (e.g., fMRI) examining the insula have produced results revealing decreased regional cerebral blood flow (rCBF) in patients with restrictive AN (Kojima et al., 2005); reduced insula activity resulting in self-image misperceptions (Sachdev, Mondraty, Wen, & Gulliford, 2008) and altered taste processing (Uher, Treasure, Heining, Brammer, & Campbell, 2006; Wagner et al., 2007); an attentional tendency towards *fat* and *thin* words with unique neural activation during performance of emotionally evocative stimuli (Redgrave et al., 2008); and hypoperfusion leading to impaired executive functioning (Connan et al, 2003; Lask et al., 2005). Cognitive deficiencies implicating insula impairment in weight-restored AN patients (as revealed by fMRI) include those discussed in Chapter II (i.e., set-shifting, weak

central coherence, visuospatial, and decision making deficits). Neuropathological lesion studies have suggested that insula damage may be linked to clinical symptoms of anosagnosia (right insula pathology) (Karnath, Baier, & Nägele, 2005); heightened pain threshold (posterior insula pathology; Cereda, Ghika, Maeder, & Bogousslavsky, 2002); overly cautious and perfectionistic behavior (Weller, Levin, Shiv, & Bechara, 2009); and bradycardia (Lupoglazoff et al., 2001). In addition, right insula lesions have been related to symptoms of anergia and fatigue, with disparate effects seen in pathology lateralized to the left (Manes, Paradiso, & Robinson, 1999).

In order to ascertain whether patients with AN have dysfunctional insulas, or to disprove the Insula Theory by demonstrating intact insula functioning, methodology will likely need to include a combination of imaging and neuropsychological assessment approaches. More specifically, functional imaging such as fMRI will need to evaluate fronto-insula-limbic-straital circuits, and neuropsychological assessment should examine executive (inhibition, set-shifting, reward behavior) and visuospatial functioning, in addition to anxiety (Nunn et al., 2008). Such a study is underway, which plans on also differentiating between state (malnourishment) and trait features of AN by conducting additional testing following weight restoration (Frampton, Fuglset, & Jensen, 2010).

**Clinical Implications**

The Insula Hypothesis lends itself to a variety of promising clinical implications. In order to assess underlying neurological features, plan appropriate interventions, and monitor treatment efficacy, individuals with AN may benefit from routine neuropsychological assessment using tests such as the Ravello Profile. As previously discussed (see *Chapter I*), current treatments of AN including CBT and psychodynamic therapy tend to be unsuccessful. It has been posited that these poor treatment outcomes may be due to these approaches' failure to

adequately remediate insula dysfunction (Nunn, Frampton et al., 2011). These patients may therefore benefit from developing compensatory skills, and more specifically, learning ways in which to improve areas of cognitive dysfunction associated with insula impairment. A core feature of this etiological theory of AN, is that insula dysfunction leads to impaired executive functioning, which presents clinically as inflexibility, poor set-shifting, and rigid behaviors related to food and weight. Cognitive remediation (CRT) techniques may be of particular value here (Davies & Tchanturia, 2005), which are discussed in detail in Chapters III and VI. An additional area of dysfunction that may be remediated involves impaired interoceptive awareness and difficulty identifying emotional experiences. Hence, certain mindfulness approaches are deemed of interest (Nunn et al., 2008). The insula hypothesis may also improve the therapeutic alliance and serve to reduce the stigma experienced by AN patients, who are at times accused of their behaviors being purely volitional.

**Critical Appraisal**

The Insula Hypothesis presents with a number of strengths, including that it is empirically derived. The presence of an impaired insula is also necessary to understand the complexity of AN psychopathology. Another quality is that this model sufficiently explains the core psychopathology and breadth of AN phenomena, including neurological, neuropsychological, and psychopathological features, in addition to food restriction, weight/shape issues, and body image distortion. The hypothesis is also specific, as insula impairment helps to explain why under the same cultural circumstances, some individuals develop AN while others do not. In addition, it distinguished AN from other disorders, and as previously noted, is testable and refutable. An additional strength of the Insula Hypotheses is its generalizability, considering that the insula is a common neural structure in all individuals.

While Nunn and colleagues' Insula Hypothesis has various strengths, weaknesses are also apparent. This model is quite difficult to test because measures designed to assess insula function will also likely activate additional neural regions because of the high levels of connectivity. Thus the selective evaluation of insula ability presents a considerable challenge. Evidence in the literature has also suggested that AN may represent a final common pathway and part of a neurobiological subtype (Nunn, Frampton et al., 2011), rather than a distinct phenomena. The authors also neglected to differentiate between the model's application to the varying AN subtypes, including Restricting and Bing-Purge. Finally, the Insula Hypothesis is reductionistic, and as a result, there is concern of notable oversimplification. However, the model's developers argued that doing so permitted for hypothesis testing, and recognized that structures do not operate in isolation, but rather, in neural networks (Nunn et al., 2008; Nunn, Lask et al., 2011).

**Summary of Main Findings**

The empirically based Insula Hypothesis developed by Nunn and colleagues, is an etiological model of AN related to executive functioning, that eloquently accounts for the physiological, psychological, and behavioral components of this eating disorder. Dysfunction within the insula, an integrating structure within the brain, represents a predisposing factor and logically implicates the varied brain regions to which it is connected. Despite being reductionistic and difficult to test, the model may be generalized, and is consistent with neuroimaging and neuropsychological data of AN patients (Connan et al., 2003; Fassino et al., 2002; Lask et al., 2005; Nakazato et al., 2009; Roberts et al., 2007; Roberts et al., 2010; Steinglass et al., 2006; Steinglass & Glasofer, 2011). Clinical implications associated with the Insula Hypothesis, encompassing remediation-based interventions aimed at ameliorating

executive functioning deficits, have evidenced promising outcomes. As such, a critical review of CRT applications that address executive functioning in AN follows.

# Chapter VI: Critical Review of Cognitive Remediation Treatment Applications that Address Executive Functioning in AN

As evident in Chapter I, engaging, maintaining, and treating AN patients remains a significant challenge to clinicians. Hypothesized explanations for this are thought to involve the executive functioning impairments described in Chapter II, including deficits in set-shifting and global processing. The neuropsychological treatment paradigm defined in Chapter III (i.e., CRT) represents the translation of neurocognitive research into practice, and is thought to remediate neuropsychological symptoms and associated maladaptive cognitive processes. Additionally, the etiological model of AN related to executive functioning discussed in Chapter V, provides a conceptual framework for this novel approach to AN treatment. The following synthesized studies on therapeutic applications that address executive functioning in AN, have examined the efficacy of CRT with adult and adolescent AN patients, across inpatient and outpatient settings, and with varied illness durations. The methods utilized, results obtained, and conclusions made, in addition to critical appraisals and suggested future directions with an emphasis on population demographics and subsequent generalizability of findings will be discussed. These morbid studies (as opposed to premorbid) are presented in ascending order of publication.

## Study 1: Cognitive Remediation Therapy for Patients with Anorexia Nervosa: Preliminary Findings (Tchanturia, Davies, & Campbell, 2007)

**Authors and study objective.** Tchanturia, Davies, and Campbell (2007) were the first researchers to formally evaluate and publish on CRT for AN. Their small case series comprised three primary objectives; to assess whether CRT interventions improve neuropsychological performance, to identify whether AN patients consider the program acceptable, and to utilize

patient and therapist evaluations to modify the treatment and establish a manualized CRT program.

**Methodology.** Four inpatients with AN participated in their study, whose ages ranged from 21 to 42, illness duration from 7 to 24 years, age of onset from 14 to 18 years, and number of previous admissions from 1 to 3. Each participant had a BMI of less than 17.5, and had received treatment as usual per the inpatient Maudsley program. Tchanturia and colleagues administered an assessment battery at baseline and following CRT, comprised of cognitive set-shifting tests (Cat Bat Task, Trail Making Task, Brixton Test, and Haptic Illusion Task), the Maudsley Obsessive-Compulsive Inventory (MOCI), and the Hospital Anxiety and Depression Scale (HADS). Qualitative information was also gathered as participants wrote reflection letters following the ninth session. The CRT intervention involved 10, approximately 45-minute sessions, focused on the following tasks; geometric figures (the participant described various complex geometric shapes to the therapist, who then drew the design based on the description); illusions (visual illusion stimuli used to promote consideration of numerous illusions within a picture); stroop material (alternate between attending to disparate stimuli (e.g., color or word)); manipulations (e.g., reversing a sequence of letters and finding different permutations for sequences of letters); infinity signs (e.g., drawing figures according to specification); line bisection (quickly marking points on lines of varied length to encourage estimating); token towers (shape sorting task); hand tasks (switching between different sequences of hand movements); and maps (identifying alternate and most time efficient routes on a map).

**Results.** Quantitative results gathered were compared to the effect sizes of 22 patients from a prior cohort, who received treatment as usual and no CRT. Following the analysis, the effect sizes from the prior study (i.e., treatment as usual) were found to be small, indicating that

set-shifting performance remained unchanged. Conversely, the effect sizes from the current study (i.e., CRT and treatment as usual) were medium to very large, suggesting that the program improved set-shifting ability. Qualitative data included both positive feedback and criticisms. Participants described enjoying the program's focus on reflecting on thought processes rather than content, found the interventions useful as a pretreatment as they avoided discussions of emotions, and believed that CRT increased their cognitive flexibility. In terms of areas of needed improvement, the authors noted that based on patient's evaluations, there was an increased need to translate the in-session skills to daily life. Tchanturia and colleagues also reported that at follow-up (18 months following CRT), all patients maintained a steady BMI, none had been readmitted, and all were either working or studying.

**Discussion, conclusions, and clinical implications.** Tchanturia, Davies, and Campbell highlighted a number of conclusions as a result of this data. In terms of the first objective, determining if the cognitive exercises changed set-shifting task performance, they concluded that targeted cognitive flexibility tasks improved performance in executive set-shifting (based on medium to large effect sizes). However, they also noted the limitations based on four case reports, as solid conclusions could not be drawn from such a small sample size. The second aim, to determine if CRT was acceptable to AN patients, was a definitive yes. This conclusion was attributed to the practicality of each task, observations of the patients during supervision, analysis of qualitative data, and witnessing the patients' experience of achievement when applying the skills to real life scenarios. The third objective, focused on treatment modifications based on feedback, was also achieved and included a variety of adjustments. For example, the therapist should actively ask the patient reflective questions throughout the sessions in order to qualitatively monitor treatment progress, and also encourage the relation of thinking styles

identified during sessions to the patient's day-to-day functioning. In addition, between-session behavioral tasks should be introduced during later sessions, and an increased number of set-shifting and global processing tasks should be added to the module.

**Critical appraisal and suggested future directions**. As previously mentioned, the results of this study are limited by its small sample size, as only four patients from the treatment program electively registered as research participants. Such a scant sample size essentially compromises the reliability of Tchanturia, Davies, and Campbell's findings while also limiting generalizability. Moreover, small sample sizes are indicative of low statistical power, which are less able to identify true effects, even if those calculated are deemed statistically significant (Button et al., 2013). Also impacting the generalizability of findings are demographic and cultural variables, such as gender, SES, and ethnicity, which the authors failed to identify. Considering that cognition is culturally constituted, these variables are clearly relevant in any treatment program involving neuropsychological performance. In terms of methodology, there was no assessment of general intelligence (i.e., (FS)IQ), or indication of the normative data used. The authors neglected to identify or discuss potential cohort effects, which is especially important as the data were analyzed in comparison to an alternate patient group. While Tchanturia, Davies, and Campbell identified the CRT tasks included in their treatment protocol, they provided extremely limited details in terms of actual session structure, influencing the studies' reproducibility.

Despite the various limitations to this study, the data obtained at follow-up is promising. Future studies will need to evaluate whether CRT directly influences long-term gains, especially since participants were receiving adjunctive treatments. The protocol was not individualized (see *Chapter III*), and future studies should assess treatment outcome following CRT programs

created specifically for the patient's unique needs (for example, based on the Ravello Profile previously discussed). While the authors concluded that targeted cognitive flexibility tasks improved performance in executive set-shifting, this was only based on the tests administered. Thus, future studies should assess the extent of ecological validity of these measures (e.g., did improved set shifting performance on neuropsychological measures translate to more flexible dietary behaviors?). Additionally, this need may have been reflected in the participants' suggestion to translate the skills taught during sessions to daily life. Future research within this domain may focus on determining whether qualitative data (i.e., a patient's perception of increased cognitive flexibility attributed to CRT) or quantitative data (i.e., improved objective results on test performance following CRT) leads to greater clinical outcomes. As previously noted, the participants identified CRT as a useful pretreatment, which they attributed to the program's avoidance of discussing emotions. Yet, considering that dysfunctional negative emotions represents a maintenance factor of AN, the development and evaluation of a CRT program that integrates emotional regulation skills represents an area of future study.

**Study 2: Anorexia Nervosa: How People Think and How we Address it in Cognitive Remediation Therapy (Pretorius & Tchanturia, 2007)**

**Authors and study objective.** Pretorius and Tchanturia's 2007 case study examined an individualized CRT program consisting of ten, twice-weekly, 30-minute sessions. Their patient was a 31-year-old female, receiving treatment for a first episode of AN within an inpatient program. She had a BMI of 13.8 at admission, and no reported history of anxiety or depression.

**Methodology.** The general format of the CRT sessions was described, with sessions one and two focused on increasing the patient's familiarity with the CRT tasks, treatment setting, therapist, and strategies. During the third and fourth sessions, the therapist encouraged the

patient to reflect on how their cognitive approaches to in-session tasks were also those applied on a day-to-day basis. At this time during the course of CRT the patient began to develop an increased awareness of her rigidity, especially those related to dietary behaviors. The focus of the fifth session encompassed identifying themes in thinking style and encouraging the patient to attempt alternative, effective strategies. Themes that became increasingly apparent included the patient's perfectionism, rigidity, and difficulty identifying emotion. The authors noted that the patient's inability to discuss her emotions was not explored, which is consistent with a CRT paradigm. The sixth through eighth sessions concentrated on transferring effective strategies to real-life situations, primarily through the implementation of behaviorally based tasks. During the ninth session, the patient was instructed to write an evaluative letter, describing her perceptions and experiences of CRT, what she believed she had learned, and aspects that should be improved. The therapist also composed a letter directed to the patient, summarizing the sessions. These letters were then read and discussed during the tenth (final) session.

**Results.** Results of their case study were identified and evaluated based on the patient's feedback letter. The patient reported that over the course of CRT, they developed an awareness of their thinking style, identified issues of perfectionism, practiced switching attention, and developed behavioral tasks in order to implement various cognitive skills to real-world functioning. Moreover, though she noted a propensity to avoid feeling states, she felt prepared to begin subsequent psychological treatment (i.e., CBT). Pretorius and Tchanturia reported that the patient's BMI increased from 15 to 16.2 during CRT, and that she was discharged 12-weeks following treatment with a BMI of 16.1.

**Discussion, conclusions, and clinical implications.** Based on these qualitative results, Pretorius and Tchanturia concluded that the CRT program enabled the patient to engage with the

therapist, increased her awareness of her cognitive processes, and reduced her cognitive rigidity in approaching day-to-day situations. They also suggested that this case study supported the use of CRT as a pretreatment, increasing the effectiveness of subsequent psychotherapy, based on two possible hypotheses. One is that the metacognitive skill development inherent in CRT facilitated utilization of interventions (such as those employed in CBT) involving set-shifting and global processing, and the second is that CRT created an enjoyable and safe therapeutic experience. While Pretorius and Tchanturia reported that no direct effect was shown between CRT and increased BMI (though this was not the focus of their study), the patient's BMI remained stable after completing CRT and until 12 weeks following termination from the program.

**Critical appraisal and suggested future directions.** Clearly, there are limitations of case reports in regard to generalization, and similar to the previously discussed study (i.e., Tchanturia, Davies, & Campbell, 2007), there was an inadequate consideration of demographic factors. From their report, it was unclear whether Pretorius and Tchanturia both facilitated the treatment, or if one of the authors conducted the CRT sessions. They also noted that a component of the first few sessions involved increasing the participant's familiarity with strategies, however they provided no further delineation of what this entailed. Another critique of their study involved the patient being told that her evaluation letter was to be discussed with the therapist during the final session. Interpersonal difficulties, considered an integral component of AN psychopathology, likely influenced what she was willing to disclose and thus introduced a potential bias. The patient indicated feeling prepared to begin alternative treatments following CRT in her feedback letter, writing, "without CRT it would have taken me a much longer time to accept these tendencies, but now I feel confident to explore these issues further in

psychotherapy." However, since she had no prior treatment and there was no control participant, it would seem that there was no basis of comparison.

The failure to address the patient's notable difficulty discussing emotions, especially considering that emotional avoidance represents a key maintenance factor of AN, is another limitation of this study (as it was for the previous one) and should be addressed in upcoming research. An interesting area of future study may also be to compare the effectiveness of behavioral experiments introduced via CRT versus CBT. For example, is there an advantage to implementing such activities following CRT tasks? Finally, future research should evaluate the two posed hypotheses supporting CRT as a pretreatment, involving increased metacognition and perception of a nonthreatening therapeutic environment.

**Study 3: Neuropsychological Task Performance before and after Cognitive Remediation in Anorexia Nervosa: A Pilot Case-Series (Tchanturia et al., 2008)**

**Authors and study objective.** Tchanturia et al. (2008) conducted a pilot case-series in order to evaluate (a) CRT utility, (b) whether CRT improved neuropsychological performance, and (c) whether neuropsychological improvements were associated with clinical symptoms.

**Methodology.** A total of 23 patients completed the intervention, which consisted of 10, 45-minute individual CRT sessions that occurred twice per week. Assessment measures were administered at baseline and following treatment, and were comprised of tests evaluating set-shifting (Trail Making Task, Brixton Test, Haptic Illusion task, and Cat Bat Task), central coherence (Rey Complex Figure Test [RCFT]), obsessive-compulsive symptoms (Maudsley Obsessive-Compulsive Inventory [MOCI]), anxiety and depression (Hospital Anxiety and Depression Scales [HADS]). Body mass index (BMI) was monitored, and participants completed a treatment satisfaction questionnaire at the end of treatment.

Characteristics of the patient population were the following; mean age of 28.8 (*SD* = 9.2); median age of onset was 15 (14-17); mean duration of AN was 13.1 (*SD* = 9.6); mean IQ 112.7 (*SD* = 6.5); mean BMI at baseline was 14.3 (*SD* = 1.4); and mean BMI at follow-up was 16.1 (*SD* = 1.5).

**Results.** Results from the analysis identified a number of improvements in patient's cognitive abilities following CRT. Specifically, they recorded improved performance time in set-shifting (Trails B, CatBat; medium and very large effect sizes), reduced perseveration in cognitive shifting (Brixton, CatBat; very large and large effect sizes), improvement in the Haptic illusion task (medium effect size) and central coherence (RCFT) (small to large effect size). Despite being elevated at pre and post treatment, psychological measures revealed a slight decrease in depressive symptomatology ($t = 2.7$, $df = 20$, $p = 0.01$). No significant changes in anxiety ($z = -1.77$, $p = 0.08$) or obsessive-compulsiveness ($z = -0.53$, $p = 0.60$) were found. Consistent with previous research, Tchanturia and colleagues found no association between changes in BMI and neuropsychological performance.

**Discussion, conclusions, and clinical implications.** Based on these findings, the authors concluded that targeted CRT interventions improved certain cognitive abilities in acute AN patients. Following the time-limited, 10-session CRT protocol, participants demonstrated refined executive functioning skills, especially in tasks requiring global processing and/or cognitive flexibility.

**Critical appraisal and suggested future directions.** Demographic variables influencing performance were neither identified nor elaborated upon, thus influencing the generalizability of their findings. Extremely limited information was included regarding the content of the CRT treatment (for example, which tasks were utilized during the sessions), influencing the studies' reproducibility, and normative data was not noted. A criticism identified by the authors, was that the study design prevented elucidation of whether cognitive performance improved as a direct result of CRT. However, they reference a previous study conducted within the program

(Tchanturia, Morris et al., 2004) the results of which indicated that increasing BMI alone does not improve neuropsychological performance. Future study is needed to elaborate upon this. An additional critique of their study included a failure to adequately address practice effects, and future research should be sure to include alternative versions of tests administered within the battery. It is interesting that no significant changes in anxiety or obsessive-compulsiveness were identified, despite reduced perseveration on neuropsychological tests. Future research should explore this finding.

**Study 4: Cognitive Remediation Therapy in Adolescent Anorexia Nervosa: Case Report (Cwojdzińska, Markowska-Regulska, & Rybakowski, 2009)**

**Authors and study objective.** Cwojdzińska, Markowska-Regulska, and Rybakowski's 2009 case study aimed to evaluate the effectiveness of CRT delivered to an adolescent with AN.

**Methodology.** The article was written in Polish and though an English version of the abstract was made available, the information gathered from this source was extremely limited. No data pertaining to the participant's age (other than reporting that they were an adolescent) or the duration of their AN were provided. In addition, information describing the CRT intervention protocol was unobtainable. Nevertheless, details regarding the assessment battery administered pre and post treatment were assessable, which was comprised of the Eating Attitudes Test 26 (EAT-26), Beck Depression Inventory (BDI), Child Yale-Brown Obsessive-Compulsive Scale (CY-BOCS), Eating Disorders Belief Questionnaire (EDBQ), Wisconsin Card Sorting Test (WCST), Temperament and Character Inventory (TCI), and Child Heath Questionnaire (CHQ).

**Results.** Following the CRT cognitive training program, the participant demonstrated a decrease in psychopathological symptoms, as evidenced by results on the EAT-26 and BDI. Cognitively, some improvement in set-shifting was identified on the WCST. The TCI results were insignificant, and an increased level of dysfunctional beliefs was reportedly observed.

**Discussion, conclusions, and clinical implications.** Based on these results, the authors concluded that CRT treatment improved both cognition (set-shifting in particular) and clinical symptomatology associated with AN. Accordingly, they suggested that CRT be used with this particular patient population.

**Critical appraisal and suggested future directions.** Considering that the full article was not available in English, limited information is available for appraisal. However, the generalizability of their results is limited by the power of a case study in addition to the effects of demographic variables. Practice effects must also be considered.

**Study 5: Cognitive Remediation Therapy (CRT) for Anorexia in Group Format: A Pilot Study (Genders & Tchanturia, 2010)**

**Authors and study objective.** Genders and Tchanturia (2010) conducted a pilot study in order to assess the potential benefits of a group based version of CRT for AN, while also evaluating the intervention's acceptability to patients.

**Methodology.** Thirty participants were recruited from the Eating Disorder Service of the South London and Maudsley NHS Trust and the Institute of Psychiatry, Kings College London. Of the 18 patients who completed the study, 2 were male, the mean age was 28.4 (ranged from 14 to 60), the mean BMI at session one was 16.4 (ranged from 14.4 to 22.4), and the mean National Adult Reading Test (NART) predicted FSIQ score (taken from an alternative study) was 108 (ranged from 92-129). The treatment program encompassed a total of four, weekly group CRT sessions focused on global and flexible thinking. Each group consisted of psychoeducation, CRT exercises, a discussion relating the exercises/homework to daily thoughts and behaviors, and homework planning. Facilitators also elicited feedback from participants, including what they considered useful and aspects of the treatment they thought should be revised. Genders and Tchanturia also provided a more detailed description of the intervention's elements, reporting that the first session included information regarding CRT and cognition,

and practice with the Figures Drawing Task. Session two focused on cognitive flexibility utilizing visual illusions. Session three involved developing set-shifting skills by having participants play card games while engaging in discussion, and the final meeting (session four) primarily encompassed summarizing and consolidating the central points of CRT group treatment.

Outcome measures administered during the first and final sessions included the Cognitive Flexibility Scale (CFS; Martin & Rubin, 1995), Rosenberg Self Esteem Scale (RSE) (Rosenberg, 1965), and Motivational Ruler (a rating of importance and ability to change). During the final session, participants also completed a self-designed feedback form, inquiring about "how much they enjoyed the sessions, how useful the sessions were and whether they felt they had learned any new skills…what they liked most about the sessions and what could be improved." T-tests and Cohen's d effect sizes were analyzed for those participants who completed measures on both the first and last meetings (18 patients).

**Results.** Quantitative results revealed that in terms of cognitive flexibility (as measured by the CFS), greater than 50% of the patients reported improvements. However, this result was not statistically significant ($p = 0.819$; $d = 0.05$). Changes in self-esteem according to the RSE were also not statistically significant ($p = 0.485$; $d = 0.15$), nor was importance to change (Motivational Ruler; $p = 0.864$; $d = 0.06$). According to data obtained from the Motivational Ruler, 73% of participants reported increased confidence in their ability to change, which was found to be statistically significant ($p = 0.030$; $d = 0.57$). Twenty percent of the original group elected to discontinue CRT, all of whom evidenced lower scores on outcome measures and lower self-esteem that was deemed statistically significant ($p = 0.020$; $d = 0.89$).

Qualitative data obtained from the feedback form highlighted what participants' liked and disliked about the CRT program. More specifically, patients reported liking "being able to talk and share experiences," "using practical tasks to demonstrate thinking and behavioral styles,"

and "educational aspects of the sessions i.e. learning about thinking styles and the brain." They also reported finding homework a helpful means of practicing novel behaviors. In terms of improvements, patients suggested an increased number of sessions, greater practice of the skills, and that individual CRT be offered in addition to the group modality.

In addition to the collation of quantitative and qualitative data, Genders and Tchanturia identified various observations made by themselves and the other facilitators over the course of CRT delivery. These included that session format led to interesting discussions, tasks clearly demonstrated specific thinking styles, the treatment seemed more tolerable to acute AN inpatients, the group was collaborative, patients appeared to benefit from sharing their difficulties and learning from peers, and that food-related discussions focused on anxiety management techniques.

**Discussion, conclusions, and clinical implications.** Based on these findings, Genders and Tchanturia concluded that CRT delivered via a short group format is positively accepted by inpatients with AN and facilitators. They also suggested that this paradigm may be considered an effective and cost effective treatment. The significant improvements in patients' perceived ability to change following CRT has implications for predicting treatment outcomes. These authors also posited that acutely ill AN patients may benefit from an increased number of CRT sessions as this intervention possibly provides a foundation for, and thus mediates, more complex treatments. More specifically, they suggested that receiving treatment focused on remediating maladaptive thinking processes (i.e., CRT), primes patients with AN for subsequent therapies that also emphasize cognitive restructuring interventions (e.g., CBT).

**Critical appraisal and suggested future directions.** In contrast to the previously described studies, which provided extremely limited demographic and cultural information, Genders and Tchanturia's 2010 study identified that two of the participants were male. However, no further discussion of treatment outcomes were addressed between female and male patients, nor were other demographic variables explored. The authors did not specify the length

of the group sessions, nor did they provide information regarding the "other facilitators." Genders and Tchanturia hypothesized that even though changes to cognitive flexibility and self-esteem were not statistically significant, the limited duration of CRT (i.e., four sessions) contributed to this finding. It appeared that they attributed the lack of statistically significant results solely to the quantity of sessions, without considering other contributing factors. Additionally, a number of their conclusions are drawn from qualitative self-report alone and not supported by quantitative statistical analyses. For example, they stated that CRT mediates subsequent psychological treatments, yet failed to elaborate. There was no clear indication that these patients were better able to participate in and benefit from successive psychotherapy, and the research in this domain is severely limited (hence indicating a need for it). Though non-completer's self-esteem scores were lower than completers, there was no indication that this represented a direct effect of CRT. The authors noted a variety of clinically observed benefits of CRT, however it is unclear as to whether these pros were specific to a CRT protocol, or whether these benefits could be achieved via alternate methods. Future research is needed to elucidate whether these qualities correlate with CRT, common factors to group therapy, and/or alternative treatment elements.

**Study 6: Cognitive Remediation Therapy in an Outpatient Setting: A Case Series (Pitt, Lewis, Morgan, & Woodward, 2010)**

**Authors and study objective.** Evidence in the literature suggests that though AN patients do not necessarily experience clinical perfectionism, this obsessive compulsive trait (Anderluh et al., 2003; Lopez, Roberts, Tchanturia, & Treasure, 2003) represents a vulnerability (Anderluh et al., 2003) and maintenance factor (Halmi et al., 2000). In consideration of these notable findings, Pitt, Lewis, Morgan, and Woodward (2010) sought to evaluate whether CRT can reduce symptoms of perfectionism in an outpatient AN population.

**Methodology.** Pitt et al. (2010) reported that outpatient clinicians selected the studies' participants, based on patients who demonstrated high levels of perfectionism. Patients were older than 18 (mean of 29.5), had a mean BMI of 16.6, and either met AN diagnostic criteria, or were described as having recently recovered from AN but continued to exhibit specific symptoms (i.e., cognitive rigidity and perfectionism). The treatment protocol consisting of 10 face-to-face, 45-minute CRT sessions delivered once or twice each week depending on the patient's availability. Data was then obtained via two methods; a) the Frost Multi-dimensional Perfectionism Scale (FMDPS), a self-report measure of perfectionism administered at baseline and following CRT, and b) feedback letters written by participants, after facilitators provided guidelines about what to include. Two of the seven patients failed to complete both pre and post FMDPS measures, therefore data analyzed were based on five completed and two partially completed data sets. Qualitative analysis was based on a grounded theory approach examining seven evaluation letters.

**Results, discussion, conclusions, and clinical implications.** Quantitative analysis of the FMDPS revealed both positive and negative changes. However, since the researchers opted not to use a statistical test (though they did not provide a reason for this) they were unable to determine whether these findings were statistically significant. Nonetheless, the authors concluded that the FMDPS may represent a useful measure for assessing the effects of CRT on perfectionism.

Through grounded theory analysis of the feedback letters, Pitt and colleagues were able to identify a variety of higher and lower order themes. Initial reactions were noted, as patients communicated some uncertainty regarding the relevance of CRT tasks. Numerous benefits were identified, such as the treatment's focus on *how* one thinks rather than on *what* one thinks (e.g., food), that the tasks seemed to improve memory and enhanced motivation to change, and that the program aided AN recovery. Participants also reported an increase in cognitive

flexibility, ability to identify problems, and skills (e.g., flexibility), in addition to identifying strengths, weaknesses, traits, and characteristics (e.g., rigidity and perfectionism). Patient's overall experience was noted as both positive (e.g., interesting, enlightening, informative, mentally stimulating, extremely useful) and negative (e.g., short-term), five of the seven patients stated that they would recommend CRT to others, and there was differing messages regarding motivation to change (e.g., need to be motivated, change was difficult but became easier, motivation was intrinsic and unrelated to CRT). There seemed to be varied opinions regarding the tasks themselves. Bad attributes included repetition and content of tasks, whereas good attributes were described as the tasks being simple, interesting, and highlighting their thinking styles. A few of the participants found that CRT created analogies to everyday life, whereas others reported that they were not able to translate the tasks to real-world functioning. Behavioral tasks were described as useful in all letters, as they were motivating and helped alter routines. The relationship with the therapist was also identified as a higher order theme, as patients felt at ease and encouraged, and that these qualities enhanced the effects of treatment. Additional themes included relationship to food and eating (eating different types of food in different places; not sure if attitude towards food and eating has changed; and increased diet, and weight not dropped since starting CRT, gradually gaining weight), in addition to the experience of CRT as compared to other therapies (no added benefit to CBT; more open to other therapies e.g., CBT; more novel approach; and that the behavioral tasks were similar to CBT).

**Critical appraisal and suggested future directions.** A number of criticisms are apparent regarding this study. Since patients received the intervention during different stages of their therapy, CRT was not necessarily delivered as a pre-treatment intervention. A potential bias was introduced as the facilitators provided suggestions regarding what the patients should include in their feedback letters, and were also informed that their therapist would read the letter. The sample size was extremely limited, as was participant characteristics (e.g., longer

duration of illness), therefore limiting the generalizability of the results. In assessing the qualitative feedback, the authors focus on alternative themes rather than specifically discussing perfectionism as was indicated in their objective. Some participant's scores on the FMDPS increased following CRT, however this is not sufficiently elaborated upon. The study lacked any longer term follow-up assessment to evaluate the extent of CRT effectiveness, and the process of selecting outpatient clinicians (who then selected participants) was not described. Additionally, the researchers failed to discuss the potential influence on treatment outcomes between the patients who received one versus two CRT sessions per week, or the differences between different clinicians (number unspecified) providing therapy. It is also unclear from the article the authors' reasons for not completing any statistical analysis on he quantitative data, especially since their objective was to evaluate perfectionism. Furthermore, their discussion of the lower order themes was limited. For example, while participants wrote that change was difficult, change was not defined. It was also unclear how the behavioral tasks in CRT differed from behavioral experiments in CBT, aside from the former representing a novel approach introducing these tasks that may be of interest to some patients. A negative lower order theme within the overall experience theme was noted as "short-term," yet no explanation or elaboration of this is provided. Future research clarifying these concerns is warranted.

**Study 7: Group Cognitive Remediation Therapy for Adolescents with Anorexia Nervosa (Wood, Al-Khairulla, & Lask, 2011)**

**Authors and study objective.** Wood, Al-Khairulla, and Lask's 2011 study focused on evaluating group-based CRT delivered to adolescent inpatients with AN.

**Methodology.** A total of nine participants were recruited from an inpatient adolescent AN program, comprised of eight females and one male. Each patient was between 13 to 19 years old, illness duration ranged from 2 to 6 years, and inpatient admissions varied from 1 to 3. Participants completed the Ravello Profile (Rose, Davis, Frampton, & Lask, 2011) in order to identify specific strengths and weaknesses. The CRT treatment program implemented was based

on the individual adult model designed by Tchanturia, Davis, Reeder, and Wykes (2010), and included four 30-minute (twice per week) and six 45-60 minute (weekly) group sessions, for a total of ten sessions. Six participants attended all ten meetings, whereas three only attended between three and four. A maximum of three cognitive tasks were covered per session, focused on developing executive functioning skills such as central coherence, cognitive flexibility, response inhibition, divided attention, and/or planning and prioritizing. Participants were also provided with individualized evaluation letters after the ninth session, regarding what the facilitators believed they had learned throughout treatment. During the tenth meeting, there was a group discussion regarding CRT and the participants also wrote feedback letters.

**Results.** Results were obtained from group facilitators' observations in addition to the feedback letters received from participants. Positive experiences identified included that participants engaged well with CRT, which the authors attributed to the fun and playful interventions. They also described the group's atmosphere as relaxed, as participants were willing to discuss difficulties while utilizing humor and responding well to constructive criticism. The program promoted the normality of imperfection, tasks encouraged cognitive flexibility, and a patient who had generally presented as withdrawn participated in CRT. Various critiques were also identified, including that some tasks seemed irrelevant, boring, and oversimplified to certain individuals; that sessions became repetitive; that participants lost concentration after 30 minutes; and that certain unspecified unfavorable group dynamics negatively impacted the group.

**Discussion, conclusions, and clinical implications.** Based on these results, Wood, Al-Khairulla, and Lask concluded that CRT increased patients' awareness of their cognitive deficits and a willingness to discuss associated thinking styles. An example was provided in which participants demonstrated an ability to relate cognitive rigidity in daily situations to CRT concepts, as well as engage in set shifting by identifying alternative strategies Improved task performance was also reported, as one participant evidenced an improved ability in considering

the bigger picture while describing a figure, rather than excessively focusing on detail as they had previously done. A third conclusion was that the CRT tasks facilitated discussions about thinking patterns and their impact on daily functioning (e.g., challenging perfectionism after a timed line bisection task). The researchers also discussed modifications of their CRT protocol following the study, reducing the number of sessions from 10 to 8, and incorporating more "age-appropriate" materials for adolescents. Overall, Wood and colleagues concluded that group CRT is a novel, exciting, and well-received treatment for AN patients.

**Critical appraisal and suggested future directions.** A variety of limitations are noted in regards to Wood, Al-Khairulla, and Lask's study. Cultural and demographic factors reported were extremely limited, and there was no discussion of generalizability to other populations. A third of the participants failed to attend all 10 sessions, instead only attending between three to four, yet no explanation was provided. Though their patients completed the Ravello Profile in order to distinguish specific strengths and weaknesses, the group intervention described did not present as individualized. Future studies should evaluate the efficacy of group CRT that is more individualized. Participants' feedback letters may have been biased considering that they had received individualized evaluation letters during the prior CRT group, and were also informed that the facilitators would read their letters.

While the researchers reported observing improved task performance, limited information was provided, findings were clinically noted, and no quantitative data were analyzed to support their conclusions. Moreover, the authors claimed that task performance improved based on observing one participant's performance on a single measure. There are clear limitations regarding the significance of this finding based on one participant. Wood and colleagues stated that a group discussion on perfectionism followed a task, yet did not provide any added benefit

to having this discussion following a CRT intervention, as opposed to simply introducing the topic. Future studies should assess the potential benefit of introducing matters such as this following a CRT task. Additionally, it seemed as though they chose to include certain results in their conclusions, for example, concluding that CRT is exciting, while also reporting that some participants found the interventions boring. They also reported that unfavorable group dynamics negatively impacted the group, however neglected to provide any additional information related to this matter. Future studies may seek to address dysfunctional group issues unique to CRT.

**Study 8: Effectiveness of Cognitive Remediation Therapy (CRT) in Anorexia Nervosa: A Case Series (Abbate-Daga, Buzzichelli, Marzola, Amianto, & Fassino, 2012)**

**Authors and study objective.** Abbate-Daga, Buzzichelli, Marzola, Amianto, and Fassino's 2012 case series explored the effectiveness of CRT delivered to an outpatient population with AN. Their two major aims included to assess whether CRT was effective in improving cognitive flexibility in verbal and nonverbal domains, and to determine if this treatment could be associated with weight and eating psychopathology improvements.

**Methodology.** Abbate-Daga's team consecutively recruited 20 AN restricting type (AN-R) outpatients over the course of one year from the Eating Disorders Center of Turin University. Participants were Caucasian females who met the Structured Clinical Interview for DSM Disorders diagnostic criteria for AN-R, had a normal IQ range, and had no severe medical comorbidities, substance dependence, or need for acute hospitalization. The authors reported that they collected sociodemographical and clinical data during the first clinical evaluation with each participant, which included an assessment of eating characteristics using the Eating Disorder Inventory-2 (EDI-2) and body mass index (BMI), mood was evaluated with the Beck Depression Inventory (BDI), and overall functioning was determined according to the Global

Assessment of Functioning scale (GAF). The mean age of participants was 22.5 (*SD* = 3.9), median age of onset was 16.65 (*SD* = 2.21), mean duration of illness was 5.85 years (*SD* = 3.87), mean years of education was 12.15 (*SD* = 2.23), mean BMI and weight at first assessment were 16.24 (*SD* = 1.09) and 43.41 kg (*SD* = 3.51), respectively. Neuropsychological assessment measures were administered by a trained investigator at baseline and following CRT, and included various executive-based measures, such as tests of abstraction ability and cognitive strategies in response to changing environmental contingencies (pen-paper version of the Wisconsin Card Sorting Test (WCST)), decision-making ability (Iowa Gambling Task (IGT)), attention and cognitive flexibility (Trail Making Test (TMT) Parts A and B), and response initiation and suppression (Hayling Sentence Completion Task (HSCT)).

Each participant completed one 45-minute CRT session each week over the course of 10 weeks, which were conducted by supervised clinical psychologists trained in a manualized CRT protocol (Tchanturia et al., 2010). CRT interventions utilized during these sessions included geometric figures, illusions, Stroop materials, manipulations, infinity signs, line bisection, token towers, hand tasks, maps, the main idea, switching attention, and embedded words. Additionally, patients wrote feedback letters following treatment, however further details regarding these were limited. In order to assess the level of statistical significance in cognitive flexibility, decision-making strategies, and clinical conditions pre and post CRT, the authors used a paired-sample statistic on the Statistical Package for Social Sciences (SPSS) program (Alpha level <.05; Cohen's *d* 0.2 = small, 0.5 = medium, 0.8 = large effect sizes).

**Results.** Results suggested significant change in neuropsychological performance and psychological symptoms following CRT. Improvements were identified on the WCST, BMI, GAF, EDI-2 subscales (impulse regulation and interoceptive awareness), reflexive skills, and awareness. Interestingly, perfectionism failed to improve.

**Discussion, conclusions, and clinical implications.** Based on these results, Abbate-Daga's team posited that their study replicated and expanded upon research supporting the efficacy of CRT in enhancing cognitive flexibility (Tchanturia, Davies, & Campbell, 2007; Tchanturia et al., 2008). Specifically, they reported that following CRT, participants' motivation increased and their neuropsychological performance improved, they were less impulsive and more interoceptively aware. The researchers suggested that increased motivation was evident as participants became more involved with treatment, did not drop out, were compliant (Genders & Tchanturia, 2010; Pitt et al., 2010; Tchanturia at al., 2008), experienced a sense of achievement and positive self-esteem upon task completion (Pitt et al., 2010), and found CRT both useful and interesting. In terms of changes in neuropsychological performance following CRT, the authors reported that participants demonstrated enhanced cognitive flexibility as evidenced by improved set shifting on the TMT (medium effect size) and WCST (large and medium effect sizes). Clinically, the researchers suggested these cognitive improvements may assist AN patients in recognizing and managing distorted cognitions. Statistical analyses revealed a small effect size for the HSCT, suggesting that the patients' verbal functioning remained unchanged. Abbate-Daga and colleagues hypothesize that this may have been because CRT does not focus on altering verbal domains, and also because verbal rigidity may be more impervious to change.

CRT was also associated with improvements on the EDI-2 subscale's impulse regulation and interoceptive awareness. The authors noted that this finding might be due to a variety of factors, and suggested that CRT's focus on increasing patients' reflexivity, awareness, and cognitive flexibility on in-session tasks translates behaviorally as patients spend more time accurately reflecting on detailed and global aspects of day-to-day situations. While these researchers identified no improvement in participants' levels of perfectionism, they suggested that a treatment's impact on perfectionism is only valid for AN participants with high levels of pre-treatment perfectionism, which was not an inclusion criteria of their study.

**Critical appraisal and suggested future directions.** While the findings of this study are promising, a variety of limitations are also apparent. Improvements in neuropsychological performance may have been a result of other factors such as nutritional stabilization, rather than a direct effect of the CRT program. However, increasing BMI alone is not effective in improving test performance (Kingston, Szmukler, Andrewes, Tress, & Desmond, 1996; Tchanturia et al., 2004), nutritional stabilization may not be the most pertinent factor. The researchers also noted prior research supporting the direct effect of CRT and that improvements following treatment-as-usual are not statistically significant (Tchanturia et al., 2004) or comparable with CRT (Tchanturia et al., 2007; Tchanturia et al., 2008). Improvements on two of the EDI-2 subscales, interoceptive awareness and impulse regulation, may be attributed to nonspecific effects, which may have been further influenced by the studies' small sample size (*n* = 8) and lack of control group. The test battery failed to include a measure of attention to details. Increased BMI may be an effect of the beginning of treatment (i.e., due to a refeeding protocol) rather than CRT.

There are a number of additional concerns to consider. The authors do not state how participant IQ was determined, nor do they identify the source of normative data. The potential influences of practice effects, such as those often seen on the WCST, are not adequately addressed (e.g., they stated that the test-retest procedure could have biased the results, however do not elaborate). While these authors gathered qualitative data via patients' feedback letters, no analysis was conducted on these data. They reported no change in patients' verbal functioning, and suggest that CRT does not focus on verbal performance. Clinically, this brings into question this intervention's ability to restructure brain regions possibly associated with cognitive distortions and maladaptive thinking patterns maintaining AN. Finally, Abbate-Daga et al.'s study has limited generalizability to other populations, including outpatients and cultural groups outside the United Kingdom.

**Study 9: Evaluation of a Cognitive Remediation Therapy Group for Adolescents with Anorexia Nervosa: Pilot Study (Pretorius, Dimmer, Power, Eisler, Simic, & Tchanturia, 2012)**

**Authors and study objective.** Pretorius, Dimmer, Power, Eisler, Simic, and Tchanturia's pilot study (2012) assessed the effectiveness and acceptability of CRT delivered to an adolescent population with AN. These researchers focused on examining changes in participants' cognitive flexibility, and their perceptions of the treatment. Of note, they reported that this represents a demographic group and study focus not previously analyzed. However, Wood, Al-Khairulla, and Lask (2011) also examine the effects of CRT on adolescent patients (previously discussed).

**Methodology.** Participants were selected from a Child and Adolescent Eating Disorders Service program offered at the Maudsley Hospital in London. Twenty four adolescents were included in the final analysis, including twenty three female and one male, all of whom met diagnostic criteria for AN or EDNOS-AN. Three self-report questionnaires were administered pre and post CRT, including the Cognitive Flexibility Scale (CFS; Martin & Rubin, 1995) to assess cognitive flexibility, the "motivational ruler" to evaluate self-reported importance and ability to change, and a satisfaction questionnaire (developed by the CRT group facilitators) to gather feedback about group experiences. The CRT treatment protocol consisted of four weekly group sessions lasting 45-minutes each, and were based on the Genders and Tchanturia model (2010). While attending the CRT groups, participants continued to receive the center's standard treatments, including DBT, CBT, family sessions, meals, and education. The group focus changed from week to week, and was comprised of 'bigger picture' exercises, such as describing a complex shape to a partner (group one); set-shifting exercises, such as practicing a color-word Stroop task (group two); multitasking exercise, such as playing a card game while

maintaining a conversation (group three); and summary, consolidation, and discussion about practical applications of skills (group four). Between session homework was also assigned in order to practice skills taught and relate CRT techniques to real-word situations.

**Results.** Following data collection, the researchers performed paired t-tests utilizing SPSS, Cohen's d effect sizes were calculated pre and post-CRT, and Pearson's correlation coefficients were used to assess changes in CFS scores. The results revealed a small effect size between the CFS scores, suggesting that participants endorsed small improvements in cognitive flexibility However, the authors posited that the scores approached significance when excluding three participants whose illness duration were outliers and the two whose illness duration was unknown. A significant positive correlation was found between adolescents' ratings of importance to changes at baseline and their CFS change score, yet there were negligible changes in their self-reported motivation to get better. In regard to the satisfaction questionnaire, a number of participants reported that they found exercises interesting, fun and not over-challenging. They also noted that it had been helpful to learn about thinking styles, the pros and cons of different approaches to situations, how to reflect on their thinking styles, trying out novel strategies, and practicing flexibility. While a few participants denied disliking any aspect of the group, others found the activities dull, repetitive, or limited. Additionally, certain participants reported felling bad or inadequate at following certain activities, during discussions, while providing feedback, and when realizing that rigid thinking was unhelpful. Participants recommended including wide-ranging activities, summary sheets to refer to, decreasing talking and including a greater number of opportunities to practice implementing skills in real-life.

**Discussion, conclusions, and clinical implications.** Pretorius's team reported that the positive comments provided by participants regarding their experience of CRT was noteworthy in terms of engaging young people with treatment. They also suggested that future CRT include the recommendations made by these participants. A variety of explanations were

provided for the small effect size of change in cognitive flexibility. One hypothesis was that the very limited number of sessions (four sessions total, meeting once per week) was not sufficient to produce change. The treatment manual suggests that CRT for AN be implemented over a course of 10 sessions (Tchanturia, Davis et al., 2010), which was the quantity utilized in a majority of previous studies (i.e., Abbate-Daga et al., 2012; Pitt et al., 2010; Pretorius & Tchanturia, 2007; Tchanturia et al., 2007; Tchanturia et al., 2008; Wood et al., 2011). Pretorius and colleagues' four-session course is notably lower, the effects of which likely influenced treatment outcome. The researches also posited that the self-report measures were unable to accurately capture changes in flexibility. However, the validity of the CFS is supported by the literature (Martin & Anderson, 1998; Martin & Rubin, 1995). Finally, the authors suggested that CRT might be ineffective for adolescents. Rather than prematurely assuming that this treatment is inefficacious, it may be more accurate to conclude that there is currently limited evidence that it works for youth populations and that future research is needed.

**Critical appraisal and suggested future directions.** A number of limitations are noted for this study, including small sample size, lack of control group, and confounding factors such reported felling bad or inadequate at following certain activities, during discussions, while providing feedback, and when realizing that rigid thinking was unhelpful. Participants recommended including wide-ranging activities, summary sheets to refer to, decreasing talking and including a greater number of opportunities to practice implementing skills in real-life.

While Pretorius and colleagues noted that AN and EDNOS-AN groups have similar eating and psychopathology (Thomas, Vartanian, & Bownell, 2009), it is possible that subtle differences lead to considerable differences in treatment outcomes. Demographic factors reported included age and sex, yet the neglect to consider additional cultural factors impacted the generalizability of their findings. Moreover, they failed to discuss in adequate detail the

experience of patients' that were not fully engaged in treatment, instead finding it dull and even feeling inadequate.

**Summary of Main Findings**

Research conducted on CRT for AN has revealed a variety of promising findings, 12-week (Pretorius & Tchanturia, 2007) and 18-month follow-ups (Tchanturia et al., 2007). There is evidence that patients having received CRT do not readmit to inpatient treatment, instead function at a level that enables them to engage in occupational or academic activities (Tchanturia et al., 2007). Evidence from these studies also suggested that CRT improves neuropsychological performance, especially within the executive domain of timed and untimed set-shifting (Abbate-Daga et al., 2012; Cwojdzińska et al., 2009; Tchanturia et al., 2007). CRT has also been shown to reduce perseveration and increase AN patients' capacity to perceive a larger, holistic picture as opposed to being excessively detail-oriented (Tchanturia et al., 2008; Wood et al., 2011). A decrease in eating disorder (Abbate-Daga et al., 2012; Cwojdzińska et al., 2009) and depressive symptomatology (Cwojdzińska et al., 2009; Tchanturia et al., 2008) is also noted following the final CRT session. Reevaluating these effects at various stages during follow-up or comparing them to alternative treatment populations remain areas of future study. Overall, this remediative treatment is accepted and even enjoyed by both patients with AN (Abbate-Daga et al., 2012; Pitt et al., 2010; Pretorius et al., 2012; Tchanturia et al., 2007; Wood et al., 2011), and treating clinicians (Genders & Tchanturia, 2010). Importantly, participants of these studies also reported increased motivation (Abbate-Daga et al., 2012; Pretorius et al., 2012) as well as confidence in their ability to change (Genders & Tchanturia, 2010) and begin subsequent therapies (Pretorius & Tchanturia, 2007). Based on these findings, CRT has been noted as a potential pretreatment which primes patients for more complex therapies (Genders & Tchanturia, 2010; Pretorius & Tchanturia, 2007).

While these preliminary findings are encouraging, the studies reviewed evidenced a number of important limitations. Sample sizes were extremely small (i.e., Cwojdzińska et al., 2009; Pitt et al., 2010; Pretorius & Tchanturia, 2007; Pretorius et al., 2012; Tchanturia et al., 2007; Wood et al., 2011), resulting in low statistical power. Generalizability was undermined by such limited power and failures to identify or consider demographic and cultural variables, such as gender, SES, or ethnicity (i.e., Abbate-Daga et al., 2012; Genders & Tchanturia, 2010; Pretorius & Tchanturia, 2007; Pretorius et al., 2012; Tchanturia et al., 2007; Tchanturia et al., 2008; Wood et al., 2011). Additional methodological limitations were also apparent, as many of the studies failed to assess general intelligence or reference the normative data used (i.e., Abbate-Daga et al., 2012; Tchanturia et al., 2007). Authors often neglected to identify or discuss potential cohort (i.e., Tchanturia et al., 2007) or practice effects (i.e., Tchanturia et al., 2008). In addition, extremely limited details were provided in terms of actual session structure (i.e., Genders & Tchanturia, 2010; Pretorius & Tchanturia, 2007; Tchanturia et al., 2007) and terms utilized (e.g., "change") (i.e., Pitt et al., 2010), influencing studies' reproducibility. Most of the studies were unable to reliably determine any direct effects (i.e., Tchanturia et al., 2008), and a number of conclusions were drawn from qualitative self-report alone and not supported by quantitative statistical analyses (i.e., Abbate-Daga et al., 2012; Genders & Tchanturia, 2010; Wood et al., 2011). Moreover, certain participants continued to receive additional treatments, such as DBT, CBT, and family therapy, undermining the possibility of assessing for direct effects (Pretorius et al., 2012). Finally, potential biases may have been introduced while collating qualitative data, as facilitators provided suggestions to patients and informed them that their therapists would read their letters (Pitt et al., 2010). At present, the most effective "dose" of CRT is unclear, and research supporting its efficacy with youth populations is extremely limited.

**Specific Future Research Directions**

As suggested by Abbate-Daga et al. (2012), the previously described studies were preliminary in nature and necessitate the need for future research on CRT for AN. Nevertheless, this groundwork illuminates promising results in the treatment of a diagnostically complex and challenging disorder. While there is some evidence that CRT improves executive functioning impairments underlying AN, generalizability of findings are clearly limited by inadequate sample sizes, lack of control groups, and limited demographic considerations. Additionally, there remains an important question of ecological validity, as no study adequately addressed the clinical implications of this treatment paradigm. In consideration of these factors, specific recommendations for areas of future research are subdivided into the following categories: improve upon generalizability, evaluate treatment efficacy, appraise CRT as a pretreatment, assess CRT implementation/logistics, and neuroimaging/neuropsychological research.

1. Improve upon generalizability.
    a. Future research would benefit from gathering a greater number of study participants in order to increase sample size and statistical power.
    b. Future studies should include a control group.
    c. Future research should elucidate upon demographic variables (e.g., age, ethnicity, education level, gender, and SES).
2. Evaluate treatment efficacy.
    a. CRT should be evaluated on its effectiveness in various cultural populations (e.g., age, ethnicity, education level, gender, and SES).
    b. Future research should evaluate the extent of behavioral and psychological changes following executive improvements.

i. Does improved cognitive flexibility and global processing abilities following CRT translate to improvements in AN symptomatology (e.g., more flexible dietary behaviors/beliefs, improved body image, less focus on food/weight/exercise)?

ii. Does increased metacognition contribute to clinical outcomes for patients with AN, and if so, in what ways?

c. Future research should reevaluate treatment effects at various stages during follow-up (e.g., 6-month, 12-month, 36-month, etc.).

d. Future studies should compare CRT with alternative treatments such as refeeding (Tchanturia, Lloyd, & Lang, 2013), DBT, CBT, family therapy, and psychoeducation.

i. Future studies should compare the effectiveness of behavioral experiments introduced via CRT versus CBT (e.g., is there an advantage to implementing such activities following CRT tasks?).

ii. Future studies should assess the potential benefit of introducing topics such as perfectionism following a CRT task, versus discussing the construct in a psychoeducative format.

e. Future research within this domain may focus on determining whether qualitative data (i.e., a patient's perception of increased cognitive flexibility attributed to CRT) or quantitative data (i.e., improved objective results on test performance following CRT) leads to greater clinical outcomes.

f. Future studies should ascertain which AN patients are optimal for CRT (e.g., are more likely to positively receive the treatment and find it helpful) and which are not (e.g., which AN patients are more likely to find the interventions meaningless, tedious, or boring).

g. Future research should elaborate on the finding that no significant changes in anxiety or obsessive-compulsiveness have been identified following CRT, despite reduced perseveration on neuropsychological tests.

3. Appraise CRT as a pretreatment
    a. Do CRT interventions mediate subsequent therapies (i.e., is there a significant treatment effect associated with receiving CRT as a pretreatment)?
    b. If so, in what ways does CRT prime patients for follow-up psychotherapy?
    c. Does CRT differentially prepare patients for particular types of treatments (e.g., does CRT better prepare patients for CBT, family-based, or psychodynamic therapy)?
4. Assess CRT implementation/logistics
    a. Future studies should evaluate various implementations of CRT, including logistics (e.g., length of treatment), modality (e.g., individual, group, family), and delivery (e.g., by a psychologist, other treatment provider, or caregiver) (Tchanturia et al., 2013).
    b. Future studies should identify and address dysfunctional issues unique to implementing CRT in a group format.
    c. The development and evaluation of a CRT program that integrates emotional regulation skills represents an area of future study.
5. Neuroimaging/neuropsychological research
    a. Future studies are needed within the domains of neuroimaging pre and post CRT (Tchanturia et al., 2013).
    b. Future research should include alternative versions of neuropsychological tests administered within the battery in order to account for practice effects.

**Specific Clinical Applications**

An in-depth understanding of the diagnostic and clinical features of AN (see *Chapter I*) is a foundational competency when providing psychological treatment to members of this unique patient population. In order to further improve upon this baseline, clinicians may integrate a comprehensive and detailed understanding of executive functioning symptomatology (see *Chapter II*) and neuropsychological rehabilitation specific to AN. By doing so, treatment outcomes may be optimized through a valuable evidence-based conceptualization (i.e., The Insula hypotheses; see *Chapter V*) and associated treatment paradigm, CRT for AN (see *Chapter III*). Careful collation, appraisal, and consideration of the research on this treatment modality (see *Chapter VI*) allows for the delineation of specific clinical applications that can be utilized, given the current limited albeit promising findings.

Developing a biological understanding of AN, such as that posed by the Insula Hypotheses, may be of particular use to clinicians, as such an etiological model serves to increase empathy and reduce stigma. Moreover, this conceptualization may prove particularly helpful when other explanations do not adequately account for a client's history or symptomatic presentation. Clinicians may also find it beneficial to have an understanding of the biological ramifications of AN, particularly those that effect the brain and are associated with observable behaviors including perseveration, obsessiveness, and perfectionism.

Clinicians may perceive the addition of CRT skills to their clinical repertoire as especially helpful when interfacing with the diagnostically complex and prognostically challenging diagnosis of AN. More specifically, they may view CRT as a novel approach to be utilized at the outset of treatment and if a patient is deemed unable to benefit from more complex therapies. CRT may be efficacious for acute AN patients who experience significant distress when discussing emotionally-laden material such as calories or body size, to the extent that

doing so is iatrogenic. Based on the literature, these patients consider CRT a relatively manageable approach, which adequately prepares them for subsequent psychotherapies. Therapists may therefore employ CRT as a means by which to create a safe therapeutic environment. Clinicians may also find that CRT activities assist them in introducing certain therapeutic discussions (e.g., the consequences of being overly detail focused or inflexible) or when implementing between session behavioral experiments (e.g., choosing a different food item as a set-shifting experiment).

The treating clinician may consider conducting a quantitative and/or qualitative evaluation during the beginning phase of treatment with a patient with AN. During this process, a focus on evaluating executive functioning may be quite helpful. This may be accomplished by providing a referral for neuropsychological assessment, administering an abbreviated cognitive assessment battery that also includes self-report questionnaires, or discussing the patient's ability to perceive the larger picture (e.g., gestalt) and multitask in an efficient manner (e.g., set-shifting ability). Based on the information gathered during the assessment, the clinician may consider developing an individualized CRT program tailored to the patient's unique needs. Treatment may then target cognitive processes, and the patient may receive psychotherapy focused on the content of their thoughts in either concurrent treatments or as a subsequent therapy following CRT.

During the course of CRT, the therapist may decide to gather and monitor data pertaining to treatment progress during supervision or case consultation. The clinician may choose to do this by carefully monitoring physical, psychological, and behavioral changes through serial assessments, such as weekly monitoring of weight/BMI; documenting behavioral observations regarding the patient's approach to CRT tasks; administering nomothetic questionnaires such as the Eating Disorder Inventory (EDI), or if clinically indicated, developing an ideographic

instrument specific to the goals of the patient; collecting qualitative data in the form of feedback letters, such as those received during a majority of the previously described studies; and/or actively posing reflective questions in order to qualitatively monitor treatment progress. The therapist may also consider supporting patients' abilities to translate in-session skills to daily life by encouraging the relation of thinking styles identified during sessions to out-of-session functioning, to ultimately increase ecological validity.

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# APPENDIX A:

## IRB Notice

IRB Notice

PEPPERDINE UNIVERSITY

Graduate & Professional Schools Institutional Review Board

Protocol #: PS0415D01
Project Title: Neuropsychological Rehabilitation Specific to Anorexic Nervosa: A Critical Review of the Literature of Executive Functioning of Symptomatology and Cognitive Remediation Treatment Applications Tailored to this Patient Population

**Re: Research Study Not Subject to IRB Review**

Dear:

Thank you for submitting your application, *Neuropsychological Rehabilitation Specific to Anorexic Nervosa: A Critical Review of the Literature of Executive Functioning of Symptomatology and Cognitive Remediation Treatment Applications Tailored to this Patient Population*, to Pepperdine University's Graduate and Professional Schools Institutional Review Board (GPS IRB). After thorough review of your documents you have submitted, the GPS IRB has determined that your research is **not** subject to review because as you stated in your application your dissertation ***research*** study is a "critical review" of the literature and does not involve interaction with human subjects. If your dissertation research study is modified and thus involves interactions with human subjects it is at that time you will be required to submit an IRB application.

Should you have additional questions, please contact the Kevin Collins Manager of Institutional Review Board (IRB) at 310-568-2305 or via email at kevin.collins@pepperdine.edu or Dr. Bryant-Davis, Faculty Chair of GPS IRB at gpsirb@pepperdine.edu. On behalf of the GPS IRB, I wish you continued success in this scholarly pursuit.

Sincerely,

Thema Bryant-Davis, Ph.D.
Chair, Graduate and Professional Schools IRB

cc: Dr. Lee Kats, Vice Provost for Research and Strategic Initiatives
Mr. Brett Leach, Compliance Attorney
Dr. Judy Ho, Faculty Advisor