

2013

# A Single Case Study of Cognitive Remediation Therapy with an Adolescent with Disordered Eating

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Philadelphia College of Osteopathic Medicine

Department of Psychology

A SINGLE CASE STUDY OF COGNITIVE REMEDIATION THERAPY WITH AN  
ADOLESCENT WITH DISORDERED EATING

By Carol Lynn Galiano

Submitted in Partial Fulfillment of the Requirements of the Degree of

Doctor in Psychology

April 2013

**PHILADELPHIA COLLEGE OF OSTEOPATHIC MEDICINE  
DEPARTMENT OF PSYCHOLOGY**

**Dissertation Approval**

This is to certify that the thesis presented to us by Carol Galiano  
on the 2<sup>nd</sup> day of May, 2013, in partial fulfillment of the requirements for the degree of  
Doctor of Psychology, has been examined and is acceptable in both scholarship and  
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## Acknowledgements

It is my great pleasure to express my sincere gratitude to my advisor, Dr. Rosemary Mennuti, for her encouragement, supervision, and support throughout the dissertation process.

I owe special thanks to my outstanding committee members, Drs. Lisa Hain and Evelyn Minaya. I appreciate your time and dedication in serving on this committee and your guidance and support have been invaluable. I would also like to thank the participant in this study for working arduously after school and on weekends to complete this project.

I owe the world to my mother and father, John and Eleanor Galiano; without their encouragement and support, none of this would have been possible. I would also like to express my thanks to my brother, sister-in-law, nephew, nieces, and friends for their support throughout my graduate studies.

## **Abstract**

Picky eating is currently not included in the diagnostic classification system DSM-IV TR as a distinct category of eating disorders in childhood. It can reach clinical significance requiring intervention when it results in chronic nutritional inadequacies and/or harmful impact on social development or family functioning. Studies have shown that patients with eating disorders have difficulties with executive functioning. These findings have been used to develop an intervention based on cognitive remediation therapy (CRT) which targets thinking skills and their role in the development and maintenance of an eating disorder. To further investigate, this study assessed the efficacy of an 8-week, intensive cognitive training program in a pre-adolescent with picky eating behaviors. The participant was assessed before and after the eight sessions using assessments of executive function and a personality measure. The parent participated in a clinical interview and completed a paper-and-pencil measure of executive functioning at baseline and post-treatment. Assessment results showed improvements in logical planning, shifting, and self-confidence. The participant was aware of an improvement in his attention. Participant feedback was generally negative towards cognitive training. This study suggests that cognitive training appears promising as an intervention in improving executive functioning. The short nature and promising results of this intervention make it an attractive addition in the school setting for at-risk students with disordered eating.

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## Chapter One

### A Single Case Study of Cognitive Remediation Therapy with an Adolescent with Disordered Eating

Anorexia nervosa (AN) is thought to be a disorder of complex etiology, in which the genetic, biological, psychological, and sociocultural factors, and the interactions between them, seem to contribute significantly to susceptibility (Jacobi, Hayward, De Zwaan, Kraemer, & Agras, 2004; Connan, Campbell, Katzman, Lightman, & Treasure, 2003). Epidemiological studies show that AN is not randomly distributed among all populations. Young females are the most vulnerable group (Hoek and van Hoeken, 2003). Studies suggest that incidence rates among children and adolescents with eating disorders are increasing (Dorian & Garfinkel, 1999). Additionally, the literature indicates that there is currently limited evidence to support psychological treatments for AN (Bulik, Berkman, Brownley, Sedway, & Lohr, 2007). A recent review suggests that outcomes for AN have not improved in the past 50 years (Steinhausen, 2002).

It has been suggested that neurobiological abnormalities may be involved in eating disorders. The most robust findings are supported with systematic reviews (Roberts, Tchanturia, Stahl, Southgate, & Treasure, 2007; Lopez, Tchanturia, Stahl, & Treasure, 2008b), which found that set shifting and central coherence are the areas where individuals with eating disorders show suboptimal performance compared with control groups. However, these neuropsychological processes and thinking styles are not addressed in current treatments (Treasure, Tchanturia, & Schmidt, 2005). In the treatment of other psychiatric disorders, for example, schizophrenia, neuropsychological processes and thinking skills are being addressed and it has been demonstrated that cognitive remediation therapy (CRT) improves working memory, planning

skills, and flexibility (Wykes, Reeder, Williams, Corner, Rice, & Everitt, 2003). More specifically, CRT aims to train basic brain processes through the bolstering and refining of neural connections and also to develop compensatory strategies (Davies & Tchanturia, 2005). Its primary function is to improve thinking skills. This intervention may increase the effectiveness of therapy because adolescents suffering from AN can practice skills in cognitive flexibility and global processing and then apply this knowledge to the areas in their lives in which they have the greatest struggles. Given the limited evidence base of existing therapies for eating disorders in pre-adolescents and the growing interest in examining the eating disorder field from a neuroscience perspective, the intent of this research project is to address cognitive characteristics such as inflexibility and an excessive attention to detail in treatment for young, at-risk individuals with disordered eating. Thus, the idea of CRT is to help to make thinking processes more flexible, to “think outside the box”, and to see the bigger picture using cognitive game-like exercises.

In summary, developmental risk factors such as age of onset and biological and cognitive developmental processes support the idea that young adolescents with disordered eating may benefit from an intervention such as CRT. It is hoped that such an intervention has the potential for greater impact on these developing processes in young adolescents with less “fixed” cognitive processing styles. In this population, it also highlights the importance of the planning and development of CRT intervention efforts at the middle school and high school levels in order to improve coping and psychosocial adjustment of students who are at known, increased risk for developing eating disorders.

### **Statement of the Problem**

Neurological studies have revealed that individuals with AN are inflexible on cognitive tasks and are unable to change past patterns of thinking (Tchanturia et al., 2004b). An important clinical factor seems to be their rigid and persistent patterns of behavior. People who are triggered into the development of an eating disorder apply these traits to food and shape. For example, individuals with AN often present with rigid rules around food and eating, when and where they can eat, and how many calories they can take in. Such rules are extremely well ingrained and difficult to change. This lack of flexibility can make therapy challenging and frustrating.

The (National Institute of Clinical Excellence [NICE], 2004) guidelines have concluded that there is currently no recommended psychological treatment nor is there substantial evidence supporting pharmacological intervention. The major focus of therapeutic work currently for AN is cognitive behavioral therapy (CBT), cognitive analytical therapy (CAT), interpersonal therapy, dynamic therapy, motivational enhancement therapy (MET), and family therapy (NICE, 2004). Unfortunately, people at a severely underweight stage of AN can have difficulties engaging in these therapeutic interventions. This can be due to a number of reasons: the inability to confront or admit to an eating disorder, thus the belief that psychological treatment is not required; anxieties about confronting deeply personal and emotional issues; and low weight and malnutrition may alter cognitive processes and stamina, which can make engagement in one of these therapeutic processes difficult (Davies & Tchanturia, 2005).

Although there is neuropsychological data showing that individuals with AN have problems with basic thinking skills, neuropsychological processes and thinking skills are not addressed in

current treatments (Treasure et al., 2005). It is hypothesized that CRT works by training basic brain processes through the creation and refining of neural connections without the complexity of confronting issues or emotions that relate to the eating disorder (Davies & Tchanturia, 2005). Thus, improved thinking skills can then be used to facilitate more complex behaviors and everyday living skills, as well as being utilized in future therapies which will address emotion and thought (Davies & Tchanturia, 2005). Consequently, the primary function of CRT is to improve the thinking process. This finding has important implications for eating disorders in childhood and adolescence. Picky eating, the rejection of a large variety of foods, represents a very strong psychological barrier to healthy eating. It is therefore important to examine factors that can reduce these barriers toward healthy eating. In a school or clinical setting, it might be possible to focus on increasing flexibility for these individuals. It may be that a broad range of flexibility tasks may have benefits to their overall functioning in everyday life and consumption of a variety of foods.

### **Purpose of the Study**

The purpose of this study will be to expand upon the existing literature about pre-adolescent eating disorders by paralleling psychological treatment applied to other psychiatric disorders such as schizophrenia, in which CRT had been found to be an effective intervention to stimulate mental activities and improve thinking skills. Picky eating is currently not included in the diagnostic classification system DSM-IV TR as a distinct category of eating disorders in childhood. It can reach clinical significance requiring intervention when it results in chronic nutritional inadequacies and/or has harmful consequences on social development or family functioning. Neuropsychological studies have shown that individuals with eating disorders have

difficulties with executive functioning. These findings have been used to develop an intervention based on cognitive remediation therapy (CRT), which targets thinking skills and the role of these skills in the development and maintenance of an eating disorder. This study will assess the efficacy of an 8-week, intensive cognitive training program on a pre-adolescent with picky eating behaviors. Its goal will be to add to the base of knowledge available to clinicians, practicing in private and/or in school settings, who are involved in working with individuals with disordered eating. Specifically, this study will encourage one to reflect on whether certain cognitive styles (local or global processing) emerge in everyday life. The individual is encouraged to think about how such processing styles interfere with his or her quality of life and also how to introduce more flexibility into his or her daily life.

Currently, the research in this area is at its early stages. The varying symptom profiles in pre-adolescent eating disorders have received not only relatively little empirical attention, but also few guidelines for best practice, despite one recent study documenting the fact that food avoidant emotional disorder and selective eating account for more pre-adolescent presentations than AN (Cooper, Watkins, Bryant-Waugh, & Lask, 2002). Thus it is hypothesized that CRT could enhance executive functions such as set shifting and achieve a more balanced approach to be more flexible. Specifically, this study will empirically test the prediction that participation in a computer-based flexibility training program will produce overall improvement in cognitive set shifting skills. It is believed that the participant involved in this intervention will report positive feedback following the treatment period.

## Chapter Two

### Theoretical Background and Related Literature

The *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision* (DSM-IV-TR) (American Psychiatric Association, 2000) defines eating disorders as disturbances in eating behavior. Eating disorders are divided into three diagnostic categories: anorexia nervosa (AN), bulimia nervosa (BN), and eating disorders not otherwise specified (ED NOS). Anorexia nervosa is a disorder that is characterized by strong desire to stay under minimally healthy body weight. Bulimia nervosa is defined as repeated episodes of binge eating and elimination of foods through artificial means such as self-induced vomiting, use of laxatives, periods of fasting, or excessive exercise. Eating disorders not otherwise specified are characterized as disordered eating patterns that do not meet the criteria for any specific eating disorder. People with AN and BN are united by a distinctive core psychopathology, which is essentially the same for both females and males. Most adolescents with eating disorders over-evaluate their shape and weight (Murphy, Straebl, Cooper, & Fairburn, 2010). Whereas most individuals evaluate themselves on the basis of their perceived performances in various areas which include relationships, work, and parenting, individuals with AN and BN judge their self-worth largely in terms of their body shape and weight and their ability to control these areas of their lives.

Eating disorders are severe and often chronic disorders associated with substantial problems in physical and psychosocial functioning (Fairburn & Harrison, 2003). For instance, many individuals evidence disturbances in cognitions, interpersonal problems, physical impairment, and psychological problems such as low self-esteem and perfectionism, as well as dysfunctional eating behaviors (e.g., Gillberg, Rastam, Wentz, & Gillberg, 2007; Hartmann, Zeeck, & Barrett,

2010; Katzman, 2005; Halmi et al., 2000). Eating disorders seem to be an increasing health threat in most Western countries (Grave, 2003). In a community-based longitudinal study, Johnson, Cohen, Kasen, and Brook (2002) followed a community sample of 717 adolescents for 10 years. The findings revealed that adolescents with eating disorders were at an increased risk for development of depressive and anxiety disorders, infectious diseases, suicide attempts, chronic pain, insomnia, neurological symptoms, and cardiovascular problems. These findings, therefore, suggest that greater effort should be made to promote increased recognition and improved treatment of eating and weight problems by pediatricians, primary care physicians, and other health professionals.

The general belief is that eating disorders have increased over recent decades. Results of epidemiologic studies have indicated that the numbers of children and adolescents with eating disorders increased steadily from the 1950s onward (Dorian & Garfinkel, 1999). However, the epidemiology of eating disorders has gradually changed; there is an increasing prevalence of eating disorders in males (Domine, Berchtold, Akre, Michaud, & Suris, 2009) and minority populations in the United States (Crago, Shisslak, & Estes, 1996) and also in countries such as China in which eating disorders had not been commonly seen (Lai, 2000). It is estimated that approximately 0.5% of females in the United States have AN, and approximately 1% to 3% meet diagnostic criteria for BN (APA, 2000). A large number of people with eating disorders do not meet the strict criteria set forth in the *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision* (DSM-IV-TR) for AN or BN and are labeled as having “partial syndromes” or “eating disorder not otherwise specified” (ED NOS) (APA, 2000). There are many more patients with ED NOS than there are patients with AN or BN; the prevalence is estimated to be between 0.8% and 14%, depending on the definition used (Chamay-Weber,

Narring, & Michaud, 2005). These patients often experience the same physical and psychological consequences as do those who reach the threshold for diagnosis of AN or BN (Eddy, Doyle, Hoste, Herzog, & le Grange, 2008). Athletes and performers, particularly those who participate in sports and activities that reward a lean body (e.g., gymnastics, running, wrestling, dance, modeling) may be at particular risk of developing partial-syndrome eating disorders (Nichols, Rauh, Lawson, Ji, & Barkai, 2006).

Reports of AN and BN are more common in industrialized nations where food is plentiful and where thinness is correlated with attractiveness. Eating disorders were first reported in Western Europe and the United States; these societies have comparatively similar rates of AN and BN (Pike & Walsh, 1996). Interestingly, industrialized non-Western nations that participate in the global economy, such as Japan and Eastern European nations, have also reported similar rates of eating disorders (Kuboki, Nomura, Ide, Suematsu, & Araki, 1996). While eating disorders appear to have a global distribution, most common in the United States, Canada, Europe, Australia, Japan, New Zealand, and South Africa, prevalence studies have found that they are generally less common in pre-industrialized non-Western societies (APA, 2000). Fichter, Elton, Sourdi, Weyerer, and Koptagel-Ilal (1988) reported the prevalence of AN in Greek girls living in Germany was double the rate for girls living in Greece and Turkey where they remained less exposed to Western values. Similarly, in a study of female university students in Australia, Hong Kong-born girls who were acculturated to Western culture were found to have more positive eating attitudes than Australian-born girls (Lake, Staiger, & Glowinski, 2000), suggesting that the Asian women had the lower risk of eating pathology. This cross-cultural variation in the prevalence of eating disorders supports the role of sociocultural factors in the development of disordered eating.

Society today is obsessed with size, weight, and image. Body dissatisfaction and weight concerns may have a negative impact on children's developing sense of self-worth (Czaja, Rief, & Hilbert, 2009). In addition, body dissatisfaction and weight concerns have been linked to unhealthy weight loss strategies, which may place children at risk for growth stunting, delayed puberty, nutrient deficiencies, illness, and future eating disorders (Cameron, 1996). Eating disorders are often associated with psychological and medical factors that have a negative impact on life expectancy, quality of life, and ability to function in educational, occupational, and social settings. The increase in the number of individuals with eating disorders and with disordered eating is alarming. The negative implications of body dissatisfaction and weight concerns for young children's physical and mental health, in combination with such behaviors and attitudes among children at increasingly younger ages, highlights the necessity of health professionals to improve their understanding and knowledge of the biological, social, and psychological risk factors in children and adolescents, and also to be familiar with early detection and management of these disorders.

### **Picky Eating**

Although the long-term health effects of picky eating are unclear, picky eating is a common disorder during childhood, often causing considerable parental anxiety. Picky (selective) eating is currently not included in the diagnostic classification system DSM-IV TR as a distinct category of eating disorders in childhood. Picky eating is manifested by a child's consumption of an extremely narrow range of foods, often high in carbohydrates. These children are unwilling to try new foods, limit their intake of vegetables and other food groups, have strong food preferences, and often require special food preparation (Mascola, Bryson, & Agras, 2010). Despite this restricted intake, most of these children do not suffer from impaired growth or low

weight. Dubois, Farmer, Girard, and Peterson (2007) found that picky eaters ate fewer calories and were twice as likely to be underweight as non-picky eaters. There is no overconcern about weight or shape and no distorted perception of body size (Murray, Thornton, & Wallis, 2012). Picky eating is a relatively common problem during childhood, and has a reported prevalence of up to 50% (Mascola et al., 2010). Boys seem to be more highly affected than girls. Parents experience picky eating as problematic because of their children's low intake of healthy foods and also because they have more frequent struggles over food and arguments about the children's eating habits (Mascola et al., 2010).

Although research has documented an increase in the prevalence of pre-adolescent eating disorders (Mascola et al., 2010), the variety of symptom presentation in this age group has resulted in difficulties in ascertaining guidelines for best practice in this population. Interestingly, one study documented the fact that food avoidant emotional disorder and selective eating accounts for more pre-adolescent presentations than anorexia nervosa (Cooper et al., 2002). A longitudinal study identified 39% of a cohort of 216 San Francisco children as picky eaters at some point between 2 and 11 years of age (Mascola et al., 2010). This study found the incidence of picky eating especially high at a younger age (13% at 2 years), leveling off after 6 years of age to approximately 3% (Mascola et al., 2010). At age 11, 22% of the sample was defined as picky eaters, indicating that picky eating is often a chronic problem, with 40% having a duration of more than 2 years (Mascola et al., 2010). Thus, research suggests the unlikelihood that picky eating will diminish automatically as the child grows older (Ashcroft, Semmler, Carnell, van Jaarsveld, & Wardle, 2008; Mascola et al., 2010). A longitudinal study found that picky eating and other eating behaviors, such as eating enjoyment, were relatively stable eating behaviors for children between 4 and 11 years of age (Ashcroft et al., 2008). Only small changes

in eating enjoyment and pickiness occurred throughout childhood. This suggests that children interact with the food environment in a specific way, and these small changes in pickiness could reflect changes in the food environment (Ashcroft et al., 2008). Exposure to a wide variety of foods in childhood might decrease picky eating and increase enjoyment of foods. As parents define the food environment for their children, parents can also play a role in promoting healthy eating and in diminishing picky eating behavior.

### **Feeding Patterns and Children's Eating Behaviors**

Current research pertaining to eating disorders indicates that early intervention is significantly correlated with favorable treatment outcome and reduced physical, emotional, and behavioral symptomatology (Lask & Bryant-Waugh, 1999). Parents can influence children's eating by making foods available, modeling appropriate behavior, frequently exposing children to different foods, exercising parenting practices such as pressure and restriction, and creating an emotional climate conducive to eating, at home (Ventura & Birch, 2008). Parental use of controlling practices such as restriction of unhealthy foods and pressure to eat healthy foods can also have adverse effects on children's eating behaviors and weight influence. For example, a study found this restriction associated with an increase in requests for the restricted foods, eating in the absence of hunger, and a higher body weight (Ventura, & Birch, 2008; Jansen, Mulkens, Emond, & Jansen, 2008). Restriction of foods leads to increased consumption when children have access to the restricted foods (Jansen et al., 2008). Pressure to eat was found to be associated with lower weight (Ventura, & Birch, 2008), restrained eating, and emotional and external disinhibition (van Strien & Bazelier, 2007).

Another issue associated with pressure is eating enjoyment. Webber, Cooke, Hill, and Wardle (2010) examined the association of pressure and restriction with child eating behaviors and found that pressure was associated with three dimensions related to food avoidance: pickiness, satiety responsiveness, and slowness in eating. Pressure was also associated with less food enjoyment. They did not find that restriction was associated with pickiness or food enjoyment; restriction was positively associated with food responsiveness (Webber et al., 2010). Therefore, highly controlling practices around eating and food might change the children's environment by creating a negative atmosphere surrounding foods and impairing enjoyment of food (Webber et al., 2010), subsequently resulting in an increase in picky eating. Thus, eating enjoyment seems to be an important aspect in the eating behavior of children. Hence, there is evidence that pressure and restriction not only disrupt the regulating mechanism of food intake in children, but these highly controlling practices also promote a problematic relationship with eating.

### **Cooking and Eating Enjoyment**

Although parents receive relatively little advice on how to actively decrease picky eating, research suggests the likelihood that co-participation in food-related activities ranging from gardening to food preparation may create a positive atmosphere surrounding foods and eating enjoyment (Heim, Bauer, Stang, & Ireland, 2011). Children like hands-on activities such as cooking, and creating a meal can give them a feeling of ownership and pride (Heim et al., 2011). This may lead to a positive evaluation of the food experience and increase the willingness to taste and enjoy foods. Parents can also create a positive meal environment by involving their children in meal planning practices such as deciding on what to eat, when to eat, and where to

eat. Although picky eating is usually not life-threatening, frustrated parents may seek treatment which includes meeting with a child psychiatrist and nutritionist to expand food choices gradually.

### **Risk Factors in the Development of Eating Disorders**

Multiple causes have been attributed to eating disorders, including those that are biological, social, familial, and psychological. Most theorists believe that thin-ideal woman depicted in the media, combined with our culture's intense focus on dieting, has contributed to the current epidemic of eating disorders (Akan & Grilo, 1995). Not surprisingly, then, sociocultural and environmental factors as they relate to ideal body shape are powerful societal influences that have managed to spread their infectious messages well beyond women and adolescent girls. Its message has reached children as young as 5 years of age.

Researchers believe that sociocultural factors are central to the development of eating disorders (Murray, Touzy, & Beumont, 1996). This theory is based on the premise that societal factors send powerful messages to young girls and adolescents, suggesting that certain physical attributes are unacceptable. These messages are detrimental to young girls who are impressionable and vulnerable during their developmental years. They increase the likelihood that young girls will engage in social comparisons which will in turn generate negative affect and negative feelings about their bodies. Children are dieting and expressing concerns about weight at increasing rates and at younger ages (Davison, Markey, & Birch, 2000). In an era of increased prevalence for obesity, Schur, Sanders, and Steiner (2000) found that young children are quite knowledgeable about body image and dieting. The authors stated, "It is also clear from talking with children that they are immersed in a culture where messages about dieting are prevalent and

that they soak up the information that is so widespread in their environment” (p. 80). In addition, Tiggemann and Wilson-Barrett (1998) found that both young girls and young boys between the ages of 7 and 11 rated obese children as having fewer friends, being less liked by parents, doing less well at school, being lazier, being less happy, and being less attractive than are average and thinner-sized children. Hence, modern society idolizes slimness and beauty, and denigrates fatness.

Dieting behavior in children and adolescents appears to be an influential factor involved with the onset of an eating disorder. French, Perry, Leon, and Fulkerson (1995) conducted a prospective study of female students in 7 - 10<sup>th</sup> grade examining health behaviors among dieters and non-dieters over a 3 year period. They found that dieters were more likely to display self-induced vomiting, laxative use, diet pill use, and alcohol use over time. In addition, Patton, Selzer, Coffey, Carlin, and Wolfe (1999) found that females who dieted at moderate levels were five times more likely to develop an eating disorder than non-dieting girls. Current research has shown that young children are not exempt from such behaviors. In a study by Schur et al. (2000), children in grades three through six were asked about body dissatisfaction, desired weight change, and knowledge or beliefs about dieting. Fifty percent of the children wanted to weigh less, with one-third of the sample desiring a thinner body. Children generally defined dieting as exercising and limiting consumption of fattening foods. In addition, they reported learning about dieting primarily from family members as well as the media.

The forces imposed by media and advertising influence children at a very early age. For girls, Barbie dolls set very early standards for unrealistic expectations in regard to body shape and size. This very popular doll is present in almost every young girl’s life, with 3- to 10-year-olds in the

United States owning eight Barbie dolls on average, and only 1% not owning any (Rogers, 1999). Dittmar, Halliwell, and Ive (2006) conducted a study that showed that girls as young as five years of age experienced heightened body dissatisfaction after exposure to Barbie doll images, and that this negative effect was specific to Barbie and not observed after exposure to dolls with a body size that resembled the average U.S. woman.

The thin-ideal woman often portrayed in the media is typically 15% below the average weight of women, representing an unrealistic standard of thinness (as cited in Hawkins, Richards, Granley, & Stein, 2004). Celebrities and fashion models are frequently in the spotlight for eating disorders that have resulted in extreme thinness. This extreme standard, as exemplified by the fashion and celebrity industries, amounts to a powerful sociocultural influence (Academy for Eating Disorders [AED], 2006). Jones (2001) conducted a study on the comparison of body image among girls and boys in grades 7 through 10 to their peers and to fashion models. The results confirmed that models and celebrities, as well as peers, were the “targets of social comparisons for physical attributes” (p. 645), which can lead to increased dieting and, in turn, can increase the risk for eating disorders.

Stice and Shaw (1994) suggested that thin-ideal media body images may produce negative mood states and that exposure to thin-ideal media images may produce an over-internalization of the thin-ideal stereotype. Interestingly, evidence for mass media effects such as body dissatisfaction and internalization of societal standards was demonstrated in a study utilizing visually impaired subjects. The results revealed that congenitally blind women have a more positive body image and healthier eating patterns than women who lost their sight later in life and women who were sighted (Baker, Sivyer, & Towell, 1998). It would therefore appear that

the ability to visualize the self and others is strongly influenced by cultural ideals of what a person should look like in order to be attractive.

In an era of modern technology, the computer is another form of media exposure having a potentially negative influence on the health and behaviors of children. Norris, Boydell, Pinhas, and Katzman (2006) conducted a study to describe, quantitatively and qualitatively, the content of pro-anorexia web sites. On the surface, these sites appeared to provide social support for those who have eating disorders; in many cases, however, they contributed to triggering and fueling the eating disorders by offering tips and forums and live online chat rooms that aid in circulating and promoting the tactics of those with eating disorders (Norris et al., 2006).

According to the authors, sections of the sites frequently focused on lifestyles and “thinspiration,” a term created by these sites that showed a gallery of photos of thin celebrities, models, quotations, and other information to motivate or enable individuals to continue the plight to thinness.

Peers have also been shown to significantly influence body image concerns among both girls and boys. Children learn behaviors and attitudes (e.g., the desire to be slim, dieting and purging) from their peers by example, harassment, and teasing for failing to conform to norms (Polivy & Herman, 2002). This negative interaction often leads to a fear of being fat and gaining weight, which can develop into low self-esteem and disordered eating. According to a study conducted by Lieberman, Gauvin, Bukowski, and White (2001), “peer pressure was a strong predictor of eating behavior and body esteem,” and in most children, as early as elementary school age, there is a strong desire to fit in and be “popular” (p. 215).

What is more, parents may influence the emergence of body dissatisfaction and weight concerns among young girls in a number of ways. First, parents may express dissatisfaction with their daughter's weight status by implicitly monitoring or restricting her food access (Birch & Fisher, 1998). Second, parents may encourage their child to lose weight for various reasons (Birch & Fisher, 1998). Smolak, Levine, and Schermer (1999) found that body satisfaction for girls was related to mother's comments about daughter's weight, mother's complaints about her own weight, mother's weight loss attempts, and father's complaints about his own weight. Third, parental dysfunction in the home tends to promote eating behaviors and weight concerns in young girls (Birch & Fisher, 1998). In a longitudinal study predicting the emergence of dieting in young children, Sinton and Birch (2005) indicated that the family environment could significantly contribute to frequent dieting and disordered eating in children. This study measured data from 5-year-old girls and their parents and then reassessed the same families when the girls were ages seven and nine. The authors concluded that families with parental conflict displaying frequent negative emotions, along with little affection, could possibly promote disordered eating in young girls (Sinton & Birch, 2005).

These societal messages (e.g., fat is bad and thin is good) are rich with unhealthy messages about attractiveness, ideal body sizes and shapes, desires, foods, and weight management. They are so pervasive that these same values and views are already advocated by children as young as kindergarten age. However, the prospect of changing the mass media or inoculating individuals against such media influences evokes the question, "What can anyone really do?" For many years campaigns using mass media to bring about important social changes have been an integral part of life in America (e.g., cigarette smoking, women's rights). Thus, media campaigns can therefore be relevant in addressing eating problems and eating disorders as public health issues,

because such campaigns can educate, advise, advocate, transform and reinforce change (Derzon & Lipsey, 2002).

In the past decade, genetic and biological risk factors have moved to the forefront in the scientific literature on eating disorders. Family studies (e.g., Strober, Freeman, Lampert, Diamond, & Kaye, 2000) have found a significantly greater lifetime prevalence of eating disorders among relatives of eating-disordered individuals. Strober et al. (2000) performed the most extensive family study in eating disorders. They compared the rate of eating and other psychiatric disorders in the relatives of 152 AN patients, 171 BN patients and 181 healthy controls. The risk of developing AN was 11.4 times higher in relatives of AN patients, compared with relatives of healthy controls, whereas the risk of developing BN was 3.5 times higher in relatives of AN patients. Relatives of BN patients had a 3.7 times increased risk for developing BN, and a 12.1 times increased risk for developing AN. Not only do these results suggest an elevation in the lifetime prevalence of eating disorders among the relatives of individuals with AN and BN, but also that familial etiological factors appear to be shared by AN and BN. Moreover, Strober et al. (2000) showed that relatives of individuals with AN and BN have a significantly increased rate of partial syndromes.

Because separate genetic and environmental contributions cannot be readily inferred in family studies, the study of twin pairs has become an increasingly important focus of eating disorder research. Klump, Wonderlich, Lehoux, Lilienfeld, and Bulik (2002) identified 26 AN patients by interviewing 672 female, 17-year-old twins. Biometrical analyses indicated that genetic and non-shared environmental factors accounted for 74 and 26% of the variance in AN, respectively. Based on data of the Swedish Twin Registry, Bulik et al. (2006) estimated the heritability of AN

at 56%, with the remaining variance attributable to shared environment (5%) and non-shared environment (39%). Overall, these studies support the familial aggregation of eating disorders and related traits and suggest that genetic factors play an important etiological role.

With the advent of new biotechnologies, molecular genetic studies of AN and BN have recently begun to appear in the literature. Kaye et al. (2000) reported on a linkage study sponsored by the Price Foundation, involving 192 families with at least one affected relative pair with AN and related eating disorders. The initial scan of the entire sample yielded no evidence for linkage, using both subtypes of AN. However, when using the narrower diagnostic category of restricting AN, this approach yielded evidence suggestive of the presence of an AN-susceptibility in one region on chromosome 1 (Grice et al., 2002). In another study also supported by the Price Foundation, analysis of the BN cohort (Bulik et al., 2003) revealed significant linkage on chromosome 10. When restricting the sample to families in which self-induced vomiting was a salient feature, this approach yielded a stronger linkage on chromosome 10. Currently, the research in this area is at its early stages with few replicated findings. However, the clear data on the familiarity of these disorders highlight the notion that children of individuals with eating disorders are, in fact, at greater risk than individuals in the general population for the development of eating disorders. Genetic research will create new ways for individuals to take action and prevent the development of eating disorders. As a result, consideration should be given to the development of targeted prevention efforts aimed at individuals who are at known, increased risk by virtue of their family histories.

Risk factors that have received relatively little attention are perinatal factors. Evidence now suggests that eating disorders are associated with neurobiological anomalies. A Swedish study

found that girls born with a cephalhematoma and those born prematurely have an increased risk of developing AN (Cnattingius, Hultman, Dahl, & Sparen, 1999). The authors suggested that subtle brain damage may result in early feeding difficulties, a factor that in other studies (e.g., Kotler, Cohen, Davies, & Pine, 2001; Marchi & Cohen, 1990) has been shown to predate the onset of AN. In addition, maternal stress and anxiety is also associated with aberrant brain development (O'Connor, Heron, Golding, Beveridge, & Glover, 2002), and elevated levels of maternal anxiety have been reported in AN samples (Shoebridge & Gowers, 2000).

Interestingly, results from the molecular genetic studies indicated that genetic effects were significantly more important for disordered eating during mid to late adolescence than during prepubertal adolescence (Klump, Burt, McGue, & Iacono, 2007). Puberty may therefore be a critical period to activate some of the genetic factors which make certain individuals more susceptible for the development of eating disorders. Unfortunately, due to methodological restraints, research on adolescent females diagnosed with an eating disorder is underrepresented in the literature. Although it might be tempting to draw conclusions from the vast amount of adult eating disorder literature, researchers (e.g., Gowers & Bryant-Waugh, 2004) have begun to contemplate the importance of considering the period of adolescence and its unique developmental variables in an effort to enhance treatment interventions for this population.

### **Brain Development**

Adolescence is a crucial time in brain development involving the frontal lobes (Luna & Sweeney, 2004). The prefrontal cortex has consistently been shown to undergo continued development during adolescence. The synaptic pruning, elaboration of dendritic branching, and increased myelination that takes place is associated with significant refinements of the brain

(Hale, lecture 2009). Synaptic pruning removes unnecessary neural connections in order to maximize the efficient network of circuitry shaped by learning and experience. Myelination speeds up neural transmission, which allows for a more rapid communication across connected regions of the brain. These two developmental processes are considered to “support the collaboration of a widely distributed circuitry, integrating regions that support top-down cognitive control of behavior” (Luna & Sweeney, 2004, p. 296).

Pruning and myelination of the frontal and limbic areas of the brain are thought to play a role in the integration of emotional behaviors with cognitive processes (Benes, 1998). This maturation serves to improve inhibitory and reflective processes, making them more efficient and consistent. Thus, any interference in such developmental processes could result in structural and functional anomalies in the brain region known to be critically involved in cognitive processing (dorsolateral prefrontal cortex ), emotion processing (anterior cingulate), and personality characteristics (orbitofrontal) (Cummings, 1993).

### **Executive Function**

The term executive function (EF) is used to describe the capacity that allows us to control and coordinate our thoughts and behavior (Luria, 1966). They are abilities generally described as high-level cognitive functions believed to be mediated primarily by the frontal lobes (Stuss et al., 2002), and are conceptualized as having four components: goal formation, planning, carrying out goal-directed plans, and effective performance (Jurado & Rosselli, 2007). These processes are mainly put into effect during tasks or situations that are novel, complex, or induce a conflict (Zelazo, Muller, Frye, & Marcovitch, 2003). In a continuously changing environment, executive abilities allow us to shift our mind set quickly and adapt to diverse situations while at the same

time inhibiting inappropriate behaviors. They enable individuals to create a plan, initiate its execution, and persevere on the task at hand until its completion.

Although early observations suggested a homogenous involvement of the frontal lobes, EF are now accepted as being associated with different regions of the frontal lobes (Stuss et al., 2002), as well as with subcortical and thalamic pathways (Royall et al., 2002). In a recent review, Royall et al. (2002) emphasized the importance of neural circuits comprising the frontal lobes, the basal ganglia and thalamus for performance on executive tasks. The authors identified three important circuits which originate in the frontal lobe and send projections to subcortical regions of the brain: the dorsolateral prefrontal circuit is believed to be implicated in the functions of planning, goal selection, set shifting, working memory, and self-monitoring; the lateral orbitofrontal circuit is involved in risk assessment and the inhibition of inappropriate behavioral responses; the anterior cingulate circuit functions in monitoring behavior and self-correcting errors. Executive functions seem to improve throughout childhood into late adolescence, and this improvement seems to coincide with growth spurts in the maturation of the frontal lobes (Anderson, Anderson, Northam, Jacobs, & Catroppa, 2001). They mediate the ability to organize an individual's thoughts in a goal-directed way, and are therefore essential for successful cognitive and social functioning.

### **Psychosocial Development**

Adolescence is a time of profound biological, psychological, and sociocultural change and demands a considerable degree of flexibility to manage the transition into adulthood successfully. This transition from childhood to adulthood is characterized by dramatic changes in identity, self-consciousness and cognitive flexibility (Rutter & Rutter, 1993). There seems to

be a qualitative shift in the nature of thinking to the degree that adolescents are more self-aware and self-reflective than preadolescent children. Adolescents develop a capacity to hold in mind more multidimensional concepts and are thus able to think in a more strategic manner.

During this period of adolescent development, children with cognitive deficits often experience a number of problems. More specifically, adolescents might have difficulties in various psychosocial domains including physical and emotional maturation, interpersonal relationships, sense of autonomy and healthy self-esteem (Huntington & Bender, 1993). For example, instead of using appropriate coping strategies in new situations, these adolescents might attempt to apply previously learned strategies which are narrow in focus and might not be functional for the current situation. The frontostriatal systems (connections between the basal ganglia and the frontal lobes) tend to be implicated in individuals with AN as well as set shifting and adaptive difficulties (Steinglass, Walsh, & Stern, 2006). Set shifting ability is essential for cognitive behavioral flexibility, which allows for the adaptation of behavior in accordance with changing demands of the environment. These difficulties during this phase of development can have a profound effect on well-being because the ability to regulate, contextualize and plan an effective coping response is immature. Therefore, it may be inferred that adolescents who exhibit neuropsychological deficits in cognitive areas are unable to develop constructive problem-solving strategies to social interactions and thus develop maladaptive eating behaviors as a means of dealing with adolescent interpersonal experiences. This inability to properly develop in these psychosocial areas serves as a pathway in which cognitive impairments increase the risk for eating disorder development in adolescence.

The relationship between cognitive deficits and eating disorders has widespread impact on various areas of an individual's life. During the transition from elementary school to secondary school, not only is the nature of the academic work and learning more complex, but new developmental challenges are also beginning to surface. Some children with cognitive deficits (e.g., Lena, Chidambaram, Panarella, & Sambasivan, 2001) who were once performing well in elementary school by establishing rigid routines and coping strategies might now experience a number of difficulties due to the increased social and academic demands. These demands might disrupt previously learned coping strategies and lead to the development of greater perfectionist tendencies and more rigidly controlled behaviors, which is often common amongst adolescents with eating disorders. Constant stress from having to work harder, coupled with repeated academic difficulties might lead to feelings of powerlessness, low self-esteem, anxiety, and suicidal ideation (Huntington & Bender, 1993). As a result, adolescent girls with cognitive deficits might feel inadequate in their academic performances and might begin to focus on their appearances. In addition, the rigid and perfectionist behaviors that were adopted for academic demands will now be extended to the physical domain, resulting in a preoccupation with food and weight.

### **Anorexia Nervosa**

According to the *Diagnostic and Statistical Manual of Mental Disorders IV-TR* (American Psychiatric Association, 2000), AN is characterized by (a) a refusal to maintain body weight at or above a minimal normal weight for age and height; (b) intense fear of weight gain or fat even though underweight; (c) disturbed body image or denial of the seriousness of current low body weight; and (d) the absence of at least three consecutive menstrual cycles in postmenarcheal

females. Anorexia nervosa is divided into two types: the Restricting Type, in which individuals primarily restrict their eating, and the Binge-eating/Purging Type, in which individuals are regularly engaged in binge eating or purging behavior.

Anorexia nervosa is a serious mental disorder with a prevalence rate of about 3-5 in 1,000 young females (Hoek & Hoeken, 2003). Eating disorders are known to occur most commonly among females in their late adolescence and adulthood (Herzog & Eddy, 2007). Keel and Herzog (2004) report that AN is associated with one of the highest risks for premature death among all the psychiatric disorders, with an estimated mortality rate of 5%-5.9% of those diagnosed. In a recent 21-year follow-up study of 103 patients with AN, the mortality rates amounted to 4.9% after 2 years, 5.8% after 6 years, and 6.8% after 12 years (Fichter, Quadflieg, & Hedlund, 2006).

Overall, the statistics are not encouraging. Following a review of 119 studies, Steinhausen (2002) concluded that AN still has a relatively poor prognosis. Mortality rates from 1953 to 1999 for those diagnosed with AN average around 5%, and of the survivors, less than 50% recover, 33% improve but are not considered recovered, and 20% remain chronically ill (Steinhausen, 2002). For many individuals AN can be a chronic disorder, with symptoms lasting many years or even a lifetime. Chronicity of illness and obsessive personality symptoms are unfavorable prognostic characteristics (Halmi et al., 2005). Clinical characteristics seen in people with AN are maladaptive preoccupations with food, weight, and body shape that manifest in stereotyped and rigid behaviors controlling eating and weight. These characteristics are seen as symptomatic expressions of obsessive-compulsive temperament traits, which frequently precede the onset of the disorder (Steinhausen, 2002) and are associated with a negative course

of the disease (Wilson, Grilo, & Vitousek, 2007). Consistent with an obsessive-compulsive phenotype, people with AN show high concern over mistakes and a relentless perfectionism (Halmi et al., 2005). However, the search for effective treatments that reverse the core symptoms of AN has met with limited success. Inpatient or residential treatment is often considered necessary or even life-saving; however, recent studies (Gowers et al., 2007; Halmi et al., 2005) suggest that therapies that were once relied upon in the past, such as cognitive behavioral therapy or dietary counseling, tend to have limited efficacy. Unfortunately, for those individuals who develop a chronic disorder, the readmittance rates are high (Lay, Jennen-Steinmetz, Reinhard, & Schmidt, 2002; Steinhausen, 2002).

### **Executive Function Deficits in Anorexia Nervosa**

Interest in the development of EF has grown in part because of research indicating that EF is implicated in a variety of developmental disorders and early developing psychopathologies (e.g., Pennington & Ozonoff, 1996). Over the past two decades, an increasing body of literature has explored the neuropsychological functioning of people with eating disorders. Although a broad range of cognitive functions have been implicated (Katzman, Christensen, Young, & Zipursky, 2001), the prominent characteristics are attentional impairment and difficulties with EF. Although null findings have been reported (Castro-Fornieles et al., 2007), the overwhelming bulk of evidence has shown underweight patients with AN to exhibit difficulties across a number of cognitive variables, with the most consistent being observed in attention, speed of processing, memory and EF, in particular deficits in central coherence (global processing) and set shifting (cognitive flexibility) (Holliday, Tchanturia, Landau, Collier, & Treasure, 2005; Lauer, Gorzewski, Gerlinghoff, Backmund, & Zihl, 1999; Lopez et al., 2008c). However, whether or

not these findings reverse with refeeding, or are outcomes of malnutrition or are a preexisting deficit is less clear. Following weight gain or treatment, some adult prospective studies have reported an improvement in cognitive impairment (Lauer et al., 1999), yet others show a persistence of impairments (Kingston, Szmulker, Andrewers, Tress, & Desmond, 1996).

### **Weak Central Coherence**

Review of the neuropsychological literature in eating disorders highlights the idea that information processing styles mirror phenotypic characteristics (Anderluh, Tchanturia, Rabe-Hesketh, & Treasure, 2003). Discrepancy in the performance seen across tests of visuo-spatial processing is suggestive of an information processing bias in AN that corresponds to clinical characteristics. People with AN have a neuropsychological profile that is suggestive of superior local (detail) processing. They excel in tasks that are aided by a piecemeal processing style such as the Embedded Figures Test (Lopez et al., 2008a; Tokley & Kemps, 2007) and the Matching Familiar Figures (Southgate, Tchanturia, & Treasure, 2008). However, they perform less well in tasks requiring global information processing such as, Object Assembly (Gillberg et al., 2007; Tokley & Kemps, 2007) and the Rey–Osterrieth Complex Figure (RCFT) (Lopez et al., 2008a). This pattern of performance is consistent with the concept of weak central coherence (Happé & Frith, 2006). It is a cognitive style which causes information to be processed in parts, rather than as a whole, and impairs global thinking. The hypothesis that weak central coherence reflects a preferential processing style in AN, relates with the extensive attention to detail found to be an enduring personality trait amongst individuals with AN (Anderluh et al., 2003).

Although in some contexts a detail-focused processing style may provide an advantage, having an extreme tendency to focus on the details at the expense of processing information in a

global fashion can quickly become problematic. Because an extreme detail focus makes it difficult for some patients with AN to “see the forest for the trees,” they can become extremely preoccupied with details, order, and symmetry. Thus this way of thinking may explain some aspects of the symptoms of AN, such as the preoccupation with rules, food, and weight. For example, patients may develop specific rules around cutting their food, or around what foods are considered “safe” and “unsafe,” and their eating behavior becomes highly ritualized. Although patients express a desire to change, they demonstrate great difficulty in changing these behaviors. This left hemisphere-predominant pattern of visual processing may account for their symptoms of focusing on details at the expense of seeing the big picture.

### **Cognitive Inflexibility**

The most consistent executive function deficit found in the AN literature involves set shifting ability (Steinglass et al., 2006). Set shifting is an essential component of cognitive and behavioral flexibility, involving the ability to move back and forth between multiple tasks, operations, or mental sets (Miyake, Friedman, Emerson, Witzki, & Howerter, 2000). Problems in set shifting may manifest in a variety of forms related to cognitive inflexibility and response inflexibility. Deficits in cognitive flexibility occur in situations in which an individual fails to be flexible with the changing demands of the environment. An example of this inflexibility occurs when actions that have shown to be effective in past situations are adamantly carried out in new situations in which they are ineffective. Inflexibility, therefore, results in perseverative, stereotyped and non-adaptive behaviors. Rigidity and lack of flexibility are core characteristics of the behavior of people with AN (Vitousek, Watson, & Wilson, 1998). This characteristic lack

of flexibility reduces the ability to engage fully in therapy and impacts the ability to function in daily life.

One group of researchers has conducted several studies in patients with AN, using cognitive and perceptual tasks (Tchanturia et al., 2001, 2002, 2004b). In the perceptual tasks, balls of different sizes were placed in the hands of individuals who had closed their eyes, and the individuals were asked to indicate the relative sizes of the balls. The degree or extent to which an individual's response was influenced by prior presentations suggests cognitive rigidity. In the cognitive tasks, individuals were presented with a story in which they were asked to complete the initial letter for certain words (i.e., “\_at” could be “cat” or “bat”). The degree to which individuals erroneously chose a letter from the previous portion of the story suggests cognitive rigidity. In the first study, the perceptual task was administered to 15 patients with AN, 15 patients with BN, and 28 healthy controls. Patients with AN and BN made more perceptual errors than the control group (Tchanturia et al., 2001). These findings were replicated in a larger sample, using both the cognitive and perceptual tasks (Tchanturia et al., 2004a). In this study, patients with AN ( $n = 34$ ) and BN ( $n = 19$ ) made more errors than controls ( $n = 35$ ). The same researchers compared both tasks in a group of acutely ill, underweight patients with AN ( $n = 30$ ), a group of patients recovered from AN ( $n = 16$ ), and healthy controls ( $n = 23$ ). Both acutely ill and recovered AN patients showed significantly poorer performance on both tasks, compared with controls (Tchanturia et al., 2002).

In another study, Steinglass et al. (2006) assessed set-shifting in patients with AN. In this study, patients with AN ( $n = 15$ ) were compared with healthy controls ( $n = 11$ ), using a neuropsychological battery including the Wisconsin Card Sorting Test (WCST). These findings

suggested that patients with AN made significantly more perseverative errors on the WCST, indicating a problem in set-shifting. Interestingly, in this study even patients with AN whose weights had been restored to the normal range exhibited poorer performance in set shifting, compared with controls. The presence of a cognitive problem at normal weight might suggest a neuropsychological disturbance in AN that is not attributable simply to being underweight. Additionally, Fassino et al. (2002) administered the WCST to patients with AN ( $n = 20$ ) and with healthy controls ( $n = 20$ ); they found that patients with AN experienced difficulty in developing new rules, thereby exhibiting a significantly higher number of errors than a control group.

Longitudinal studies are difficult, given the young age of potential subjects, the rarity of the disorder and the many years of follow-up required. An alternative strategy is to study individuals who have recovered from AN, thus avoiding the confounding influence of malnutrition and weight loss on biological systems. Twelve studies have used a longitudinal design in order to investigate the effect of weight gain on cognitive functions in AN, thus trying to delineate state and trait factors of the illness. The results across studies are contradictory, with conflicting reports about whether or not improved nutrition enhances neuropsychological performance. The majority of studies that have examined AN subjects upon significant weight gain or end of treatment or hospital discharge indicate that some deficits seem to ameliorate with improved nutritional status. The most consistent improvements in cognition reported across studies concern attention, speed of information processing, and problem solving (Lauer et al., 1999; Moser et al., 2003). However, the studies of Grunwald, Ettrich, Assmann, Dahne, and Krause (2001) and Tchanturia et al. (2004b) suggest that deficits in recall, reaction time and motor speed, somatosensory processing, and set shifting are not affected by weight gain. Although it may be tempting to suggest that these deficits may represent enduring features of the

disorder, it is important to note that the mean body mass index was in the AN range and just below what may be considered a normal healthy range (Grunwald et al., 2001; Tchanturia et al., 2004b). Of particular interest, Holliday et al. (2005) found more set shifting difficulties in healthy sisters of AN subjects than in unrelated healthy subjects, proposing a genetic basis for impaired cognitive set shifting. The implication of all of these findings might be that a therapy improving cognitive flexibility and performance on set shifting tasks in individuals at-risk for eating disorders will be beneficial for their well-being and long term treatment (Tchanturia, Davies, & Campbell, 2007). Overall, set shifting difficulty in individuals with AN suggests the possibility of an underlying brain-based abnormality that may help to explain patients' difficulty with changing established cognitions and the stereotyped, ritualized eating behavior patterns that are often maladaptive.

### **Neuroimaging in Anorexia Nervosa**

Although the interpretation of neuropsychological findings in the area of eating disorders have produced conflicting results due to confounding variables such as comorbidity, age of onset, state of starvation, and inadequate sample size (Key, O'Brien, Gordon, Christie, & Lask, 2006), neuroimaging research has enhanced the study of brain dysfunction in eating disorders by providing direct evidence to support the involvement of the frontal lobes. Executive functions are now being associated with different regions of the frontal lobes as well as with other connections and pathways of the brain (Eslinger & Grattan, 1993). Neural pathways (limbic and cognitive) affect emotionality and cognitive control and seem to be particularly relevant to behavior in AN. The limbic neurocircuit includes the amygdala, insula, ventral striatum, and ventral regions of the anterior cingulate cortex and orbitalfrontal cortex; it seems to help people

identify the emotional significance of events and stimuli allowing one to respond appropriately (Phillips, Drevets, Rauch, & Lane, 2003). The cognitive neurocircuit, which affects selective attention, planning, inhibition, and emotional self-control, includes the hippocampus, dorsal regions of the anterior cingulate cortex, dorsolateral prefrontal cortex, and parietal cortex (Phillips et al., 2003).

Hendren, DeBacker, and Pandina (2000) reviewed the neuroimaging studies completed on children and adolescents diagnosed with AN from the previous 10 years. The studies which were reviewed had utilized MRI techniques. The authors concluded that starvation led to hypercortisolism. Further, the combination of hypercortisolism and starvation in AN appeared to lead to the persistent loss of gray matter and to the cognitive deficits that were only partially reversible with weight recovery (Hendren et al., 2000). Similarly, Lena, Fiocco, and Leyenaar (2004) reported that a number of studies have shown significantly widened cerebral sulci, ventricular dilation, and cortical atrophy in individuals with AN. These brain abnormalities are harmful to intelligence and to other neurocognitive functions in AN. Such neurocognitive deficits may also impact other areas of functioning, such as social and emotional domains. In fact, qualitative studies in patients with AN consistently highlight the fact that these patients experience emotions and social interactions as highly problematic (e.g., Fox, 2009).

Functional Magnetic Resonance Imaging (fMRI) studies in AN in response to illness related cues (food, body image) illustrated abnormal activation distributed across cortical and sub-cortical regions, in particular in those areas relating to affective processing and the control and planning of behavior (Ellison et al., 1998; Uher et al., 2003; Uher et al., 2004; Uher et al., 2005). One fMRI study (Uher et al., 2003) found that pictures of food stimulated the anterior cingulate

cortex and the medial prefrontal cortex activity in both ill and recovered AN individuals, but not in the healthy control group. This finding suggested that hyperactivity of these regions may be a trait marker of AN. Similarly, in the largest fMRI study of this clinical group and the first to directly compare different eating disorder diagnoses, Uher et al. (2004) reported abnormal prefrontal reaction to symptom-related (food stimuli) but not to standard emotional images in both AN and BN, involving the orbitofrontal cortex and the anterior cingulate cortex. The presence of functional anomalies in this area highlights the potential for underlying problems in information processing in AN and BN. Furthermore, a recent fMRI study examining behavioral and cognitive set shifting reported that during shift trials of a target detection task, frontal-parietal networks were significantly more activated, indicative of effortful cognitive control and the dorsal anterior cingulate cortex and ventral striatum were significantly less activated, in ill individuals with AN, relative to control subjects (Zastrow et al., 2009). Because abnormalities in perception and evaluation of body shape are hallmarks of eating disorders, an fMRI study was initiated to measure brain responses to body image drawings (Uher et al., 2005). Activation in the lateral fusiform gyrus and the parietal cortex to these drawings were less strong in individuals with eating disorders and aversion ratings to body shapes in all weight categories were correlated positively with activity in the right medial prefrontal cortex (Uher et al., 2005). This activation is comparable with reactions to subjectively aversive food stimuli (Uher et al., 2003, 2004). This network of structures activated by eating-disorder related cues may be involved in the experience of self in the context of social behaviors; this may exemplify how ideas about food, weight, and shape become entangled with self-concept. Overall, these brain imaging studies suggest that activation in the limbic-medial prefrontal networks are altered during perception of emotion cues in AN. Currently, the research in this area is still at its early stages with few replicated studies.

Tchanturia, Campbell, Morris, and Treasure (2005) reported that there is a general consensus that there are no gross neuropsychological deficits in AN. The authors indicated that the reported deficits appear to be subtle and may be difficult to demonstrate formally with tools developed for research on patients with severe brain lesions (Tchanturia et al., 2005). Nevertheless, these observations do not take into consideration the varying combinations of deficits that exist and how such deficits interfere with the developmental process of adolescents. The presence of neuropsychological markers may be an indicator of, or marker of, a risk for symptomatology and a need for further assessment and/or closer case review. For example, Lena et al. (2004) recommended that children between the ages of 9 and 14, who present with body image disturbances, restricted or disrupted eating patterns, and fear of fat, be monitored and screened for both mild and severe cognitive impairments. Therefore, neuropsychological assessment should be used to explore the possibility that there may be dysfunction in the central nervous system that contributes to the risk, etiology, and maintenance of eating disordered behaviors.

### **Treatment of Anorexia Nervosa**

Anorexia nervosa continues to remain a challenge for clinicians in terms of understanding and treating this disorder. It is still seen by clinicians as "one of the most frustrating and recalcitrant forms of psychopathology" (Vitousek et al., 1998). Cognitive behavioral therapy is based on the approach delineated by Aaron Beck for the treatment of depression and anxiety (Beck, Rush, Shaw, & Emery, 1979). A CBT model for understanding and treating this disorder has been elaborated by several authors (Fairburn, Shafran, & Cooper, 1999). A central premise of the CBT model of AN is that eating disorder symptoms are maintained by the interaction between

cognitive disturbances involving extreme concern for eating, shape, and weight and behavioral disturbances that affect eating and weight control behavior and also more encompassing issues of temperament, character, and motivation.

The empirical data on CBT for AN is limited. Nevertheless, CBT is one of the therapies of choice when it comes to treatment of eating disorders. One of the strengths of the CBT model of AN is its acknowledgment that there are numerous reasons for the development of an eating disorder. Thus, in addition to the core components of the CBT model of AN described previously, this model recognizes that various biological factors may contribute to increased vulnerability for the development of AN; this possibility is addressed in the psychoeducational component of the model. Additional factors that can contribute to the etiology and maintenance of AN, such as problems with motivation for recovery, difficulties with emotion regulation, core negative beliefs, and interpersonal problems, are also frequently incorporated into this model.

To investigate CBT for AN further, Ball and Mitchell (2004) compared individual CBT with behavioral family therapy in a sample of adolescents and young adults with AN. Treatment involved 25 sessions over a 12-month period. No between-group differences were found at post-treatment or at 6-month follow-up. Approximately 78% of patients in both conditions were classified as having a “good outcome” in terms of weight and menstrual functioning at follow-up. Similarly, looking further at treatment combinations, Gowers et al. (2007) randomized 167 adolescent patients with AN to inpatient treatment, 24 sessions of outpatient therapy, or treatment in community-based clinics. The outpatient therapy condition comprised elements both of CBT and of family therapy. Treatment lasted up to 6 months. At 1-year follow-up, there were no statistically significant differences among the three groups in terms of weight. It was

found that patients in all three conditions had made substantial improvements in terms of weight and eating disorder psychopathology. The researchers concluded that there is no advantage of specialized treatment over community-based treatment and no advantage of inpatient treatment over outpatient treatment for AN. In summary, CBT was not found to be superior to comparison treatments.

Shafran and Segal (1990) have suggested several client characteristics that are necessary for meaningful engagement in therapy. These include the ability to access relevant cognitions; an awareness of, and ability to differentiate different emotional states; acceptance of the cognitive rationale for treatment; and the ability to accept personal responsibility for change (Shafran & Segal, 1990). Thus, for a variety of reasons, including severe malnourishment and low body weight, many patients with AN do not possess the physical and psychological stamina to engage in CBT therapy. Therefore, it is believed that implementing CRT prior to starting other psychological interventions may be beneficial for patients with AN because CRT targets the basic thought processes that are necessary for meaningful engagement in more complex cognitive therapy.

The most consistent and positive results for treatment of adolescent AN have occurred with a type of family therapy originated at the Maudsley Hospital in London (Eisler, 2005). More recent refinements of the Maudsley approach by Lock and le Grange (2001) suggest it can be standardized for the treatment of adolescent AN, and is a method acceptable to patients and families. This form of family therapy focuses less on the psychological roots of disordered eating, and more on addressing actual eating problems and behavior. The participation of the family is vital to the Maudsley method because parents will initially be responsible for ensuring

that the adolescent eat properly and reach a healthier weight. Food and its role in the family dynamic are examined in therapy, as are the effects that the eating disorder has on the entire family. Each member of the family cooperates to support the adolescent in reaching a goal weight set by the doctor. Once weight is restored, treatment begins to focus more closely on family and individual concerns; the therapist will be responsible to provide problem-solving skills to help prevent the recurrence of the eating disorder. This phase then transitions the family to leave therapy in order to work together and to deal with life's issues as a unit.

Other therapies are also emerging in the treatment of eating disorders. For example, dialectical behavior therapy (DBT; Linehan, 1993), originally designed to treat Borderline Personality Disorder, has now been adapted for individuals with eating disorders (Wisniewski & Kelly, 2003). Dialectical behavior therapy has been found to be an extremely useful treatment for managing noncompliant eating disorder clients (e.g., Salbach-Andrae, Bohnkamp, Pfeiffer, Lehmkuhl, & Miller, 2008). Therapy combines standard cognitive behavioral techniques for emotion regulation and reality-testing with concepts of mindfulness, distress tolerance, and acceptance, for better tolerance of emotional dysregulation and resulting reduction in eating disorder symptoms. Dialectical behavior therapy organizes treatment into stages and targets, and with very few exceptions, adheres strictly to the order in which problems are addressed. The first stage of treatment focuses on decreasing life threatening behaviors, behaviors that interfere with therapy, quality of life threatening behaviors, and increasing skills that will replace ineffective coping behaviors. The goal of Stage I DBT is for the client to move from behavioral dysfunction to behavioral control so that there is a normal life expectancy. In Stage II, DBT addresses the client's inhibited emotional experiences. The goal of Stage II is to help the client move from a state of quiet desperation to one of full emotional experiencing. Stage III DBT

focuses on experiences and issues in daily living. Achieving balance between dependence and independence is a focus of treatment during this stage.

### **Cognitive Remediation Therapy**

Another developing treatment is CRT. Specifically, CRT identifies impaired cognitive functions through neuropsychological assessment and directly repairs (strengthens) impaired cognitive skills by using drill and practice exercises. Cognitive remediation therapy was originally conceptualized and developed as an intervention for patients with brain lesions, with the aim of rehabilitating a wide range of neuropsychological difficulties (e.g., Goldberg, 2001). Cognitive remediation therapy is intended to help with the rehabilitation of neurological impairments through the implementation of simple cognitive and behavioral exercises that can affect and improve function in specific brain regions that have been damaged or in surrounding (intact) regions that might be useful in compensating for injuries (e.g., Parentae & Herrmann, 2003).

Cognitive remediation includes exercises to decrease rigidity using structured tasks which train different aspects of cognitive flexibility and move away from an excessively detailed focus (Davies & Tchanturia, 2005). The goal of treatment is to illustrate how rigid, detailed thinking may be keeping individuals trapped within their illness. It emphasizes a more flexible and global approach to processing information, thereby seeing the “bigger picture” in their daily lives. This promising approach to treating adolescent AN can provide novel information and advance an understanding of the cognitive processes and specific skill deficits that may influence the development and maintenance of eating disorders.

Cognitive remediation therapy is not an alternative to other therapeutic interventions. It is hypothesized that CRT can be a pretreatment for other standard psychological interventions such as cognitive behavioral therapy (CBT) (e.g., Tchanturia & Hambrook, 2010). Baldock and Tchanturia (2007) provide a rationale about how and why CRT and CBT might be mutually compatible. Patients with AN are often avoidant of emotions (e.g., Geller, Cockell, & Goldner, 2000), and CRT may be appealing because it provides a structured, unthreatening therapeutic environment designed to remediate cognitive functioning rather than dealing with core beliefs, affective states, or eating disorder psychopathology. It also improves awareness of cognitive strategies, including cognitive inflexibility and extreme detail focus, both of which may contribute to obsessive-compulsive-type symptoms. A recent systematic review of randomized controlled trials for AN found that obsessive-compulsive-type traits seem to moderate treatment outcome negatively (Crane, Roberts, & Treasure, 2007). That is, patients who exhibit more of these traits are likely to struggle in therapy. Thus, it is hypothesized that if CRT is effective in reducing these obsessional and perfectionistic traits and in teaching patients to adapt more flexibly and efficiently to novel situations, then treatment outcomes are likely to improve with other psychological therapies such as CBT in which relatively high levels of these skills are needed. Interestingly, participants in a pilot study using modified tasks of the adult CRT version (Tchanturia & Lock, 2011) provided feedback on CRT tasks and reported liking therapy and their therapists which are not common reports for adolescents with AN. The adolescents also seemed to agree that working on their thinking styles was potentially worthwhile, and that having a treatment that did not focus on eating and weight was helpful in some ways by distracting them from these more challenging problems, while also being beneficial.

Research questions this author would like to explore in this study are as follows:

- Is CRT a beneficial intervention for an adolescent with poor eating behaviors?
- Does CRT help improve executive function and cognition with an adolescent with poor eating behaviors?
- Will CRT help to engage the adolescent to improve his overall range of food intake?

## **Chapter Three**

### **Method**

#### **Participants**

A pre-adolescent male who was being treated by a nurse practitioner specializing in pediatrics in Central New Jersey was utilized for this study.

#### **Inclusion and Exclusion Criteria**

At the time of investigation, the participant was required to have met certain criteria in order to participate in the study. The participant in the study was to be a male or female between 10 and 18 years of age in medical treatment. The participant met medical conditions including one or more of the following: Anorexia Nervosa (AN), Bulimia Nervosa (BN), Eating Disorder-Not Otherwise Specified (ED-NOS), or poor eating behaviors. In addition, the participant was required to have a computer at home with access to the internet. All male and female participants who did not meet medical conditions including one or more of the following: Anorexia Nervosa (AN), Bulimia Nervosa (BN), Eating Disorder-Not Otherwise Specified (ED-NOS), or poor eating behaviors were excluded from this study in order to include only participants with disordered eating behaviors. In addition, any participant under the age of 10 or over the age of 18 was excluded.

#### **Subject Recruitment**

The subjects were referred for this study by a nurse practitioner specializing in pediatrics in a private practice in Central New Jersey. The nurse practitioner identified potential participants who met the inclusion criteria and provided them with a description of the study. The

investigator called participants who gave permission to be contacted in order to discuss the study and their desire to participate.

### **Initial Screening**

The consent and assent forms were reviewed and signed by Thomas and his parent, Mrs. Smith, in the presence of the investigator. The M-PACI and BRIEF rating scale were also reviewed with Thomas and Mrs. Smith. Within two weeks of their completion, these forms were returned to the investigator in a self-addressed, stamped envelope.

### **Setting**

This clinical study was conducted in an office of a public library.

### **Design**

The design for this study was a single subject design. The Cognitive Hypothesis Testing model (CHT; Hale & Fiorello, 2004) was utilized in a modified form to develop and test hypotheses about the subject's performance on cognitive measures. It is subsequently used to design an appropriate intervention based on the findings. The model employs a scientific approach for interpreting cognitive and neuropsychological processes together with evaluation of ecological and treatment validity data to develop targeted interventions for students who do not respond to standard academic interventions in schools. The CHT model combines both individual psychoeducational assessment and intervention, thus providing a methodology for linking assessment practices to successful interventions. The CHT model has four component parts: theory, hypothesis, data collection, and interpretation. Hale and Fiorello (2004) propose

that once a student is referred for a psychoeducational or school neuropsychological evaluation there are up to 13 steps in a CHT evaluation.

In the CHT model, the presenting problem, history, and prior intervention data are examined in order to develop an initial theory about the student's problem. When it is hypothesized that a cognitive problem is contributing to a student's academic and/or behavioral difficulty, a standardized cognitive/intellectual test is administered as an initial screening tool. The results are interpreted, including the implementation of a demands analysis of individual tasks to determine cognitive processing requirements. Hypotheses are developed about the student's cognitive strengths and weaknesses and then evaluated through the administration of related construct tests and gathering of environmental data to confirm or refute the hypotheses. These data are used to establish a concordance between the cognitive weaknesses and academic deficit(s), and a discordance between cognitive strengths and cognitive weaknesses/academic deficit(s) (Hale & Fiorello, 2004) to ensure the fact that the student meets the definition of specific learning disability under the Individuals With Disabilities Education Improvement Act of 2004 (IDEIA;2004). Based on this case conceptualization, consultation is initiated in order to develop, implement, and monitor an intervention designed to meet the student's learning needs. In this way, the results of cognitive and neuropsychological assessments, together with background review, systematic observations, behavior rating scales, and parent/teacher interviews are used to develop individualized interventions based on cognitive processing strengths and weaknesses within the context of the student's natural environment to ensure ecological and treatment validity.

## Measures

The clinical interview is a central part of an intake assessment because it identifies the problem for which the client and/or family is seeking treatment, and it forms the basis of a treatment plan. Different approaches may be employed for the intake interview, ranging from an unstructured case-history interview to a structured diagnostic interview. It is important to utilize open-ended statements for opening a dialogue with the parent and/or subject. Once the conversation is begun, details of the problem behaviors can follow. Following a thorough assessment of the eating problems, including onset and course of disordered eating symptoms, it is important to assess for presence of comorbid syndromes that may require clinical attention. As noted previously, AN is associated with an elevated risk of mortality (Keel et al., 2003). Thus it is also important to evaluate for the presence of suicidal thoughts, plans, availability of means, and intentions. Given that comorbid substance use disorders significantly increase the risk of fatal outcomes (Keel et al., 2003), an assessment of drug and alcohol use should be completed as well. Furthermore, a medical evaluation is advisable for any client diagnosed with an eating disorder, given the risk of medical complications often associated with the illness.

In addition to the clinical interview, self-report measures can also be administered to determine the presence of eating and clinical pathology during the assessment process (Anderson, Lundgren, Shapiro, & Paulosky, 2004). Clients with eating disorders are not always able or willing to provide accurate information about their illness for a variety of reasons. Clinicians should be aware of the impact of secrecy or denial on the accuracy of assessments that rely on clients as the sole source of information. Thus, repeating assessments throughout treatment is necessary in order to verify information because clients may become more willing to

reveal symptoms as they improve and develop greater trust in their therapeutic relationship. The following section describes the measures used in the current study.

### **Clinical Interviews**

Comprehensive Interview for Child/Adolescent Evaluations (Christner & Mennuti, 2001) – This semi-structured interview is designed to obtain information about patient background (age, family history, developmental background, medical history, education) as well as information about the child/adolescent's affective state, hobbies and interests, and social interactions. A semi-structured interview offers the clinician the opportunity to explore issues while allowing the interviewee to express their opinions, concerns, and feelings. The fact that it is semi-structured allows the conversation to flow where it needs to in order to deal with the referral concerns.

### **Questionnaires/Rating Scales**

Behavior Rating Inventory of Executive Function (BRIEF; Gioia, Isquith, Guy, & Kenworthy, 2000) – The BRIEF uses a questionnaire format that is completed by parents, teachers, day care providers, or the adolescent (based on the version of the test) that fall into eight different, theoretically and empirically derived scales designed to measure various aspects of executive functioning in children between the ages of 5- to 18-years. It serves as the first behavior rating scale for parents and teachers that measures behavioral manifestations of executive function impairment. The eight scales of the BRIEF include Inhibit, Shift, Emotional Control, Initiate, Working Memory, Plan/Organize, Organization of Materials, and Monitor. The BRIEF yields two broad indexes, Behavioral Regulation (BRI) and Metacognition (MI), as well as an overall Global Executive Composite (GEC) score. The BRI comprises the Inhibit, Shift,

and Emotions Control scales, and represents the ability to shift cognitive set and regulate emotion through inhibitory control (Gioia et al., 2000). The MI comprises the Initiate, Working Memory, Plan/Organize, Organization of Materials, and Monitor scales, and represents the ability to initiate, plan, organize, and sustain future-oriented problem-solving in working memory (Gioia et al., 2000). The BRIEF is reported to have good reliability and validity. The test–retest reliability for the parents in the normative group was 0.76 to 0.85 across the scales (Gioia et al., 2000). Overall, the BRIEF yields high internal consistency with correlations ranging from 0.80 to 0.98, yields good test–retest reliability, and has moderate interrater reliability between parent and teacher ratings for the normative group (Gioia et al., 2000). Evidence for validity of the BRIEF is based on the content of the items, convergence and divergence of the BRIEF scores with other measures, and the internal structure of the BRIEF.

Millon Pre-Adolescent Clinical Inventory (M-PACI; Millon, Tringone, Millon, & Grossman, 2005) – The M-PACI is a multidimensional self-report inventory designed to measure both personality and clinical symptoms among children between the ages of 9- to 12-years. The M-PACI consists of 97 true-false items written at a third grade reading level. The inventory has 14 profile scales grouped into two sets: Emerging Personality Patterns and Current Clinical Signs. The seven Emerging Personality Patterns scales of the M-PACI include Confident, Outgoing, Conforming, Submissive, Inhibited, Unruly, and Unstable. The Unstable scale measures more severe personality problems. The seven Current Clinical Signs scales of the M-PACI include Anxiety/Fears, Attention Deficits, Obsessions/Compulsions, Conduct Problems, Disruptive Behaviors, Depressive Moods, and Reality Distortions. Scores on these scales are reported as base rate scores, scaled to reflect the relative prevalence of the characteristics they measure. In addition to the profile scales, there are two M-PACI response validity indicators.

Millon's personality theory is the underlying and guiding theory for the M-PACI inventory (Millon et al., 2005). The theory postulates three primary polarities – self-other, active-passive, and pleasure-pain. When personality patterns are construed as learned strategies to secure positive reinforcement and minimize punishment, the self-other polarity represents the source to which the individual turns to enhance his or her life and gain satisfaction or to avoid pain and discomfort. Those who look to themselves for gratification and pain avoidance are termed independent on the self-other polarity. Those who look to others are termed dependent. The active-passive polarity represents the behavior intended to maximize rewards and minimize pain. Active personalities take the initiative and interact with their environment to achieve gratification and avoid distress. Passive personalities are much more reserved and maintain a more accommodating stance with their environment. The third polarity, pleasure-pain, represents the nature of the response elicited from others, which can be positive or negative. The data gathered for the development and initial validation of the M-PACI indicate that the inventory measures a number of important personality patterns and clinical signs with adequate reliability and strong validity. Overall, the M-PACI yields moderate internal consistency with correlations ranging from 0.63 to 0.84 and strong convergent and discriminant validity, as well as high correlations between M-PACI scales and measures of related constructs (Millon et al., 2005).

### **Neuropsychological Assessments**

The Wechsler Intelligence Scale for Children – Fourth Edition (WISC-IV; Wechsler, 2003) - The WISC-IV is a measure of general intelligence. It is intended for use with children ranging in age from 6 years, 0 months to 16 years, 11 months of age. The instrument yields five composite scores (FSIQ, Verbal Comprehension Index [VCI], Perceptual Reasoning Index [PRI], Working

Memory Index [WMI], and Processing Speed Index [PSI]). These indexes provide measures of verbal intelligence, fluid intelligence, working memory, and processing speed. The WISC-IV FSIQ is obtained using the 10 core subtests (Wechsler, 2003). The Verbal Comprehension Index score represents the child's ability to think and work with verbal concepts, verbal reasoning and comprehension ability, acquired knowledge, and ability to attend to verbal stimuli (Zhu & Weiss, 2005). Within the Verbal Comprehension Index, the Similarities subtest presents the examinee with two words or concepts and asks the examinee to indicate how they are similar. The Vocabulary subtest shows a picture or a written word and then asks the examinee to provide a definition. The Comprehension subtest asks the child to answer verbally presented questions based on his or her understanding of social situations. The supplemental Information subtest requires the examinee to answer questions that tap into one's general knowledge base. Finally, the supplemental Word Reasoning subtest requires the child to identify a concept based on a series of increasingly specific clues (Wechsler, 2003; Zhu & Weiss, 2005). The Perceptual Reasoning Index describes fluid reasoning, spatial processing, attention to visual detail and visual-motor integration abilities (Zhu & Weiss, 2005). Among the Perceptual Reasoning Index subtests, the Block Design subtest is a timed task that requires the examinee to view a constructed model or picture and then use red and white stimulus blocks to recreate the model or picture. The Picture Concepts subtest presents the child with rows of pictures and he or she is asked to choose one picture from each row that is related to one from each of the other rows. The Matrix Reasoning subtest requires the examinee to look at an incomplete matrix and then select the missing piece from a group of options. Picture Completion is a supplemental subtest that presents a picture with a missing feature that the child is asked to identify within a specific time limit (Wechsler, 2003; Zhu & Weiss, 2005). The Working Memory Index is associated

with the location at which incoming information is temporarily stored, calculations or transformations take place, and then an output is produced (Zhu & Weiss, 2005). In the Working Memory Index area, the Letter-Number Sequencing subtest requires the examinee to listen to a sequence of random letters and numbers and then recall them in numerical and alphabetical order. The supplemental Arithmetic subtest requires the examinee to solve arithmetic problems mentally (Wechsler, 2003; Zhu & Weiss, 2005). The Processing Speed Index is associated with the speed at which a child can accurately process simple or routine information (Zhu & Weiss, 2005). Within the Processing Speed Index, all of the subtests are timed. The Coding subtest presents the child with a key containing geometric symbols and then the child is asked to copy them in the corresponding areas below the symbols. The Symbol Search subtest requires the child to scan a row of symbols and indicate if one or more target symbols is or is not present. The supplemental Cancellation subtest requires the child to scan an array of designs and mark specific target pictures (Wechsler, 2003; Zhu & Weiss, 2005).

The participants in the standardization sample were matched on several demographic characteristics, as indicated for the general population by the 2000 U.S. Bureau of the Census. These characteristics included age, race, gender, parent education level and geographic region of residency. The internal consistency of the WISC-IV was examined using data collected from the standardization sample through the split-half method. The reliability coefficients between the scores of the two half-tests were then computed. Average coefficients for the subtest scores across age groups ranged from 0.79 to 0.89. The reliability coefficients for the WISC-IV composite scales ranged from 0.88 (Processing Speed) to 0.97 (Full Scale). The relatively higher coefficients seen on the composite scores were due to the broader sample of abilities represented in the composite scores, compared with the subtest scores (Wechsler, 2003; Zhu & Weiss, 2005).

A split-half method of examining the reliability of the WISC-IV for use among special populations was also conducted. The sample for this analysis included 661 children belonging to 16 groups, including: Intellectually Gifted; Mental Retardation-Mild Severity; Mental Retardation-Moderate Severity; Reading Disorder; Reading and Written Expression Disorders; Mathematics Disorder; Reading, Written Expression, and Mathematics Disorders; Learning Disorder and Attention-Deficit/Hyperactivity Disorder; Attention-Deficit/Hyperactivity Disorder; Expressive Language Disorder; Mixed Receptive-Expressive Language Disorder; Open Head Injury; Closed Head Injury; Autistic Disorder; Asperger's Disorder, and Motor Impairment (Wechsler, 2003). The internal consistency reliability coefficients for these groups were reported to be similar or higher than those obtained in the analysis of data from the normative sample. These results were interpreted to mean that the WISC-IV is useful as a reliable measure of intellectual functioning among the normative sample as well as with individuals belonging to the 16 special populations (Wechsler, 2003; Zhu & Weiss, 2005). The test-retest reliability of the WISC-IV was additionally examined for the subtest and composite scores. A sample of 243 children, approximately 18 to 27 from each age group, were administered the WISC-IV twice. The time between administrations ranged from 13 to 63 days, with an average interval of 32 days. The test-retest reliability was estimated for five age groups: six to seven years, eight to nine years, 10 to 11 years, 12 to 13 years, and 14 to 16 years. The average corrected stability coefficient for the majority of the subtests fell into the 0.80s. The coefficient for the Vocabulary subtest was 0.92; others fell into the 0.70s. The average corrected coefficients for the composite scores were determined to be in the good to excellent range (e.g., high 0.80s or 0.90s). The results also indicated that the test-retest gains in scores were reduced on the Verbal Comprehension and Working Memory composites, when compared with the gains

on the Perceptual Reasoning and Processing Speed composites (Wechsler, 2003; Zhu & Weiss, 2005). WISC-IV scores are reported to have good reliability and validity for use in the determination of special education eligibility (Wechsler, 2003). In addition, WISC-IV scores are said to possess good content, response process, and internal structure validity (Wechsler, 2003).

The Wechsler Individual Achievement Test-Third Edition (WIAT-III; Wechsler, 2009) – The WIAT-III is a diagnostic achievement test that is individually administered to students in grades pre-kindergarten through twelve or to individuals age 4 years 0 months through 19 years 11 months. The WIAT-III is a revised version of the WIAT-II. The revision was undertaken to develop a more comprehensive test that is responsive to changes in federal mandates and state regulations. Particularly, the WIAT-III is designed to (a) identify academic strengths and weaknesses, (b) inform decisions regarding eligibility for services, placement, or diagnosis of specific learning disabilities, and (c) design instructional objectives and plan interventions (Wechsler, 2009). The WIAT-III provides eight composite scores, with 16 subtests (Wechsler, 2009). The composite scores include Oral Language, Total Reading, Basic Reading, Reading Comprehension and Fluency, Written Expression, Mathematics, Math Fluency, and Total Achievement. The 16 subtests include Listening Comprehension, Oral Expression, Early Reading Skills, Word Reading, Pseudoword Decoding, Reading Comprehension, Oral Reading Fluency, Alphabet Writing Fluency, Spelling, Sentence Composition, Essay Composition, Math Problem Solving, Numerical Operations, Math Fluency-Addition, Math Fluency-Subtraction, and Math Fluency-Multiplication.

Although participants in the standardization sample were not randomly selected, the sample was stratified to reflect the 2005 U.S. Census data. Stratification was done by grade, age, sex,

race/ethnicity, education level, and geographic region. Norms were developed with 2,775 students in grades pre-kindergarten through twelve. Separate norms are reported for Fall (N = 1,400) and Spring (N = 1,375). The norming samples were constructed so that they were representative of the U.S. population for each grade level, each age level, and total. Students were also added from special groups (e.g., specific learning disabilities, speech or language impairment, intellectual disability, and developmental delay) to be nationally representative. Reliability of the WIAT-III was assessed using the split-half reliability method, corrected by the Spearman-Brown formula. It reflects good (0.83 to 0.89) to excellent (0.90 to 0.97) reliability for subtests. All of the mean reliability coefficients for the composite scores are excellent (0.91 to 0.98) and are consistent with the expected reliability seen in most Wechsler tests (Wechsler, 2009). With regard to the validity of the WIAT-III, the correlations are adequate and ranged from 0.60 to 0.82 (Wechsler, 2009).

Delis-Kaplan Executive Function System (D-KEFS; Delis, Kaplan, & Kramer, 2001) – The D-KEFS is the first comprehensive battery of executive function with a national normative sample (1,750 children). It can be used with individuals aged 8 to 89 years. The D-KEFS was designed to detect mild forms of executive dysfunction. All nine tests were either relatively new or were modifications of long-standing clinical and experimental measures that have demonstrated validity over the last 50 years in terms of sensitivity in detection of brain damage, particularly frontal lobe dysfunction. The D-KEFS was intended to be used in a flexible manner. The tests can be used singly or in combination with other D-KEFS tests. The nine subtests include: Trail Making Test, Verbal Fluency Test, Design Fluency Test, Color-Word Interference Test, Sorting Test, Twenty Questions Test, Word Context Test, Tower Test, and Proverb Test. Baseline conditions tapping more fundamental cognitive skills are provided for four tests (Trail

Making Test, Color-Word Interference Test, Verbal Fluency Test, and Design Fluency Test). Successful performances on other conditions for these four tests require higher-level cognitive functions and can be interpreted from fundamental cognitive skills.

The D-KEFS was normed on a sample of 1750 individuals, aged 8 to 89 years, selected to match the U.S. population in terms of age, gender, race/ethnicity, education, and geographic region. Internal consistency was evaluated for primary measures in the normative sample. Coefficients range from inadequate on Verbal Fluency Category Switching Total Correct Test to adequate/high on Twenty Questions Initial Abstraction Test, depending upon the particular measure and the age group (Delis et al., 2001). The test-retest studies of the standard form of the D-KEFS were based on a sample of 101 cases, distributed across all the age groups. Test-retest correlations ranged from low on Trail Making and Design Fluency Tests to adequate/high on Letter and Category Fluency Total Correct (Delis et al., 2001).

The D-KEFS provides many process variables, including several measures reflecting initiation of problem-solving behavior (i.e., the number of attempted sorts on the Sorting Test, and the number of total responses generated on the Verbal and Design Fluency Tests). The correlations among these measures are low (0.10 - 0.30), given that they are purported to measure a similar underlying construct (Delis et al., 2001). Indicators of speed of processing also tend to be low across tasks. These low correlations raise concerns regarding the meaning of the various scores and the possibility that measures that have the same label may in fact measure different constructs. The authors reported only one study comparing the D-KEFS with another measure of executive function. A correlational study with the WCST found moderate/high correlations (0.31 - 0.59) between WCST measures and various D-KEFS measures from the nine

tests (Delis et al., 2001). The number of perseverative responses on the WCST showed a more variable pattern of associations with the D-KEFS. The implication is that the D-KEFS and WCST are assessing similar, though not identical, processes. Although additional study of validity is needed, several studies have documented the fact that performance on the D-KEFS is adversely affected by frontal lobe lesions. Baldo, Delis, Wilkins, and Shimamura (2004) reported that patients with focal frontal lesions were impaired on the Twenty Questions Test, asking significantly more questions than controls in their attempt to guess the target items. In addition, poor performance on this measure of problem solving was strongly associated with a fewer number of correct sorts on another concept-formation task, the Sorting Test. Similarly, Keil, Baldo, Kaplan, Kramer, and Delis (2005) reported that patients with frontal lobe lesions were significantly impaired on the Word Context Test, relative to a control group.

Wisconsin Card Sorting Test (WCST; Heaton, Chelune, Talley, Kay, & Curtiss, 1993) – “The WCST is often referred to as a measure of ‘frontal’ or ‘prefrontal’ functioning” (Heaton et al., 1993, p. 1) and it requires strategic planning, organized searching, the ability to use environmental feedback to shift cognitive set, goal-directed behavior, and the ability to modulate impulsive responding (Strauss, Sherman, & Spreen, 2006). The presently accepted method of administration and scoring are based on the work of Heaton et al. In this revised and updated method, an examinee can complete the WCST on a computer. It requires an examinee to match cards to a set of four stimulus cards (one card with a red triangle, one with two green stars, one with three yellow crosses, and one with four blue circles) on three parameters of color, form, or number (Heaton et al., 1993).

Success on the WCST necessitates the examinee to determine the correct sorting principle, based on examiner feedback (correct or incorrect) and then maintain set while the stimuli changes (Heaton et al., 1993). The WCST provides objective scores not only of overall success, but also for specific sources of difficulty on the task (e.g., inefficient initial conceptualization, failure to maintain cognitive set, and perseveration). Scores on the WCST are compared with a normative stratified group of nearly 900 individuals from six different samples. Heaton et al. (1993) reported that the normative group closely reflected the United States population, classified by age. Inter-rater and intra-rater reliabilities have been investigated for the WCST. Axelrod, Goldman, and Woodard (1992) conducted a study on the reliability of the WCST. The authors reported inter-rater reliability coefficients of 0.93 (Perseverative Responses), 0.92 (Perseverative Errors), and 0.88 (Nonperseverative Errors); the sample's consistency was reported as 0.96 (Perseverative Responses), 0.94 (Perseverative Errors), and 0.91 (Nonperseverative Errors).

Evidence of concurrent validity for the WCST has been shown. Perrine (1993) used a sample of inpatient veterans to establish discriminate validity between the WCST and the Halstead Categories Test (HCT). He found that these two measures shared 30% of the variance. The results revealed that the WCST was associated with attribute identification, whereas the HCT was more closely associated with rule learning. Although research to date has demonstrated general equivalence between computerized administration and card administration of the WCST (Artiola I Fortuny & Heaton, 1996), no definitive equivalence data are available for the computerized administration of this version of the WCST.

## **Procedure**

Ethics approval was obtained from the Institutional Review Board for the Protection of Human Subjects at Philadelphia College of Osteopathic Medicine. The investigator, a graduate student working toward a doctoral degree, administered, scored, and analyzed the measures involved in this study.

The intake and neuropsychological assessment portions of this study were conducted in two parts. First, the investigator met with Thomas and Mrs. Smith for a two-hour session. The consent and assent forms were reviewed and signed by Thomas and Mrs. Smith in the presence of the investigator. The investigator informed them about the purpose of the treatment and explained that Thomas can withdraw at any stage. The M-PACI and BRIEF rating scale were also reviewed with Thomas and Mrs. Smith. Within two weeks of their completion, these forms were returned to the investigator in a self-addressed, stamped envelope. The Comprehensive Interview for Child/Adolescent Evaluations was completed during this session with Mrs. Smith. The clinical interview obtained information about Thomas's current difficulties, medical history, family composition, developmental delays, school-related problems, and interpersonal and social history. The investigator administered the WISC-IV and WIAT-III in order to gain an understanding of Thomas's cognitive and academic strengths and weaknesses.

In the second session, the investigator met with Thomas for a two-hour session. First, the D-KEFS and a computerized version of the WCST were administered to the subject in order to confirm or refute the cognitive test data and to obtain a baseline of EF. Second, the investigator provided Thomas with an introduction to the home-based computer-assisted cognitive rehabilitation program. During the final face-to-face session, the M-PACI, BRIEF questionnaire,

and preliminary neuropsychological evaluations were re-administered to Thomas and Mrs. Smith following the completion of the computer-based intervention. In addition, Thomas and Mrs. Smith provided feedback on their experiences during the study. The investigator also reviewed the results of the information obtained from the evaluations with them. The time required to complete the final session was no longer than two hours.

### **Intervention**

As indicated by Fairburn, Cooper, and Shafran (2003), eating disorders that are developed during early-to mid-adolescence, most often take the form of AN, a complex and challenging disorder. It is not until late adolescence and early adulthood that the disorder morphs into BN or ED NOS, meaning an eating disorder that does not fit perfectly into the criteria required for AN or BN, but one that borrows aspects from both. As a result, the consequences of failing to treat eating problems at an early stage must be emphasized. There are still many areas for which knowledge is lacking, both in terms of theoretical understanding and treatment approaches, particularly for eating problems in childhood, where issues of classification remain far from resolved and treatment and outcome studies are lacking. Although the subject in this study had no formal diagnosis, the intervention that follows will target this population because of the importance of intervening and addressing these problems early before it becomes a later onset disorder and complicated clinical course.

The Captain's Log software from BrainTrain was utilized for this study. The programs in the Captain's Log system are organized into three training sets, which include Attention Skills Training Set, Problem-Solving and Memory Skills Training Set, and Working Memory Training Set. Each of BrainTrain's training exercises has a beginning or starting stage. The stages are

arranged in hierarchical order in terms of difficulty and increasing training time. The difficulty level was made based on Thomas's age and grade.

Thomas performed the CRT therapy exercises at home, on his own computer via the internet, for 45 minute intervals one to two days per week over an eight week period. At the end of the third and sixth computer sessions, Thomas documented his experiences by answering two questions which were posed to him by the investigator during scheduled sessions. Questions included: "What did you learn from these tasks?" and "What did the tasks show you about your thinking style?" This part of the intervention was important in order to make sure that Thomas linked the laboratory experiences of the intervention to ecologically valid, everyday situations. The following includes a description of the computer tasks and cognitive skills that can be trained using the Captain's Log System.

<b>Alternating Attention:</b>	the ability to shift the focus of attention quickly back and forth between two different sets of stimuli in the same sensory modality and respond appropriately.
<b>Auditory Processing Speed:</b>	the time it takes to perceive relevant auditory stimuli, encode and interpret it and then make an appropriate response.
<b>Central Processing Speed:</b>	the time it takes to encode, categorize, and understand the meaning of any sensory stimuli which is the focus of attention.
<b>Conceptual Reasoning</b>	the cognitive skills, which include concept formation (the capacity to analyze relationships between objects), abstraction (the ability to think symbolically), deductive logic (the application of general rules or concepts in making a decision for a specific set of stimuli) and/or inductive logic (the analysis of feedback or identification of relevant details in formulating a concept to use in decision making).

<b>Delayed Recall</b>	the ability to remember via recognition or recall numbers, letters, symbols, words, sentences, stories, visual sequences or images after performing mental exercises which may interfere or compete with the specific information presented. These interfering or competing mental exercises are operationally defined as lasting 30 seconds or more.
<b>Detailed Reading</b>	the ability to read, understand and implement detailed instructions correctly. Once an individual has mastered basic reading skills, this skill can then be trained by requiring the player to read the exercise instruction screens without the text being spoken.
<b>Divided Attention</b>	the capability to attend to, process and respond appropriately to two or more different types of sensory stimuli (typically visual and auditory) which occur simultaneously or in close temporal proximity in the environment.
<b>Fine Motor Control</b>	the ability to control fine motor movements accurately and avoid making erroneous responses.
<b>Fine Motor Speed</b>	the time it takes to perform a simple motoric response independent of central processing speed.
<b>Focused Attention</b>	the ability to recognize and respond to specific relevant stimuli.
<b>General Attention</b>	the ability to focus, sustain and selectively attend to relevant stimuli and make correct responses (a combination of Focused, Sustained and Selective attention).
<b>Immediate Memory</b>	the ability to recognize or recall numbers, letters, symbols, words, sentences, stories, visual sequences or images immediately. The immediate delay period is operationally defined as less than 30 seconds after viewing or hearing the stimuli.
<b>Response Inhibition</b>	the capability of understanding and holding in working memory a rule which defines a correct response and using this rule to help avoid automatically reacting to an incorrect stimuli.
<b>Selective Attention</b>	the capacity to continue making a correct response during a task when competing or distracting stimuli are present.
<b>Sustained Attention</b>	the capability of maintaining consistent and accurate responses during a continuous and repetitive activity.

<b>Visuospatial Classification</b>	the ability to discriminate relevant features accurately, count and group visual objects based on a concept or rule.
<b>Visuospatial Sequencing</b>	the ability to discriminate and discern the sequential or relational order of visual objects accurately based on a concept or rule.
<b>Visual Perception</b>	the ability to discriminate accurately and respond appropriately to specific visual objects.
<b>Visual Processing Speed</b>	the time it takes to perceive relevant visual stimuli, encode and interpret it and then make an appropriate response.
<b>Visual Scanning</b>	the ability to discriminate accurately and respond appropriately to visual objects that appear, without a cue and randomly over time within the field of vision.
<b>Visual Tracking</b>	the ability to follow a continuous visual cue, discriminate accurately and respond appropriately to visual objects that move continuously within the field of vision.
<b>Working Memory</b>	the ability to encode and “hold” perceptual information while processing it and the capability to recall and apply relevant procedural rules in order to respond accurately.

## **Chapter Four**

### **Results**

#### **Case Summary and Clinical Information**

Included within this case study are a detailed background and a relevant clinical history, including the subject's reason for referral for medical treatment and current target problems. A full and detailed history of the subject includes medical, psychological, developmental, educational, and social history as well as other relevant information.

"Thomas" is a 10-year-old Caucasian male who resides in a small suburban community situated in northwestern New Jersey. He is the older of two children born to "Michael" and "Elizabeth." He is currently in the fifth grade at a medium-sized, intermediate public school, where he is enrolled in the general education program. He currently participates in ongoing outpatient medical treatment at Healthy Kids Pediatric Group. Interviewing and testing took place during December of 2012.

#### **Reason for Referral and Presenting Problem**

Thomas is a 10 year, 8 month old boy with a history of being a picky eater. He has demonstrated difficulties in the areas of planning, organization, and problem solving. Thomas was described by his parents as a rigid and inflexible child. Anxiety and worry were also noted to be problematic for him. Thomas attends Auten Road Intermediate School where he is currently in the fifth grade. He is in the general education program and there are no reported academic concerns. This evaluation was performed as a part of a dissertation project in order to obtain a baseline of Thomas's current profile of intellectual, cognitive, neuropsychological,

academic, and psychosocial functioning. The data will later be used to provide a comparison for assessing intervention impact.

### **Instruments Administered/Sources of Information**

Wechsler Intelligence Scale for Children – Fourth Edition (WISC-IV)

Wechsler Individual Achievement Test – Third Edition (WIAT-III)

Delis-Kaplan Executive Functioning System (D-KEFS)

Wisconsin Card Sorting Test – 64:Computer Version 2 (WCST-64:CV2)

Behavior Rating Inventory of Executive Function - Parent Form (BRIEF)

Millon Pre-Adolescent Clinical Inventory (M-PACI)

Clinical Interview: Parent

Review of Records

### **Medical and Developmental History**

The parent interview revealed that Thomas was the product of a full-term pregnancy and vaginal delivery, weighing 6 pounds, 12 ounces at birth. Although the length of the labor was not disclosed, there were no reported problems during the mother's pregnancy, labor, or delivery, and she was discharged two days after giving birth. APGARS were within healthy limits. He suffered mild jaundice which was treated with phototherapy at home. There were no sleeping problems noted during infancy. Breast feeding problems were reported due to improper latch and low milk supply. Bottle feeding began shortly after birth.

With regard to developmental milestones, Thomas spoke his first words close to his first birthday and he began to speak in sentences at 18 months. Motor milestones such as reaching up, sitting, and crawling were attained within normal limits. Thomas walked at 12 months. His fine motor development was considered slower in development when compared with age-mates. Thomas is right-handed and he has just recently learned to tie his shoes.

In terms of medical history, Thomas has been relatively healthy. He has no history of recurring strep, no loss of consciousness, and no seizures. Ear infections were more common when he was young. He has had no major surgeries or emergency room visits. At 3-years-old, he was hospitalized for four days due to pneumonia. Thomas does not take any medications and he has no known medication and food allergies. Thomas's vision and hearing are within normal limits. He has no reported problems with sleeping or elimination. Mrs. Smith reported that as a toddler Thomas had difficulty swallowing foods and he would often choke on solid foods during self-feeding. As a result, Thomas was spoon-fed baby food until he was 2 ½-years old. He is currently a picky eater who eats only a select group of foods and refuses to try new foods. He will often decide that he does not like a food even without tasting it. Thomas has developed a cough while eating as if it was a habit or tic.

### **Family History**

Thomas resides in an intact, supportive family unit with his parents and 8- year-old brother named Michael. Thomas's relationship with his parents is reported to be strong and loving. Mrs. Smith described his relationship with his brother as typical because they enjoy playing together, but they also have their differences. The Smith's have been married for 12 years and

the marital relationship was described as very good. The family has lived in the community for two months.

### **Social and Emotional History**

Thomas was described as a polite, reserved, orderly, and literal child who is often resistant to accepting a different way to solve a problem. He will frequently get upset by a change of plans. Mrs. Smith reported that Thomas benefits from having explicit details about events and activities spelled out for him so that he knows what is going to happen. Thomas spends an excessive amount of time making his room neat and organized. His belongings need to be in their proper place. He is careful to obey rules both at home and school. Mrs. Smith reported that Thomas is a quiet child who does not make friends easily. Thomas has a small group of friends whom he enjoys interacting with in school. Although Thomas's peer relationships and play skills are positive, he feels comfortable playing by himself. He enjoys soccer, swimming, bike riding, video games, and sleepovers. Thomas is involved in recreational soccer.

### **Academic and School History**

Thomas attended the ABC Day School in New Jersey at the age of three. The staff reported no academic concerns in school. He entered Franklin Road Elementary School in kindergarten and continued there until the end of fourth grade. Mrs. Smith reported that Thomas is a good student, earning 3's (meets expectation), and is generally well-liked by his teachers because he is polite and attentive to teacher direction. Mrs. Smith also indicated that Thomas is a slow reader, and that he sometimes has difficulty with reading comprehension. As a result, he does not enjoy reading and will avoid it whenever possible unless it is absolutely necessary. Mrs. Smith reported that she is concerned about Thomas's ability to transition to his new school because he often

complains about disliking school. The family has recently moved to a new home and he has been attending fifth grade at Auten Road Intermediate School since November. He continues to do well in school and has never received accommodations or academic supports. Mrs. Smith reported that she rarely spends time helping Thomas with his school work because he is very conscientious, structured, and rule-bound.

### **Assessment Observations**

Thomas presented as a polite and pleasant young man who was dressed in casual attire. He appeared to be in good health and was appropriately groomed. Thomas greeted the examiner with a smile as he was accompanied to the testing session. Thomas was willing to engage in conversation about his interests and activities. He readily talked about his family and his relationship with his brother. Thomas was an active participant in the assessments and tasks asked of him. At times, he seemed anxious about his performance, and stated, "Do I have to?" with a nervous laugh. Rapport was easily established and Thomas appeared motivated to put forth his best effort. His affect was positive, yet he made some self-deprecating remarks about his academic and social relationships. He preferred to use his right hand to perform tasks that required manual manipulation. Breaks were offered and Thomas appeared to enjoy these breaks. During these times, Thomas requested to play a game with the examiner.

On language-based tasks of crystallized knowledge, Thomas appeared less confident in his abilities and he did not persevere when items became difficult. Although he was able to converse in casual conversation, he struggled with expressing information on formal verbal tasks. Further prompting usually did not produce much in the way of elaboration or refinement of initial statements. This often resulted in Thomas receiving less than full credit. His ability to

reason with language when convergent thinking skills were required appeared age-appropriate. On visual-spatial tasks, he appeared confident in his nonverbal reasoning abilities and he was able to persevere when items became difficult. Throughout the evaluation, Thomas displayed performance anxiety as evidenced by nervous laughter, fidgeting, and requests for feedback. He often questioned the use of the examiner's timer before administration of subtests. Thomas performed best on auditory memory and working memory based verbal tasks. He struggled with block designs and graphomotor (paper and pencil) reproduction skills. At times, he mentioned that certain items were more difficult than others; however, he was always compliant and responsive to encouragement. When attempting reading tasks, Thomas appeared nervous and asked to perform these tasks following mathematical tasks. He seemed to have insight into his weaknesses in this area of functioning. Given the above observations, the assessment work completed, and the information gathered and interpreted, the results appear to be a fairly reliable and valid indicator of Thomas's current level and pattern of intellectual, cognitive, neuropsychological, academic, and behavioral functioning.

### **Cognitive and Intellectual Functioning**

To screen for cognitive and intellectual functioning, Thomas was administered the WISC-IV. The WISC-IV is an individually-administered clinical instrument for assessing the cognitive functioning of children and adolescents, aged 6-16. Thomas was administered ten WISC-IV core subtests. The Full Scale Standard Score (SS; mean = 100, standard deviation = 15; higher scores = better performance) is typically considered an estimate of overall intellectual functioning when there is a minimal amount of variability noted across assessed areas. Thomas displayed consistencies across subtests, with all scores in the average range. However, to examine further his various cognitive abilities, his performance was most meaningfully

summarized by shared ability clusters, groups of subtests that are made up of similar cognitive processes, or in many cases, individual subtest scores. The Verbal Comprehension Index (SS = 93) was reliable, with subtest scores in the low average to average range (mean = 10, standard deviation = 3). The Perceptual Reasoning Index (SS = 102) was not reliable, with subtest scores ranging from a weak Block Design score (ss = 7) to average scores on Picture Concepts and Matrix Reasoning subtests (both ss = 12). The Working Memory Index (SS = 104) was reliable, with subtest scores in the average range on Digit Span and Letter Number Sequencing (ss = 10 and 12 respectively). Additionally, the Processing Speed Index (SS = 94) was reliable, with subtest scores in the average range on Coding and Symbol Search (ss = 8 and 10 respectively).

Thomas's performance revealed relative strengths with immediate auditory memory and nonverbal problem solving. He evidenced a good capacity to effectively process orally-presented material when asked to sort and re-order random sequences of numbers and letters. Thomas also demonstrated average skill on rote recall of verbally presented digits in forward and backward sequence. Overall, his performance was quite good with rote auditory-verbal memory, sequencing, and working memory. Although in the average range, some scatter was observed on visual-spatial-holistic and nonverbal problem solving tasks. Thomas exhibited average skill when comparing and contrasting rows of meaningful objects to determine common characteristics, demonstrating age appropriate discordant/divergent and concordant/convergent reasoning. He also performed adequately with novel problem solving skills when he was asked to solve analogic problems requiring fluid reasoning. Thomas was successful at recognizing and solving items by choosing the correct response from a group of distracters. The most difficult task for Thomas involved making block designs from a model using two-color cubes to construct replicas of two-dimensional, geometric patterns. This suggests that Thomas had difficulty with

global-holistic-spatial processing, perceptual analysis and synthesis, and understanding part-whole relationships. Errors reflected global pattern problems (i.e., configuration errors), suggesting that he had difficulty seeing the gestalt or “big picture.”

Thomas had more difficulty with tasks requiring vocabulary and lexical-semantic knowledge, verbal reasoning and cause-effect relationships, and visual-motor processing speed. Although he evidenced a good capacity to understand and express his thoughts effectively, using spoken language during informal conversation; he was less successful with formal tasks that required expressive language and word knowledge. Thomas struggled to develop oral definitions after being presented with common vocabulary terms. His lexical-semantic knowledge and word retrieval may be somewhat limited and these limitations are further challenged by his lack of confidence in his abilities because he did not persevere when items became difficult. Thomas performed solidly on categorical tasks that assess common characteristics shared by word pairs. He performed adequately with verbal reasoning and conceptualization when answering questions that required an understanding of cause-effect relationships and generally accepted social rules and conventions. Thomas’s vocabulary (lexical-semantic knowledge) was in the low average range. His performance on this subtest might suggest some inconsistencies with formal educational and experiential opportunities.

Thomas demonstrated consistent performance on tasks requiring visual-motor processing speed. When asked to scan and detect abstract visual shapes visually, in order to determine if a target shape was contained within an array of distracters, he performed solidly in the average range. Thomas had some difficulty with constructional praxis and graphomotor skills to reproduce symbols according to a visual template. On the latter task, Thomas was accurate but

slow, and frequently referred to the template or previous items when responding, indicating difficulty with learning novel symbolic representations, visual-motor coordination, and/or integration. Table 1 presents Thomas's cognitive abilities as measured by the WISC-IV.

Table 1

*Results of Wechsler Intelligence Scale for Children – Fourth Edition*

<b>Composite</b>	<b>Standard Score</b>	<b>Percentile</b>	<b>Category</b>
Verbal Comprehension	93	32	Average
Perceptual Reasoning	102	55	Average
Working Memory	104	61	Average
Processing Speed	94	34	Average
Full Scale	98	45	Average
<b>Subscale</b>	<b>Scaled Score</b>	<b>Percentile</b>	<b>Category</b>
<i>Verbal Scale</i>			
Similarities	10	50	Average
Vocabulary	7	16	Low Average
Comprehension	9	37	Average
<i>Performance Scale</i>			
Block Design	7	16	Low Average
Picture Concepts	12	75	Average
Matrix Reasoning	12	75	Average
<i>Working Memory Scale</i>			
Digit Span	10	50	Average
Letter Number Sequence	12	75	Average
<i>Processing Speed Scale</i>			
Coding	8	25	Average
Symbol Search	10	50	Average

### **Cognitive Hypothesis Testing**

Based on the intellectual screening, several hypotheses regarding Thomas's cognitive strengths and weaknesses can be developed and subsequently evaluated using several neuropsychological measures. However, this study is examining executive functions in adolescents with disordered eating. Executive functions are involved in planning, organizing, monitoring, evaluating, and changing cognitive processes and behavior in an adaptive fashion. As a result, cognitive hypothesis testing was conducted to examine Thomas's executive functions. Although his attention, auditory memory, sequential and categorical processing, and working memory appeared age-appropriate, he seemed to have some difficulty with quick and efficient performance. Weaknesses with quick and efficient processing could likely be related to executive difficulties. Interestingly, efficient processing might impact many areas of academic performance, including reading tasks. Other executive weaknesses included reasoning, logical planning, visual scanning and tracking, and cognitive flexibility.

### **Executive Function**

Although Thomas's overall intellectual profile was in the average range, several additional measures were administered to explore further, weak performance on reasoning, logical planning, visual tracking, quick and efficient processing, and cognitive flexibility measures. On the D-KEFS, a measure of executive function, Thomas performed well, with only some minor concerns noted. With regard to organization, Thomas showed skill in planning and organizing his actions in order to reach a goal; however, performing this task in the most efficient way seemed to be slightly more challenging for him (Tower Achievement Scs = 11; Move Accuracy Scs = 9). On tasks measuring verbal fluency (i.e., generating words that start with a letter or belong to a category), Thomas performed above expected levels (Verbal Fluency Letter Fluency

Scs = 11; Category Fluency Scs = 13; Category Switching Scs = 13; Category Switching Accuracy Scs = 12). On a measure assessing flexibility of thinking utilizing a visual-motor sequencing procedure, where Thomas had to draw a line between numbers and letters in alternate sequence (i.e., 1-A-2-B), Thomas performed in the average range; however, on the simple scanning condition which required visual scanning and processing speed to recognize numbers among many distracters, Thomas's performance fell slightly (Trail Making Number Sequencing Scs = 12; Letter Sequencing Scs = 11; Number-Letter Switching Scs = 12; Motor Speed Scs = 11; Visual Scanning Scs = 9). He demonstrated skill at inhibiting an automatic verbal response in order to generate a conflicting response, thereby suggesting good decision making and cognitive flexibility (Color-Word Interference Color Naming Scs = 12; Word Reading Scs = 11; Inhibition Scs = 11; Inhibition/Switching Scs = 12). Table 2 presents Thomas's executive function skills as measured by the D-KEFS. In contrast, on the WCST-64:CV2, his ability to formulate and test hypotheses while using feedback to guide his responses was less well-developed (Total Errors Sts = 87; Conceptual Level Responses Sts = 89). Thomas was able to generate alternative problem-solving approaches (Perseverative Responses Sts = 107). Similarly, he was able to maintain a consistent problem-solving strategy within categories (Failure to Maintain Set >16%); however, he became less efficient with sorting as the test continued (Learning to Learn 6-10%). Table 3 presents Thomas's shifting abilities as measured by the WCST-64: CV2. Overall, these findings suggest mild difficulty with visual scanning, mental flexibility, organization, and planning.

Table 2

*Pre-test Results of Delis-Kaplan Executive Function System*

<b>Subtest</b>	<b>Scaled Score</b>	<b>Percentile</b>	<b>Category</b>
Trails Visual Scanning	9	37	Average
Trails Number Sequencing	12	75	Average
Trails Letter Sequencing	11	63	Average
Trails Number/Letter Switching	12	75	Average
Trails Motor Speed	11	63	Average
<b>Subtest</b>	<b>Scaled Score</b>	<b>Percentile</b>	<b>Category</b>
Verbal Letter Fluency	11	63	Average
Verbal Category Fluency	13	84	High Average
Verbal Category Switching	13	84	High Average
Verbal Switching Accuracy	12	75	Average
<b>Subtest</b>	<b>Scaled Score</b>	<b>Percentile</b>	<b>Category</b>
Color Naming	12	75	Average
Word Reading	11	63	Average
Inhibition	11	63	Average
Inhibition/Switching	12	75	Average
<b>Subtest</b>	<b>Scaled Score</b>	<b>Percentile</b>	<b>Category</b>
Tower Achievement	11	63	Average
Move Accuracy	9	37	Average

Table 3

*Pre-test Results of Wisconsin Card Sorting Test-64: Computer Version 2*

	<b>Standard Score</b>	<b>Percentile</b>	<b>Category</b>
Total Errors	87	19	Low Average
Perseverative Responses	107	68	Average
Conceptual Level Responses	89	23	Low Average
Failure to Maintain Set		>16	
Learning to Learn		6 -10	

**Academic Achievement**

The WIAT-III was administered to gain insight into Thomas's reading, written language, and mathematics skills. On the WIAT-III, his performance was compared with students of similar age. To achieve this end, age-based standard scores and percentile ranks are used to describe Thomas's level of academic functioning in these areas.

Clearly, Thomas is functioning at or slightly below academic levels for his age and grade. The area of mathematics appears to be Thomas's strongest academic area, with the area of reading abilities, specifically decoding and fluency, being the weakest. Of interest is that on math tasks tapping problem solving and multi-step problem solving Thomas solved most without benefit of paper and pencil (even though it was offered), again implying adequate auditory working memory (WIAT-III Math Problem Solving Sts = 115). His knowledge of mathematical concepts, computations, and operations was average (WIAT-III Numerical Operations Sts = 107). Thomas's ability to complete simple arithmetic quickly was in the average range; however, he earned a weaker fluency score with basic addition facts (Math Fluency Sts = 102).

Reading was an area of relative weakness for Thomas. Interestingly, he often appeared hesitant and anxious about his reading, asking to do these tasks last. When asked to read, Thomas expressed the question, “Do I have to?” Although he demonstrated adequate single word reading, his decoding skills and fluency were relatively weak (Word Reading Sts = 92; Pseudoword Decoding Sts = 89; Oral Reading Fluency Sts = 88). Specifically, he often added additional words and endings when he read, which impacted his fluency, accuracy, and comprehension. On an untimed reading task, Thomas’s comprehension was adequate, although he had difficulty with questions that required inferential thinking and reasoning (WIAT-III Reading Comprehension Sts = 91). His performance on a spelling task was average and was similar to his basic reading skills (WIAT-III Spelling Sts = 95). Table 4 presents Thomas’s academic achievement as measured by the WIAT-III.

Table 4

*Results of Wechsler Individual Achievement Test – Third Edition*

<b>Subtest</b>	<b>Standard Score</b>	<b>Percentile</b>	<b>Category</b>
Pseudoword Decoding	89	23	Low Average
Word Reading	92	30	Average
Reading Comprehension	91	27	Average
Oral Reading Fluency	88	21	Low Average
Spelling	95	37	Average
Numerical Operations	107	68	Average
Math Problem Solving	115	84	High Average
Math Fluency – Addition	98	45	Average
Math Fluency – Subtraction	106	66	Average
Math Fluency – Multiplication	102	55	Average

**Social-Emotional and Behavioral Functioning**

Due to the focus of this study, Thomas’s mother, Mrs. Smith, completed the Behavior Rating Inventory of Executive Functions (BRIEF). The BRIEF is an indirect measure of rater perception of a child’s self-control and problem-solving skills. Mrs. Smith’s ratings revealed concerns with initiating problem-solving and flexibly regulating behavior and thinking, with the former being in the clinical range. Items endorsed suggest that Thomas struggles with problem-solving flexibly, with adjusting to changes in routine, task demands, or foods, with beginning a task, with independently generating ideas, and with a lack of initiative. Table 5 presents Thomas’s executive function behaviors as measured by the BRIEF.

Thomas completed the Millon Pre-Adolescent Clinical Inventory (M-PACI). The M-PACI is a multidimensional self-report assessment tool designed to measure both personality and clinical symptoms among children between the ages of 9 and 12. His endorsements revealed concerns with anxiety and matters of personal adequacy and low self-worth. Emerging personality patterns revealed elevations on the Submissive and Inhibited scales. His ratings were indicative of a shy, quiet, and cooperative young man who often prefers others to take the lead and to make decisions. Thomas also revealed that he tends to be apprehensive and socially ill at ease. Preoccupations with matters of personal adequacy and low self-worth appear to indicate a predominantly, clinical picture of dysthymia. Of note is his tolerance of his current unhappiness and willingness to accept his sad fate as perhaps being inevitable. Interestingly, Thomas's ratings of himself seem to concur with his mother's concerns during the clinical interview. Mrs. Smith reported that she worries about his emotional and social well-being. She indicated that Thomas is a serious and rigid child. She also described him as a quiet child with a few close friends. Mrs. Smith noted that she is particularly concerned about Thomas and his transition to fifth grade. The family has recently relocated to a new home and new school district and he has a difficult time adjusting to change and making new friends. Thomas is a hard worker who follows classroom rules; he is a role model for his peers in the classroom. Although Thomas's peer relationships and play skills seem positive, he feels comfortable playing by himself. Mrs. Smith noted that he seems sad at times. She reported that his lack of self-confidence can impact his daily functioning because he will be hesitant to partake in activities that he does not feel confident in attempting. Mrs. Smith explained this behavior as a part of growing up and becoming an adolescent.

Table 5

*Pre-behavior Results of Behavior Rating Inventory of Executive Function*

<b>Subtest</b>	<b>T-Score</b>	<b>Percentile</b>	<b>Category</b>
Inhibit	37	14	NA
Shift	60*	85	At-Risk
Emotional Control	58	81	NA
<b>Behavioral Regulation Index</b>	<b>51</b>	<b>59</b>	<b>NA</b>
Initiate	69*	98	Clinically Significant
Working Memory	40	24	NA
Plan/Organize	48	51	NA
Organization of Materials	36	11	NA
Monitor	40	24	NA
<b>Metacognition Index</b>	<b>46</b>	<b>44</b>	<b>NA</b>
<b>Global Executive Composite</b>	<b>48</b>	<b>47</b>	<b>NA</b>

*Note.* The BRIEF ratings are negative indicators and high scores indicate a lack of functioning.

### **Results Following the Intervention**

Thomas's overall neuropsychological profile was in the average range; however, weak performance had been noted on reasoning, logical planning, visual tracking, quick and efficient processing, and cognitive flexibility. Following Captain's Log (computer-based intervention), several measures from the D-KEFS, WCST-64:CV2, BRIEF, and M-PACI were re-administered in order to assess the effect of the intervention. Interestingly, Thomas appeared more relaxed

and sure of his abilities during this administration. Results of the pre and post assessments and behavior ratings are illustrated in Figures 1-6. On the D-KEFS, a measure of executive function, Thomas's performance improved, with some concerns noted. With regard to organization, Thomas showed strong skill in planning and organizing his actions in order to reach a goal; however, performing this task in the most efficient way seemed to be more challenging for him than on the initial presentation (Tower Achievement Scs = 14; Move Accuracy Scs = 7). On tasks measuring verbal fluency (i.e., generating words that start with a letter or belong to a category), Thomas's overall performance was weak (Verbal Fluency Letter Fluency Scs = 11; Category Fluency Scs = 10; Category Switching Scs = 9; Category Switching Accuracy Scs = 10). Performance on this subtest was quite variable from his performance on the initial subtest presentation. Interestingly, this examiner noted that although Thomas was cooperative, he appeared less engaged and somewhat indifferent while working on this task. As a result, it appears that his limited engagement and motivation had a negative impact on his performance and might not be an accurate representation of his true ability. Therefore, this subtest was excluded from interpretation in this study. On a measure assessing flexibility of thinking, utilizing a visual-motor sequencing procedure, during which Thomas had to draw a line between numbers and letters in alternate sequence (i.e., 1-A-2-B), Thomas performed in the average to high average range; however, on the simple motor condition which required good graphomotor skills to trace lines, Thomas's performance fell slightly from the previous administration (Trail Making Visual Scanning Scs = 11; Number Sequencing Scs = 13; Letter Sequencing Scs = 11; Number-Letter Switching Scs = 12; Motor Speed Scs = 9). He demonstrated strong skill at inhibiting an automatic verbal response in order to generate a conflicting response, thereby suggesting good decision making and cognitive flexibility (Color-Word Interference Color

Naming Scs = 14; Word Reading Scs = 11; Inhibition Scs = 13; Inhibition/Switching Scs = 11). Table 6 presents Thomas's executive function skills as measured by the D-KEFS. Similarly, on the WCST-64:CV2, his ability to formulate and test hypotheses when using feedback to guide his responses was exceptionally well-developed (Total Errors Sts = 126; Conceptual Level Responses Sts = 124). Thomas was adept at generating alternative problem-solving approaches (Perseverative Responses Sts = 145). He was able to maintain a consistent problem-solving strategy within categories (Failure to Maintain Set >16%). Thomas performed well with sorting as the test continued (Learning to Learn >16%). Table 7 presents Thomas's shifting abilities as measured by the WCST-64: CV2.

Table 6

*Post-test Results of Delis-Kaplan Executive Function System*

<b>Subtest</b>	<b>Scaled Score</b>	<b>Percentile</b>	<b>Category</b>
Trails Visual Scanning	11	63	Average
Trails Number Sequencing	13	84	High Average
Trails Letter Sequencing	11	63	Average
Trails Number/Letter Switching	12	75	Average
Trails Motor Speed	9	37	Average
<b>Subtest</b>	<b>Scaled Score</b>	<b>Percentile</b>	<b>Category</b>
Verbal Letter Fluency	11	63	Average
Verbal Category Fluency	10	50	Average
Verbal Category Switching	9	37	Average
Verbal Switching Accuracy	10	50	Average
<b>Subtest</b>	<b>Scaled Score</b>	<b>Percentile</b>	<b>Category</b>
Color Naming	14	91	High Average
Word Reading	11	63	Average
Inhibition	13	84	High Average
Inhibition/Switching	11	63	Average
<b>Subtest</b>	<b>Scaled Score</b>	<b>Percentile</b>	<b>Category</b>
Tower Achievement	14	91	High Average
Move Accuracy	7	16	Low Average

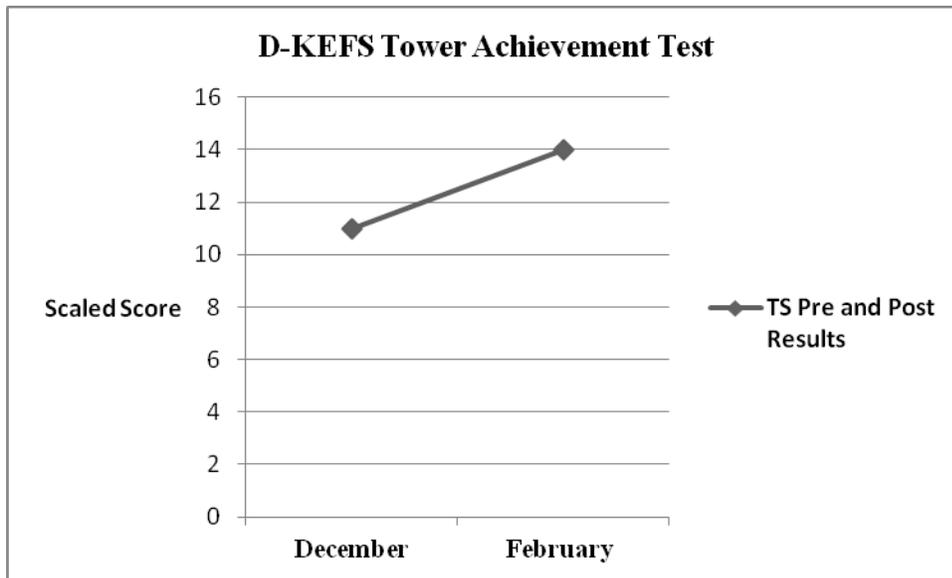


Figure 1. D-KEFS Tower Achievement Test pre and post assessments.

Table 7

Post-test Results of Wisconsin Card Sorting Test-64: Computer Version 2

	Standard Score	Percentile	Category
Total Errors	126	96	Superior
Perseverative Responses	>145	>99	Very Superior
Conceptual Level Responses	124	95	Superior
Failure to Maintain Set		>16	
Learning to Learn		>16	

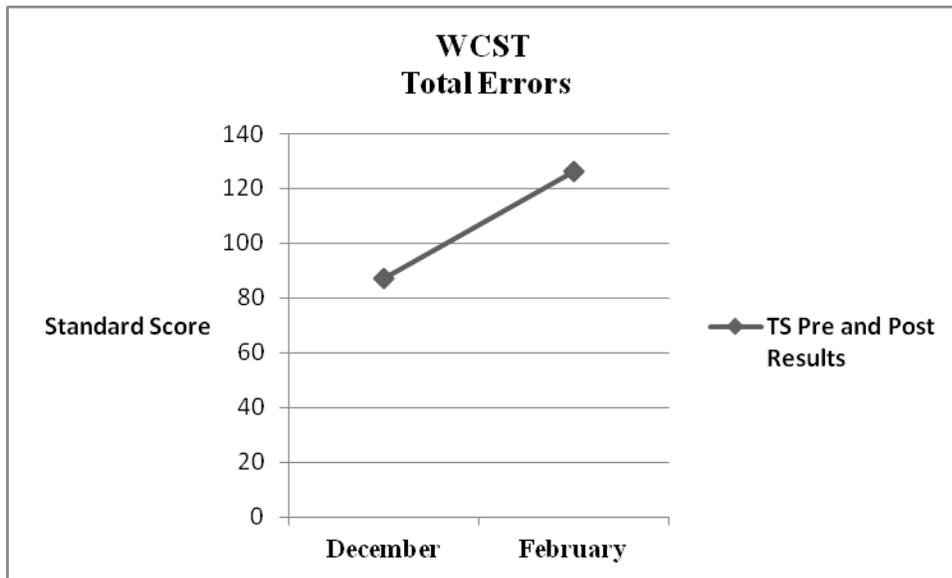


Figure 2. WCST Total Errors pre and post assessments.

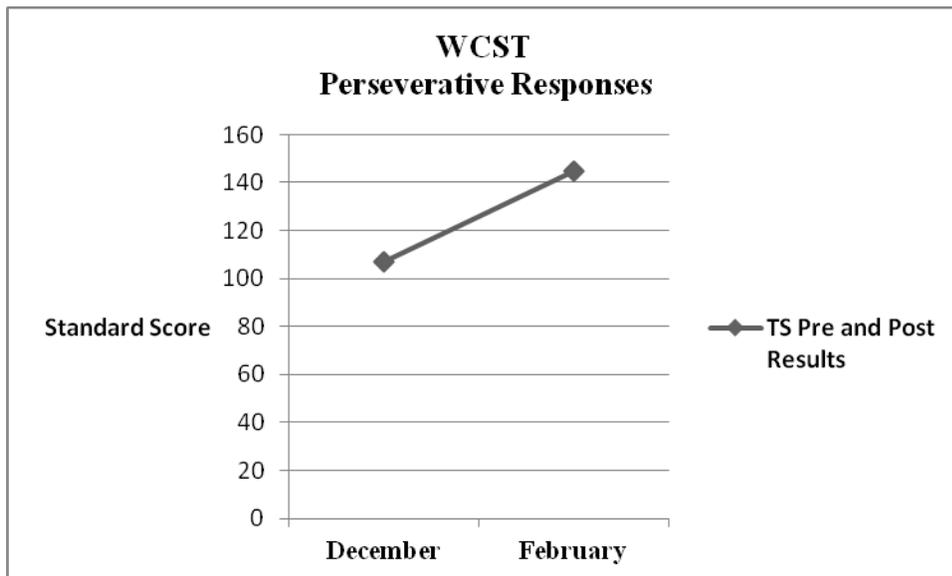
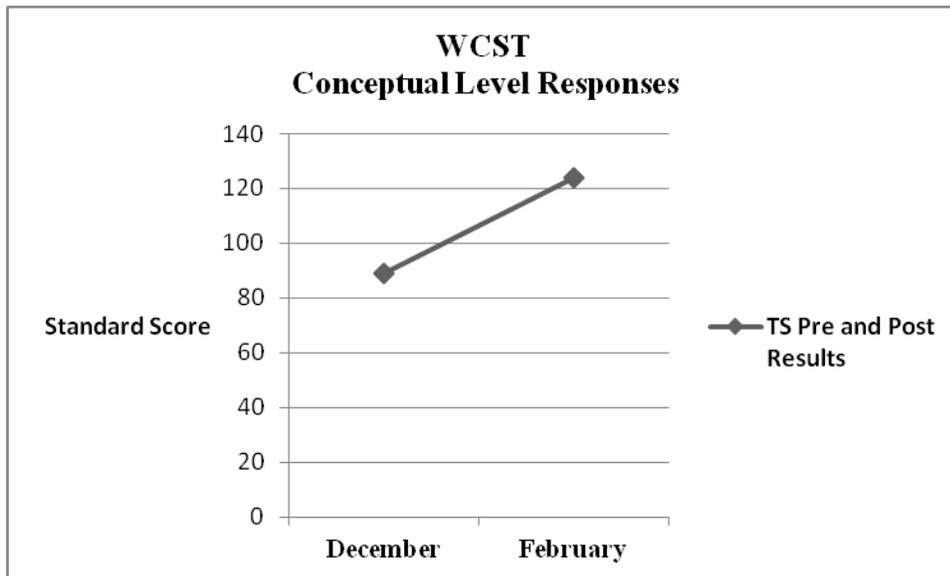


Figure 3. WCST Perseverative Responses pre and post assessments.



*Figure 4.* WCST Conceptual Level Responses pre and post assessments.

On the BRIEF, Mrs. Smith's ratings on the second administration revealed all areas assessed by the BRIEF as demonstrating executive functions within the typical range of functioning for children Thomas's age. Items previously endorsed as a concern on the behavioral regulation scales (Shift) and metacognition scales (Initiate) were no longer elevated. In addition, seven of the eight scales revealed lower scores than on the previous administration. The Inhibit scale remained constant throughout the entire study. Table 8 presents Thomas's executive function behaviors as measured by the BRIEF. Overall, these findings suggest that Captain's Log had a beneficial impact on his executive functions. Areas of improvement included mental flexibility, reasoning, and logical planning.

Table 8

*Post-behavior Results of Behavior Rating Inventory of Executive Function*

<b>Subtest</b>	<b>T-Score</b>	<b>Percentile</b>	<b>Category</b>
Inhibit	37	14	NA
Shift	53	74	NA
Emotional Control	40	22	NA
<b>Behavioral Regulation Index</b>	<b>41</b>	<b>22</b>	<b>NA</b>
Initiate	56	79	NA
Working Memory	38	13	NA
Plan/Organize	37	10	NA
Organization of Materials	33	7	NA
Monitor	37	10	NA
<b>Metacognition Index</b>	<b>38</b>	<b>9</b>	<b>NA</b>
<b>Global Executive Composite</b>	<b>39</b>	<b>11</b>	<b>NA</b>

*Note.* The BRIEF ratings are negative indicators and high scores indicate a lack of functioning.

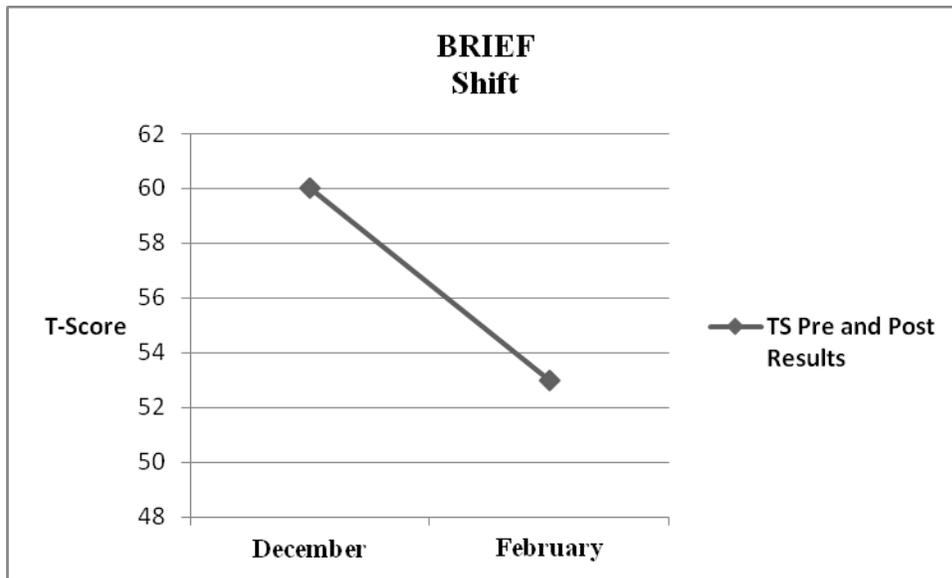


Figure 5. BRIEF Shift pre and post behavior ratings.

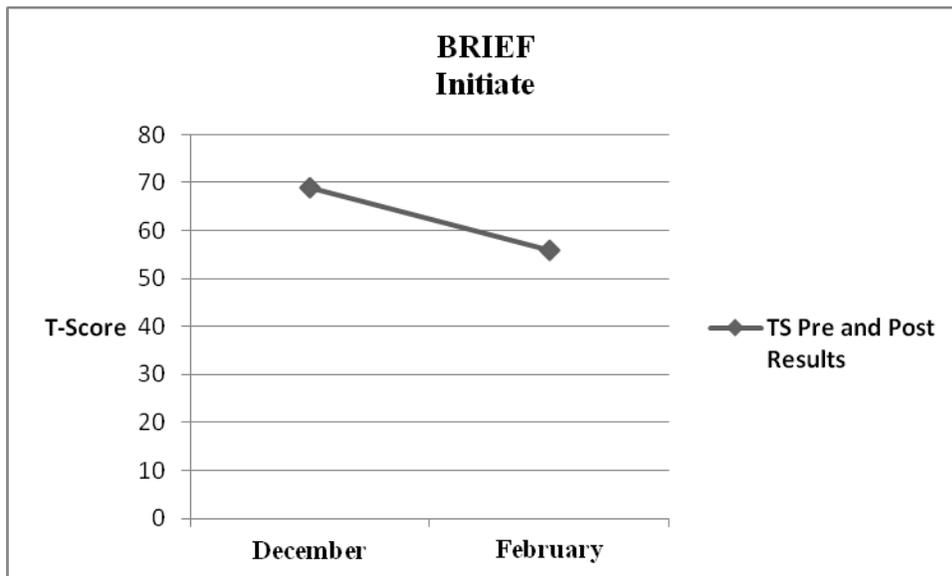


Figure 6. BRIEF Initiate pre and post behavior ratings.

Thomas once again completed the Millon Pre-Adolescent Clinical Inventory (M-PACI). Contradictory to his initial ratings, the items he endorsed revealed a self-assured young man. Emerging personality patterns revealed an individual who is confident in his abilities. Thomas will often approach activities and interests with a sense of spirit. In his interactions, he is affable and good-natured. However, Thomas also exhibits an inflated sense of self-worth. This tendency toward self-centeredness is not malicious in intent because it is derived from the arrogant assumption that few rules apply to him. When others become irritated, Thomas is likely to react, initially, with indifference. Although he has a conscience, he will quickly project blame onto others and will be especially resentful of anything that can be construed as personally derogatory. Persistent rebuffs to his self-esteem may elicit increasingly disruptive behaviors, such as overt resentment and moodiness. Although conflicting pre and post behavior ratings are evident, it is important to note that developmental fluctuations in emotion and behavior are characteristic of this age group. Therefore these ratings should be considered a snapshot of Thomas's emerging and changeable psychological patterns. Similar to his initial ratings, the M-PACI reveals a clinical picture of depressive features. He is unable to tolerate humiliation, failure, or frustration; these sharply deflate his self-esteem.

At the time of the feedback session, Thomas presented as a more assertive and self-assured young man. Throughout the study, he had a difficult time answering the two reflection questions. Thomas reported that the tasks allowed him to increase his control of his attention because he understood the importance of attending to the variety of tasks. However, he was unable to make a connection between his thinking style and real life scenarios. Thomas did not find the intervention to be helpful. In fact, he described the intervention as "boring." He reported receiving A's in all of his academic subjects for the first marking period in his new

school. He seemed excited with his report card, but expressed his concern that school was getting more difficult. Although Thomas continues to maintain a limited variety of foods, Mrs. Smith reported that he is now more interested in tasting foods he has not tasted before.

## Chapter Five

### Discussion

The present study, using a pre-adolescent with disordered eating behaviors, tested the effectiveness of an intensive cognitive training program. His clinical profile reveals a shy, apprehensive, cautious, and introspective young man who is struggling with anxiety and sadness. The training program was conducted in the participant's home, which is a practical setting for this type of intervention. Previous cognitive training studies have been conducted in hospital settings (e.g., Davies & Tchanturia, 2005).

The most robust findings in the current study are found when comparing pre- and post-treatment results. The overall results of this study show that there is significant improvement in executive functions after 8 sessions of CRT. More specifically, cognitive exercises changed performance in planning (D-KEFS Tower Achievement Score Scs = 14) and shifting tasks (WCST-64:CV2 Total Errors Sts = 126; Conceptual Level Responses Sts = 124; Perseverative Responses Sts = >145) on follow up neuropsychological assessment. Similarly, after training, the parent reports clinical improvements on two executive function scales of the BRIEF (Shift and Initiate). Specifically, the Shift scale assesses the ability to move freely from one situation, activity, or aspect of a problem to another as the circumstances demand (Gioia et al., 2000). The Initiate scale pertains to beginning academic tasks or activities and involves problem-solving strategies. It is important to note that seven of the eight BRIEF scales showed improvements on executive functioning at post-treatment. The Inhibit scale remained constant throughout the entire study. These results indicate that cognitive training had a beneficial effect of reducing parent-reported problems with different types of behavior related to the seven domains of

executive functioning. In summary, the results of this study suggest that executive functioning may be improved by practice.

The present study suggests that baseline findings on neuropsychological measures and parent reports of executive functioning can be improved by intense and prolonged training. One possible mechanism for ways in which cognitive training can lead to improvements on executive functioning is altering brain activity. For example, Zastrow et al. (2009) found that after trials of set-shifting tasks there was increased activation in the frontal-parietal networks in individuals with AN. Another possible explanation is that the intense and prolonged nature of the training may increase the use of executive strategies that compensate for weaknesses in basic processes, or of the increase in voluntary control of attention. Support for this possibility was proposed, based on qualitative feedback by Thomas. Although the two interview questions were difficult to answer, Thomas was able to report that the tasks allowed him to increase his control of his attention. However, it was apparent that Thomas struggled to make connections between his thinking style and real life scenarios because he was unable to answer the second question.

Benefits of the training program appeared to generalize to improvements in Thomas's self-esteem and self-confidence; however, it is important to note that developmental fluctuations in emotion and behavior are characteristic of this age group. As a result, caution should be used when interpreting these results as a true picture of Thomas's psychological profile. A clinical picture of depressive features was persistent throughout this research project.

Qualitatively, parent-reported improvements in accepting new food groups would have strengthened the findings of the current study. Following training, Thomas continued to maintain a limited variety of foods. However, Mrs. Smith reported that he is now more

interested in tasting foods that he has not tasted before. Despite the fact that Thomas did not find the intervention to be helpful, he reported receiving A's in all of his academic subjects for the first marking period in his new school

Although the entire CHT model was not utilized in this study, the model served as a guide in order to develop and test hypotheses about Thomas's performance on cognitive measures. This approach identified several areas of weakness including reasoning, logical planning, visual tracking, quick and efficient processing, and cognitive flexibility. Interestingly, when reviewing the literature on eating disorders as a whole, it would appear that eating disorders are associated with similar anomalous cognitive functioning, extending across many domains including attention, memory, executive functions, motor control, and visuo-spatial processing. In the CHT model, emphasis is also placed on linking the assessment data to an intervention. That is, the intervention is subsequently developed using the new-found understanding of the student. In this study, Captain's Log software from BrainTrain was utilized as the targeted intervention for Thomas's executive function deficits. This software, Captain's Log, works to improve working and short-term memory, attention, mental processing speed, impulse control, listening skills, problem solving, and much more (J. McLaughlin, personal communication, December 6, 2011).

Although the restrictive nature of Thomas's eating practices do not feature the dramatic medical complications characteristic of anorexia nervosa, early intervention remains crucial. The difficulties characteristic of picky eating are long standing and may be associated with significant impairment to quality of life, including impinging upon friendships, social activities and family relationships. There is a relatively good prognosis for childhood and adolescent eating disorders if they are treated soon after onset. However, if these disorders are not treated,

they may become chronic conditions with devastating physical, emotional, and behavioral consequences (Lask & Bryant-Waugh, 1999). In a study of over 800 families interviewed on three occasions, from 1–10 years, 9–18 years and 11–21 years, picky eating was found to be a risk factor for the development of symptoms of anorexia nervosa (Marchi & Cohen, 1990). Jacobi, Schmitz, and Agras (2008) assessed 426 children between the ages of 8 and 12 and found that picky eaters were more likely to exhibit problem behaviors than were non-picky eaters. Consequently, when reviewing the literature on eating disorders in children and young adolescents, there is evidence that picky eaters, in their childhood, are likely to consume fewer calories and to weigh less, and in later childhood and adolescence to demonstrate behavior problems and symptoms of anorexia nervosa.

Indeed, school psychologists and school counselors can play a critical role in the prevention and early identification of eating problems and eating disorders in elementary schools. School psychologists and school counselors are in daily contact with the highest risk group for developing eating disorders - children and adolescents. They are in a unique position to identify at-risk students, provide support for children and adolescents, implement effective school-based prevention programs, and make appropriate referrals. The primary goals of school-based eating disorder prevention programs are to prevent the development of a negative body image and eating problems. Most models emphasize the importance of developing problem solving and decision making skills (Levine & Smolak, 2001) in order to be an effective program. In this study, Captain's Log software from BrainTrain was utilized as the targeted intervention. The Captain's Log exercises work to improve memory, attention, reasoning, planning, judgment, learning, and overall executive functioning. Thus, the primary areas of improvement for Thomas following the training program included logical planning and cognitive flexibility. In this

manner, targeting and strengthening thinking skills may be of value as part of a standard treatment program for individuals with eating disorders.

### **Limitations of the Study**

So far the intervention is limited to one case study, but the encouraging results from this study merit further investigation and adds to the body of literature demonstrating that cognitive training has a beneficial effect on executive functions. However, the results from this study may not be generalizable to a larger population of adolescents with disordered eating and do not reflect the same level of evidence as a randomized controlled trial. Another important shortcoming of the study is that the parent was not blind to treatment and may have unintentionally been biased in her ratings because of expectancy effects. It can be argued that the parent may have been more closely attuned to the potential executive function improvements in her adolescent, based on the daily one-on-one observations of this young man. A third shortcoming of the study is that practice effects may have shaped and enhanced subsequent performance. Moreover, the novelty of testing possibly diminished with re-testing, further contributing to enhanced performance. Therefore, the subject may have been more comfortable and better able to attend to testing tasks during subsequent assessments. Finally, this study did not perform follow-up data. Future studies on executive function training need to conduct follow-up sessions to further assess the lasting benefits of training.

### **Future Research**

This study shows that executive functions can be improved by training. In addition, the study saw effects on reasoning, planning, shifting, a decrease in parent-rated executive function deficits, and a decrease in self-reported anxiety and an increase in personal adequacy. Future

studies with children and adolescents diagnosed with eating disorders will be valuable to determine whether or not cognitive training could contribute to global treatment outcome in eating disorders. It is the hope that further research will provide a more comprehensive source of CRT data from which one can reliably tailor a program for children and adolescents who are at risk for developing an eating disorder. Moreover, further research with CRT can be a viable part of the therapeutic program in the treatment of AN specifically, especially because there is currently not a specific psychological regimen that is exclusive in the treatment of AN. Exercising cognitively with this population can serve as a first step and a building block before introducing more complicated approaches. It is not only easier to engage individuals with CRT than with other approaches, but it also provides training for weak neuropsychological function.

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